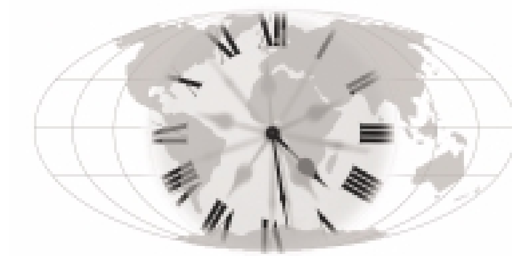
Flight Operations Support & Line Assistance



getting to grips with ETOPS

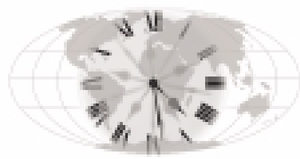
issue V - October 1998

Customer Services

AIRBUS

Flight Operations Support & Line Assistance

Customer Services
1, rond-point Maurice Bellonte, BP 33
31707 BLAGNAC Cedex FRANCE
Telephone (+33) 5 61 93 33 33
Telefax (+33) 5 61 93 29 68
Telex AIRBU 530526F
SITA TLSBI7X



getting to grips with ETOPS

Issue V - October 1998

AIRBUS

Note

Should any deviation appear between the information provided in this brochure and that published in the applicable CMP, AFM, MMEL and FCOM, the information set forth in these documents shall prevail at all times.

FOREWORD

The purpose of this brochure is to provide Airbus operators with:

- the currently applicable ETOPS regulations, as published in the various relevant circulars,
- the agreed interpretations thereto, which have been defined in the frame of the JAA/FAA Harmonization Committee,
- the latest amendments thereto, which have also been defined in the frame of the JAA/FAA Harmonization Committee.

Pending the re-issue of the circulars, operators may take credit of these amendments, subject to the approval of their local operational authorities.

Should any deviation appear between the information provided in this brochure and that published in the applicable CMP, AFM and MMEL, the information given in CMP, AFM and MMEL shall prevail at all times unless agreement is obtained from the local operational authorities.

The objective of this brochure is to provide recommendations which satisfy the ETOPS operational and reliability requirements in order for an airline to obtain operational approval from the presiding operational authorities.

All recommendations conform to the current regulatory requirements and are intended to assist the operators in maximizing the cost effectiveness of their ETOPS operations.

Should the reader wish to search a particular topic within this brochure, a reference Index is provided at the end of the document.

All brochure holders and users are encouraged to forward their questions and suggestions regarding this brochure.
Any questions with respect to information contained herein shall be directed to:

AIRBUS

Flight Operations Support & Line Assistance (STL)
Customer Services Directorate
1, Rond Point Maurice Bellonte, BP 33
31707 BLAGNAC Cedex - FRANCE
TELEX AIRBU 530526E
SITA TLSB17X
TELEFAX 33/(0)5 61 93 29 68 or 33/(0)5 61 93 44 65

Table of contents

Table of contents

Chapter 1

1 - WHAT DOES ETOPS MEAN ?

ETOPS (Extended Twin Operations) is the acronym created by ICAO (International Civil Aviation Organisation) to describe the operation of twin-engined aircraft over a route that contains a point further than one hour's flying time from an adequate airport at the approved one-engine inoperative cruise speed.

ETOPS regulations are applicable to routes over water as well as remote land areas.

The development of modern twinjet aircraft has required the rewriting of one of the chapters in aviation to accommodate the unique capabilities of these special aircraft. The old rules were not appropriate for modern twin-engined aircraft because they were based on the performance and safety features of aircraft from a much earlier technology, which were much less capable and reliable.

The civil aviation regulatory authorities have responded favorably to these technological and safety advances and have worked with the industry to create a new set of rules. These new rules take advantage of the unique efficiency, performance and safety features of today's twinjets. These rules also permit operators to manage their resources in a more effective and efficient way.

The purpose of ETOPS is very clear. It is to provide very high levels of safety while facilitating the use of twinjets on routes which were previously restricted to three- and four-engined aircraft. ETOPS operations also permit more effective use of an airline's resources.

2 - HISTORICAL

There is an extensive history in the evolution of the rules which are the foundation of ETOPS operations. Such an operation is not as recent as one would think, the first one taking place in 1919 when two Britons, Captain John Alcock and Lieutenant Arthur Whitten Brown crossed the Atlantic in a twin-engined Vickers Vimy, eventually landing in an Irish peat bog after a sixteen-hour flight.

Original regulations

As early as 1936, the FAA created the requirements that are incorporated in principle in FAR section 121.161 today. The initial rule applied to all types of aircraft regardless of the number of engines. All operations were restricted to an en-route area of operation that was within 100 miles of an adequate airport. In those days 100 miles was about 60 minute flying time in many aircraft if an engine was inoperative.

The initial FAA "60-minute rule" was established in 1953. This rule focused on engine reliability of piston power plants that were available during the late 1940s and early 1950s. In general, twin-engined aircraft were restricted to areas of operation defined by 60 minutes at the one engine inoperative cruise speed (in still air) from an adequate airport. However, the rule was flexible. It permitted operations beyond 60 minutes if special approval was obtained from the administrator. This special approval was based on the character of the terrain, the kind of operation, and the performance of the aircraft to be used. There was no regulatory upper limit for this special approval.

The purpose of these rules was to restrict flying time to an alternate airport, and hence reduce the risk of a catastrophe by lowering, to an acceptable level, the probability that all engines would fail. In other words, the lower level of reliability in piston power plants required that aircraft remain within 60 minutes of an adequate airport to ensure that, if one engine failed at any point along the route, a landing could be made before the remaining engine failed.

The ICAO Standing Committee on aircraft performance reviewed piston engine failure data during 1953.

Also in the 1950s, ICAO published recommendations stating that 90 minutes (two-engine speed) diversion time was acceptable for all aircraft. The more flexible ICAO recommendation was adopted by many non-US regulatory authorities and many non-US airlines started to operate their twins under this rule.

First generation of turbine engine reliability

The introduction of the jet engine into civil aircraft led to significant improvements in power plant reliability compared to piston power plants. The introduction of the Pratt & Whitney JT8D turbojet powered aircraft led to a major advance in propulsion system reliability and safety that permitted the development of twin-engined aircraft that were bigger and faster than four-engined piston aircraft.

Operational experience with the JT8D and others over the last 25 years has demonstrated that very high levels of reliability can be achieved with jet engines.

Statistics show that jet engines are much more reliable than piston engines, and propulsion-related accidents have been reduced significantly when compared to piston-powered aircraft.

High-bypass engines and wide body twin aircraft development

By the early 1980s, great advances had been made in the aircraft operational environment, design reliability and integrity. These advances were based on the highly satisfactory JT8D experience and the knowledge gained from the operational introduction of the Pratt & Whitney JT9D, the General Electric CF6, and the Rolls-Royce RB211 large high-bypass engines.

Wide body twinjets had been in service for some time (A300 was the first in 1974, A310 in 1983) and operators could see the advantage of utilizing their twinjets in applying ICAO rules on routes where, by the old rules, they were forced to use three-and four-engined aircraft. Also, contrary to the experience with piston engines, jet engine power and size did not appear to have any discernible impact on failure rate. The failure rates of some of the large high-bypass engines were almost as good as the JT8D and were nearly ten times better than piston engines.

The greatest initial interest in 120-minute rules ETOPS operations was over the North Atlantic (NAT). The highly competitive nature of NAT operations made the use of wide body twinjets very attractive. However, operations under the 60-minute rule required indirect routings (usually referred to as random routes) and the use of en-route alternate airports which have limited airport services and facilities and are subject to frequent weather limitations. NAT operations under the 120-minute rule, however, would permit operators to use the minimum cost routings (Organized Tracks System) and enable the use of alternates that were properly equipped to support an aircraft that was diverting.

All of this slowly led the authorities and the industry to the realization that advancements in airframe, avionics, and propulsion system technology had, created the need and the opportunity to create a new kind of operation. All twinjets could now be designed with performance and safety improvements that permitted them to safely conduct operations that had been historically restricted to three- and four-engined aircraft. The advent of the A300-600, A310, 757, 767, MD-90, A320, A321, A319, A330, 777, and a new generation of high- bypass engines provided twinjets with the efficiency, safety, and range/payload capabilities which made the old 60-minute rule restriction inappropriate.

In the early 1980s, ICAO formed an ETOPS Study Group to examine the feasibility of extended-range operations with these new twinjets and to define the special criteria that should be met to ensure that these operations were conducted with a very high level of safety. At the same time, the FAA had begun the initial work that resulted in Advisory Circular (AC)120-42 which is the US criteria for ETOPS. The ICAO Study Group recommended that a new ICAO rule be established to recognize the capabilities of these new aircraft and the limitations of the older aircraft.

The end result was an amendment to ICAO Annex 6 which, unless the aircraft could meet special ETOPS safety criteria, recommended that all turbine-powered aircraft be restricted to 60 minutes, at single-engine speed, from an adequate airport.

Initial 120-minute ETOPS operations

Although a limited number of extended-range operations had been conducted under the old ICAO guidelines, ETOPS as we know it today began in the mid 1980s. In 1985, the FAA issued AC 120-42 which established criteria for approval of a deviation in accordance with FAR 121.161 to increase the ETOPS area of operation to 120 minutes at the single-engine cruise speed under standard conditions in still air. Several other civil aviation authorities also issued ETOPS criteria including CAA UK, DGAC France, Transport Canada, DOT Australia and CAA New Zealand during the same time period. Many other countries relied on the guidance provided in the ETOPS amendments to ICAO Annex 6.

In 1993, the European Joint Airworthiness Authorities (JAA) developed their own criteria [IL 20 / AMJ 120-42 (IL: Information Letter, AMJ: Advisory Material Joint)] which combines the best points from the individual European rules and the FAA criteria.

Modification of existing aircraft

Although there were several aircraft that could meet the proposed ETOPS performance requirements and had the range/payload capabilities to make ETOPS operations economically feasible, there were no aircraft capable of meeting the aircraft system and propulsion system requirements at the time that the ETOPS rules were being developed. Therefore the first ETOPS aircraft were modified versions of aircraft originally intended for pre-ETOPS service. These modifications were necessary to improve primarily the reliability of the propulsion systems and to enhance the redundancy and performance of electrical, hydraulic and avionics systems. A hydraulically driven electrical generator was added to most of these aircraft to provide four independent sources of AC electrical power to ensure that power to all critical systems would always be maintained without a time limitation.

The very good experience overall with 120-minute ETOPS led the authorities and the industry to consider the possibility of 180-minute ETOPS operations. The potential for 180-minute ETOPS was very important to operators because it meant that almost any route in the world could be serviced by twinjets. In addition to the major design enhancements incorporated in ETOPS aircraft, improvements in high-bypass engine reliability made 180-minute operations possible.

The FAA issued AC 120-42"A" on December 30, 1988, which provided the criteria for 75-minute, 120-minute, and 180-minute operations. On January 18, 1989, FAA approved the first 180-minute ETOPS operation. ETOPS operations are now commonplace on the North Atlantic routes where actually more twins than trijets or quads are flying.

Development of modern ETOPS aircraft

The very successful experience during the introduction of ETOPS, the safety benefits associated with these designs, and the large economic benefits provided to ETOPS operators have had a powerful effect on the design of all modern twinjets. Because of the success of ETOPS, it is now economically feasible to build very large twinjets. These new aircraft have even better safety features and higher operating efficiencies.

The effect ETOPS has had on high-bypass engine reliability is especially impressive. Today, the engines used in ETOPS are as much as ten times more reliable than high-bypass engines were ten years ago. More significantly, the engines on new ETOPS aircraft, such as the A330, should be even more reliable due to design improvements that are based on current ETOPS experience.

ETOPS milestones

Airbus operators have been operating their A300 twinjet aircraft across the North Atlantic, the Bay of Bengal and the Indian Ocean under the 90-minute ICAO rule since 1976. However, ETOPS officially began in 1985 with the newly issued ETOPS criteria.

In 1985, the first ETOPS operations (90 minutes) were made in February by TWA with a 767 and in June by Singapore Airlines with an A310.

In April1986, PanAm was the first to inaugurate transatlantic revenue service with A310-200 and A310-300 aircraft. In less than five years, more than 20 operators joined the two pioneers in Airbus ETOPS operations.

In March 1990, the A310-324 (PW4000) was the first FADEC engine powered aircraft to receive ETOPS approval by the FAA. At the same time, the A300B4-605R was the first Airbus aircraft to get ETOPS approval for 180 minutes diversion time.

By the end of 1991, all A310 and A300-600 were approved for 180 minutes diversion time by the French DGAC.

In September 1991, the A320 was the first fly-by-wire aircraft to be approved for ETOPS operations with 120 minutes diversion time.

In April 1994, the A330-301 (CF6-80E1A2 engines) obtained the ETOPS Type Design Approval from the JAA with 120-minute diversion time. This was the first new aircraft to receive early ETOPS approval worldwide. In May 1994, Aer Lingus was the first operator to inaugurate ETOPS operations over the North Atlantic with this model.

In the same time, the A300-600 with CF6-80C2A5F engines (featuring FADEC) obtained the ETOPS Type Design Approval (180-minute diversion time) from the JAA at entry into service.

In November 1994, the A330-300 with Pratt & Whitney engines obtained the ETOPS Type Design Approval from the JAA with 90-minute diversion time at entry into service. The first ETOPS operators were Thai Airways, Malaysian Airlines and LTU.

In January 1995, the A330-300 with Rolls-Royce engines obtained the ETOPS Type Design Approval from the JAA with 90-minute diversion time at entry into service.

The A330-300 obtained the ETOPS Type Design Approval from the JAA with 180-minute diversion time (GE engines in February 1995 ; PW engines in August 1995 ; RR engines: in June 1996).

In May 1996 and February 1997, respectively the A321 and A319 obtained the ETOPS Type Design Approval from the JAA with 120 minutes diversion time.

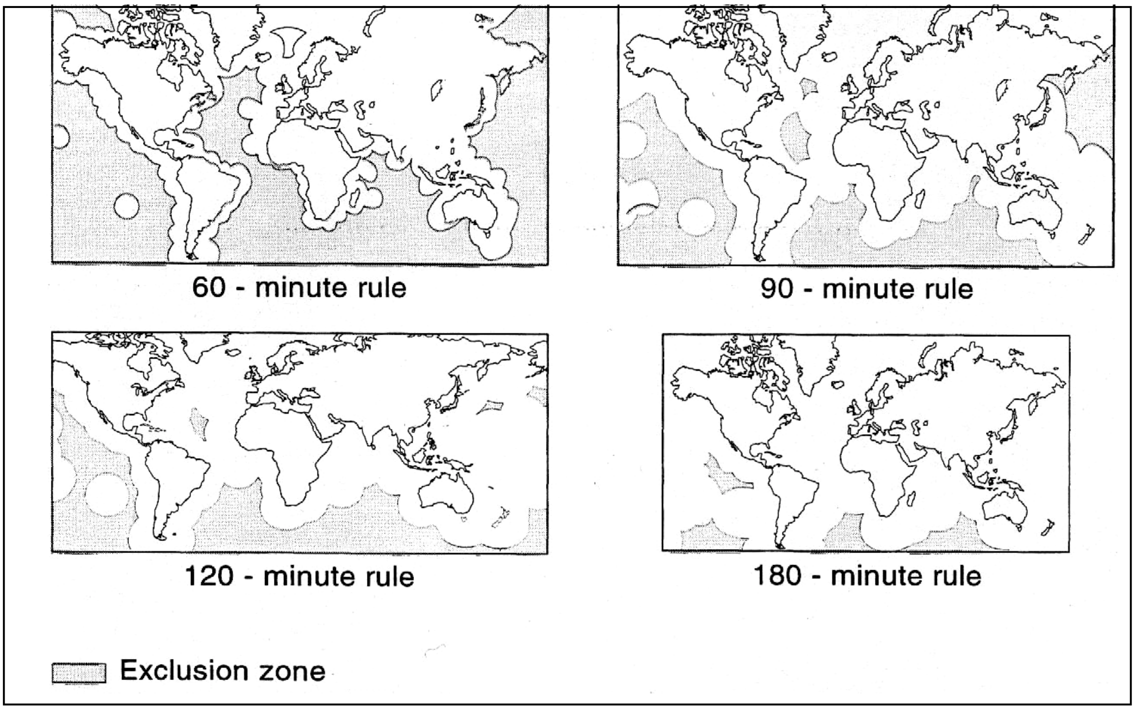
NOTE: *The A320/A321/A319 family can be approved for 180min ETOPS. However in the absence of a customer request, Airbus has not applied for it.*

In April 1998, the A330-200 with GE engines obtained the ETOPS Type Design Approval from the JAA with 180 minutes diversion time prior entry into service.

3 - THE BENEFITS OF ETOPS

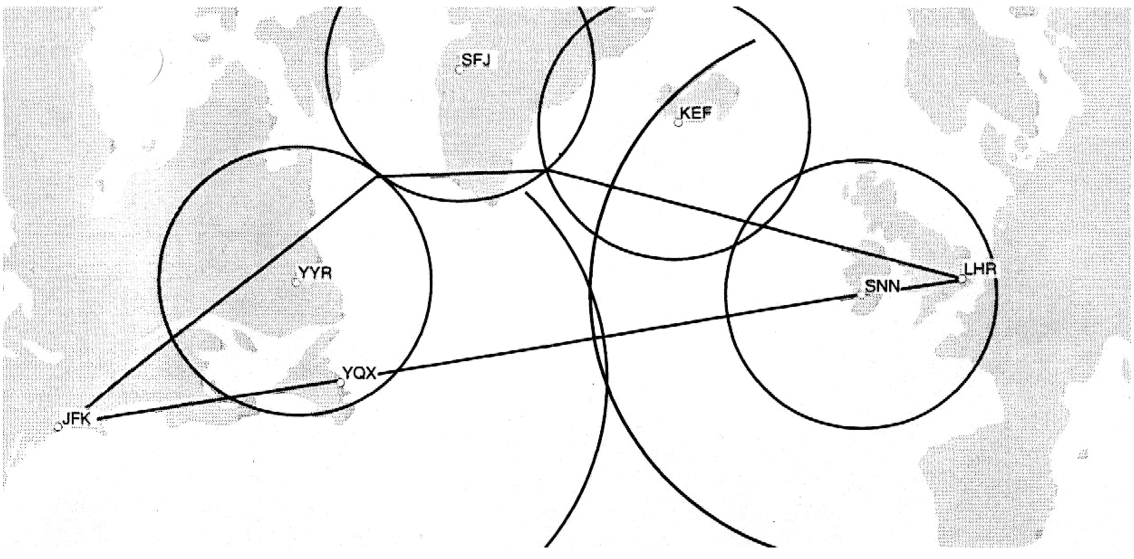
The advent of the ETOPS regulations permitted an enlarged area of operation for the twin-engined aircraft. This area of operation has been enlarged in steps by allowance of maximum diversion time to an adequate airport from the nominal 60 minutes up to the current 180 minutes.

The following maps have been established independently of aircraft type at a typical single-engine true airspeed of 400kt.



World exclusion zones for 60-, 90-, 120-, 180-minutes rules

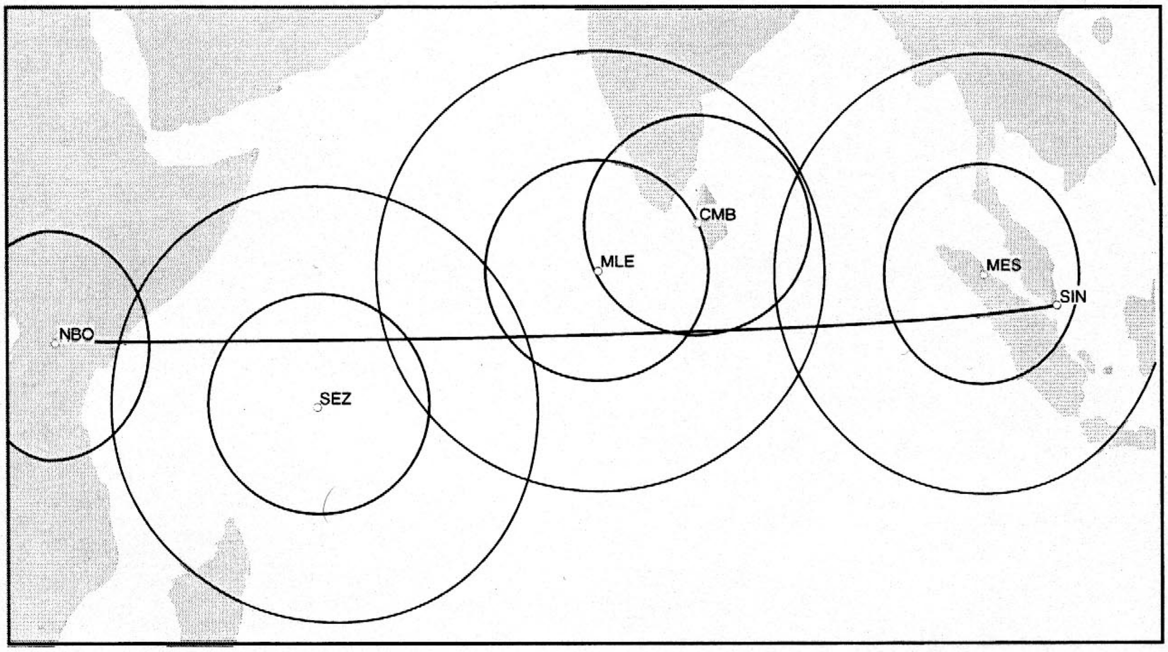
The efficiency of direct ETOPS routing can be demonstrated by a comparison of distance, time and fuel savings. A good example is the New York to London route which is now feasible in direct track with 120-minute rules.



New York to London track: *- within 60-min. circles (radius 435nm)*
- within 120-min. circles (radius 860nm)

Compared to the non-ETOPS 60-minute case, the operator can save up to 2.4 tonnes of fuel with an A310-300 or make an equivalent payload gain. In addition to the elimination of dog-leg tracking (use of the Organized Track System instead of random routes), efficiency can also be improved by a reduction of the number of en-route alternates required. Thus, New York to London twin operations become practically independent of airfields in Iceland and Greenland.

A second benefit to operators is that ETOPS permits twins to be used on routes previously denied them. For example, a track from Nairobi to Singapore is not possible with a 60-minute diversion time as there are not sufficient diversion airfields available. However, the increase of the diversion time to 120-minutes easily permits an operator the flexibility to use twins on this route which would otherwise remain the sole preserve of larger three- and four-engined aircraft.



Nairobi-Singapore route, possible only with 120 minutes

Moreover, the passengers also benefit from ETOPS operations with the opening of new routes between city pairs where the traffic is too thin for an economically viable operation with larger aircraft but can be supported by a smaller twin. ETOPS operations also permit flights frequencies to be increased on high-density routes such as North Atlantic routes by using smaller twins. In addition, airlines can have greater flexibility with ETOPS aircraft which can be economically used on short- as well as long-haul routes.

Chapter 2

1 - GENERAL

ETOPS requirements are essentially the same for all the airworthiness authorities and are detailed in the following regulations:

- FAA Advisory Circular (AC) 120-42A provides the criteria for 75-, 120- and 180-minute operations,
- the European Joint Airworthiness Authorities (JAA) developed the Advisory Material Joint (AMJ) 120-42 which provides the criteria for 90-, 120-, and 180-minute operations and provisions for accelerated approval for 90-, 120-, 138- and 180-minute operations (currently published as Information Leaflet (IL) number 20),
- Transport Canada issued Technical Publication (TP) 6327 which authorizes ETOPS up to 180-minute operations,
- CAA (United Kingdom) issued the Civil Aviation Publication (CAP) 513,
- DGAC (France) issued Condition Technique Complémentaire CTC 20 (Complementary Technical Condition),
- ACAA (Australia) issued Air Navigation Orders,
- CAA NZ (New Zealand) issued CAP 35A,
- many other countries rely on the guidance provided in the ETOPS amendment of the International Civil Aviation Organisation (ICAO Annex 6).

The benefits of ETOPS are clear. Airlines recognize this by choosing to operate ETOPS and aircraft manufacturers perceive this by designing ETOPS-capable aircraft. However, it is also clear that ETOPS operations must be regulated in order to ensure that twin-engined aircraft operating under ETOPS are at least as reliable and safe as existing three- or four-engined aircraft.

To achieve this expected level of reliability and safety, the airworthiness authorities control the certification of the "Aircraft ETOPS Type Design Approval" as well as granting "ETOPS Operational Approval" to airlines. Moreover, the aircraft ETOPS Type Design Approval and Operational Approval, although not renewable, is continually reviewed and may even be withdrawn.

2 - AIRCRAFT ETOPS TYPE DESIGN APPROVAL

Before an airline can even contemplate operating an aircraft under ETOPS conditions, the aircraft must first have either been designed or modified and approved to meet the more stringent ETOPS certification requirements.

It is therefore the responsibility of the aircraft manufacturer to ensure that the aircraft's design satisfies the ETOPS regulations.

To meet all these requirements, it is convenient to split the aircraft ETOPS Type Design Approval into two parts:

- ETOPS type design eligibility,
- ETOPS type design capability.

The former concerns the ETOPS design features envisaged prior to in-service experience and the latter concerns reliability improvements considered after such experience.

a) ETOPS Type Design Eligibility

The aircraft manufacturer must first demonstrate that its aircraft complies with the required ETOPS design criteria and is therefore eligible for ETOPS.

Design assessment

The aircraft's design must conform to the valid ETOPS regulations notified by the certificating authorities at the time of the Type Design Approval. Any changes required to the aircraft's basic design are contained in the Airbus "Configuration, Maintenance and Procedure Standards" (CMP) document. This document is an authority-approved document and is regularly updated.

The following design considerations must be introduced:

- **Propulsion system reliability**

  Propulsion system reliability is the most vital aspect of ETOPS and must be sufficient to ensure that the probability of a double engine failure from independent causes is lower than defined limits (this requirement establishes a maximum In-Flight Shutdown (IFSD) rate of 0.02/1000 engine hours for 180-minute ETOPS).

- **Electrical power sources redundancy**

  A sufficient number of reliable, independent and non-time-limited electrical power sources (at least three) must be available to ensure that basic aircraft functions including communication, navigation and basic flight instrumentation (such as altitude, airspeed, attitude and heading) remain available.

  Engines and APU electrical generators must provide full technical electrical power availability throughout the normal flight envelope. Every Airbus ETOPS aircraft is equipped with an emergency/standby generator which gives a total of four independent generators. The design intent is to obtain dispatch flexibility when conducting an ETOPS mission.

- **APU design**

  APU must be designed to have airstart capability throughout the normal flight envelope and cold start capability at all certified operating temperatures within flight duration limitations.

- **Emergency/standby electrical generator design**

  In the event of any single failure or combination of failures, electrical power is still provided for essential equipments. All information provided to the flight crew remains sufficiently accurate for the intended operation.

- **Minimum crew workload**

  In the event of a single failure or any combination of system failures, indications of residual system capabilities should be such that the flight crew have the necessary information to make decisions or diversions at any point on the route. Crew workload should be kept to an acceptable level.

  To achieve the required system redundancy, Airbus has paid particular attention to the supply of sufficient emergency/standby electrical power for emergency services following the loss of engine and APU generators.

- **System redundancy**

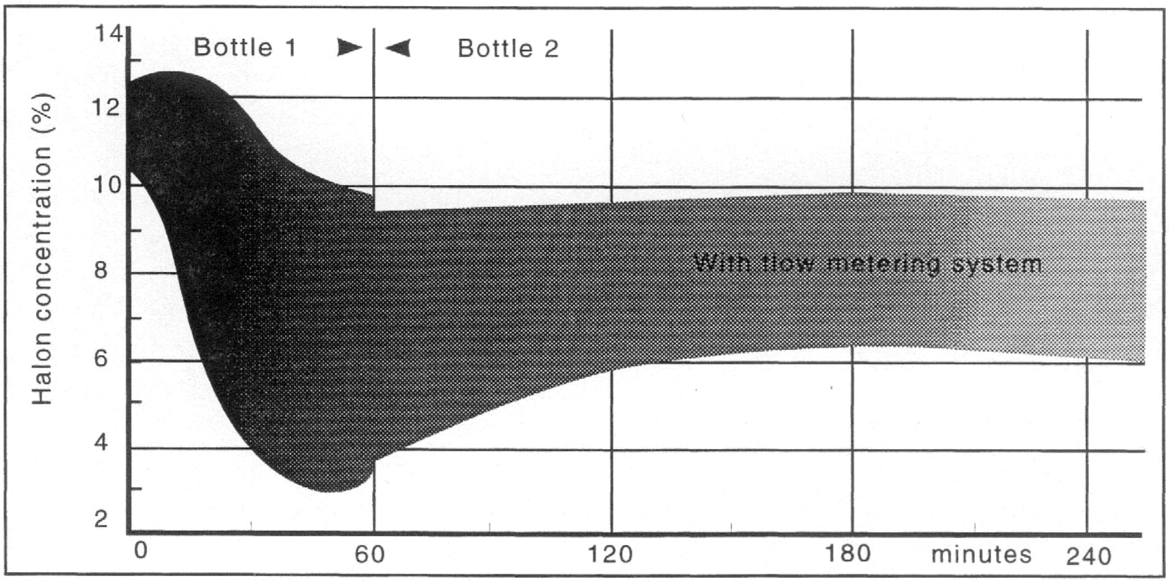
  During single-engine operations, the remaining electrical, hydraulic and pneumatic power should continue to be available at levels necessary for safe flight and landing.

Systems	Normal	One engine shutdown	Remark
Hydraulic	3 systems 1 RAT back-up	3 systems (1) 1 RAT back-up	(1) One affected system can be restored by power transfer unit or electropump
Electrical	4 generators: - 2 engines - 1 APU - 1 standby (4) Batteries	3 generators: - 1 engine (2) - 1 APU (3) - 1 standby (4) Batteries	(2) Full electrical capability (3) APU operation restores redundancy and independence of electrical generation (4) ETOPS modification for A310-200/A300-600
Pneumatic (5)	2 air bleed sources - 2 engines	1 air bleed sources - 1 engine	Any air bleed source has cabin pressurization and wing anti-ice capability. (5) for A310/A300-600 and A319/A320/A321
Pneumatic (A330)	3 air bleed sources - 2 engines - 1 APU	2 air bleed sources - 1 engine - 1 APU	Any air bleed source has cabin pressurization and wing anti-ice capability. (not simultaneously for APU bleed)

NOTE: For A330, the APU air bleed extraction in flight is certified up to 22 500ft.

- **Time-limited equipments**

  ETOPS is allowed provided any time-limited equipment, essential for safely conducting the flight, has a minimum endurance equal to the intended diversion time plus a 15-minute allowance for approach and landing. The only time-limited equipment on all Airbus models is the cargo Compartment fire extinguishing system.



Fire extinguishing system endurance

Modifications, in the form of installation of a larger fire extinguishing bottle (A310/A300-600R) or a second bottle (A300-600/A310/A320/A321) plus a flow metering system, extend the protection to meet or exceed the ETOPS requirements.

NOTE: As of today, Class D cargo holds are authorized for ETOPS except in Canada without any time limitation.

- **Ice protection**

  Airframe and power plant ice protection should provide adequate capability for the intended operation (taking into account prolonged exposure at lower altitude during engine-out diversion).

Safety assessment

The system safety assessment must take into consideration the extended average flight duration and maximum diversion time allowed for ETOPS.

Flight testing

To validate the concept of ETOPS, flight tests are performed with the airworthiness authorities crew on board. During these flights, the aircraft single-engine performance, the ETOPS diversion procedures and the crew workload during diversion with various simulated critical systems failures are demonstrated.

For example, in August 1993, the A330 successfully completed ETOPS trials over the North Atlantic. A total of six single-engine flight hours combined with various system failures simulation, pilot workload assessment and operating procedures were performed as follows.

Toulouse - Gander. Diversion to Santa Maria (Azores) after simulated engine failure by a real engine shut-down. Engine was relighted at beginning of final descent for safety reason, and for landing, the engine was kept at idle with electrical generator, air bleed and hydraulic pump off.

No specific comment was made by the pilots.

Santa Maria - Montreal. Dispatch with failed electrical generator on one engine, then diversion to Gander following the simulated failure of the other engine (hence the loss of its associated electrical generator), as well as the simulated failure of the APU electrical generator. Therefore, the diversion was conducted in Emergency Electrical Configuration, this means electricity on standby generator.

Neither operational nor workload problems were encountered. However, various suggestions were made for improvement of procedures and documentation.

Gander - Toulouse. Dispatch with one engine bleed air source failed under MEL. After in-flight simulated failure of the other bleed air source, descent down to 22 000ft where the APU had sufficient capability to maintain normal cabin pressurization. With such a failure, a diversion is not mandatory, but a return to Gander was done for the purpose of the exercise.

No specific comment was made but suggestions were proposed for improvement of the MEL procedures.

Gander - Toulouse. Diversion to Shannon after simulated engine and pressurization failures (this can be the consequence of an engine burst). Cabin altitude was increased to 12 000ft manually to simulate the depressurization. After an emergency descent, the diversion was done at FL100 and 300kt. Three hours were flown on one engine.

No specific comment was received.

Shannon-Toulouse. Failure of autopilot and autothrottle simulated, requiring manual flight (non-ETOPS condition).

These missions were all flown by pilots of the airworthiness authorities unaware of what failures to expect and when. The most critical failure cases have thus been demonstrated successfully in a real operating environment.

The following is an extract from the FAA report (the FAA pilot was acting as captain on the flight with engine failure and electricity on standby generator): "...The airplane's suitability for two-crew operations, including ETOPS two crew operations, is excellent. Flight crew workload during systems abnormalities is driven more by communication and replanning requirements than by basic airplane attention requirements..."

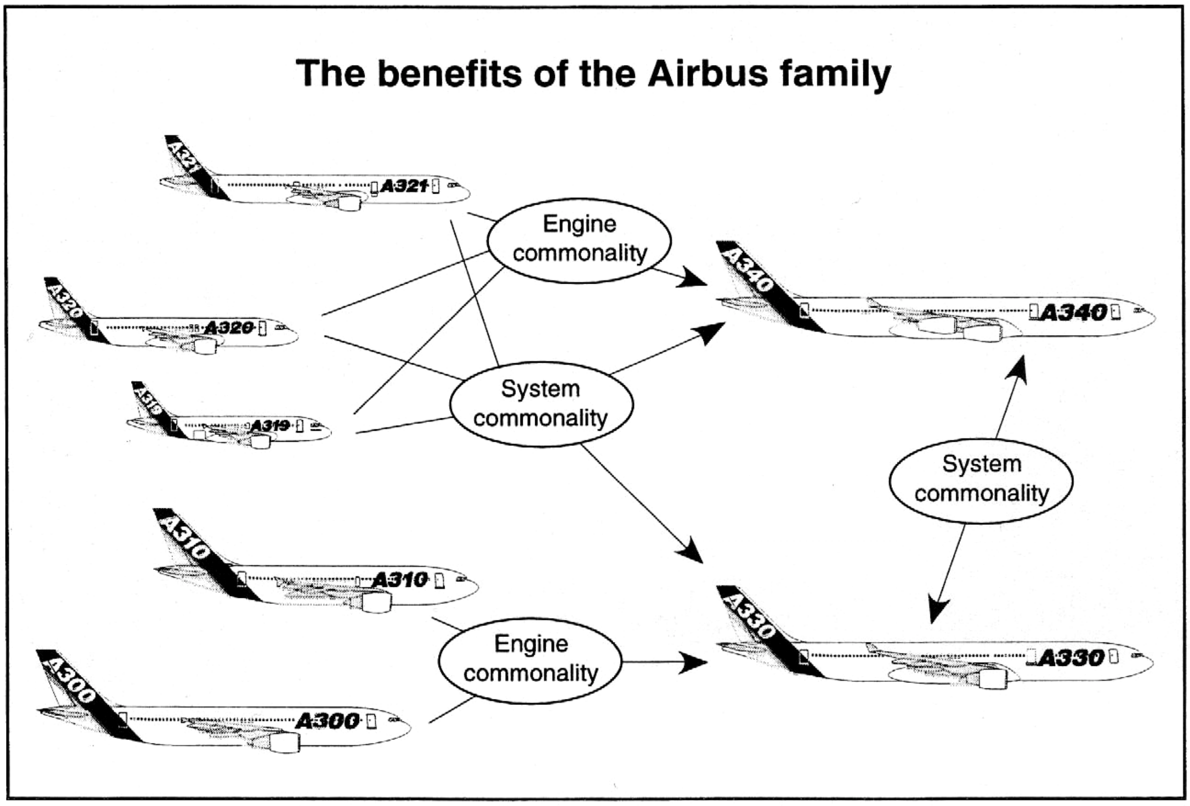
During this ETOPS flight test campaign, the total of six single-engine flying hours performed represents more than the worldwide fleet of A310s and A300-600s have experienced in over five years of day-to-day airline ETOPS service.

b) ETOPS Type Design Capability

After the manufacturer has demonstrated that its aircraft design is "eligible" for ETOPS, it must then show that the aircraft/engine combination has attained a sufficient reliability level based on in-service experience. Generally, the authorities require in the order of 100 000 to 250 000 engine flying hours of experience in order to obtain statistically viable reliability analysis.

However, this experience can be substantially reduced by a procedure known as "Technical Transfer Analysis" which allows credit to be awarded for development work and experience already gained on similar systems engines. Such a procedure has been extremely useful for Airbus whose aircraft have a high degree of commonality between their systems and engines.

For example, the A310-308 and A310-325 derivative models were directly approved for 180 minutes diversion time at entry into service, credit having been given for their close similarity with already approved 180-minute ETOPS Airbus aircraft. This procedure was also used to demonstrate the ETOPS type design capability of the A330, A321 and A319. The wealth of experience gathered on the A320/A340 and other Airbus models, as well as dedicated ETOPS testing by the engines manufacturers, serves as the experience base to obtain "early ETOPS" approval at, or shortly after, entry into service. It should, however, be noted that not all aircraft types can benefit from Technical Transfer Analysis, since similar experience is a prerequisite for such an analysis; new technologies are not commensurate with early ETOPS.



Technical Transfer Analysis

Capability assessment

In order to assess the aircraft's ETOPS capability, the manufacturer's regulatory authority analyses the In-Flight Shutdown (IFSD) rate of the concerned propulsion system, as well as other in-service events (both in flight and on the ground), for the engine, its associated equipment and other aircraft systems.

All the events are analyzed by the airworthiness authorities which may consider the demonstrated effect of corrective actions (configuration changes, maintenance tasks and procedures) when making their assessment.

The maximum allowable ETOPS diversion time for the candidate aircraft/ engine combination is then granted based on the airworthiness authorities' engineering judgement (which quantifies the proposed reliability solution) and the predicted reliability level (calculation methodology specified in each set of ETOPS regulations).

c) JAA policy statement

JAA has issued in June 1993 a policy statement regarding ETOPS Type Design Approval at entry into service (also referred to as "early ETOPS"), in which it is mentioned that:

- 180-minute ETOPS Approval will not be available without some in-service experience being gained on the airframe/power plant combination (except for derivative aircraft),
- 120-minute ETOPS Approval is considered feasible at the introduction to service of an airframe/power plant combination, so long as the authority is totally satisfied that all aspects of the Approval Plan have been completed,
- any deficiency in compliance with the Approval Plan can result in some lesser level of approval from that sought,
- operators and manufacturers will be required to respond to any incident or occurrence in the most expeditious manner. A serious single event or series of related events could result in the immediate revocation of ETOPS approval. Any isolated problem not justifying immediate withdrawal of approval will have to be under control within a specified timeframe,

- progress to 180-minute ETOPS Approval will be possible for a particular airframe/power plant combination, subject to the application of any required corrective action, after the accumulation of the following in-service experience:
  - 20 000 engine hours for derivative technology powerplants,
  - 50 000 engine hours for new technology powerplants.

In consequence, for the A330 programme, Airbus has set up a "30-day reaction time process", as required by the airworthiness authorities.

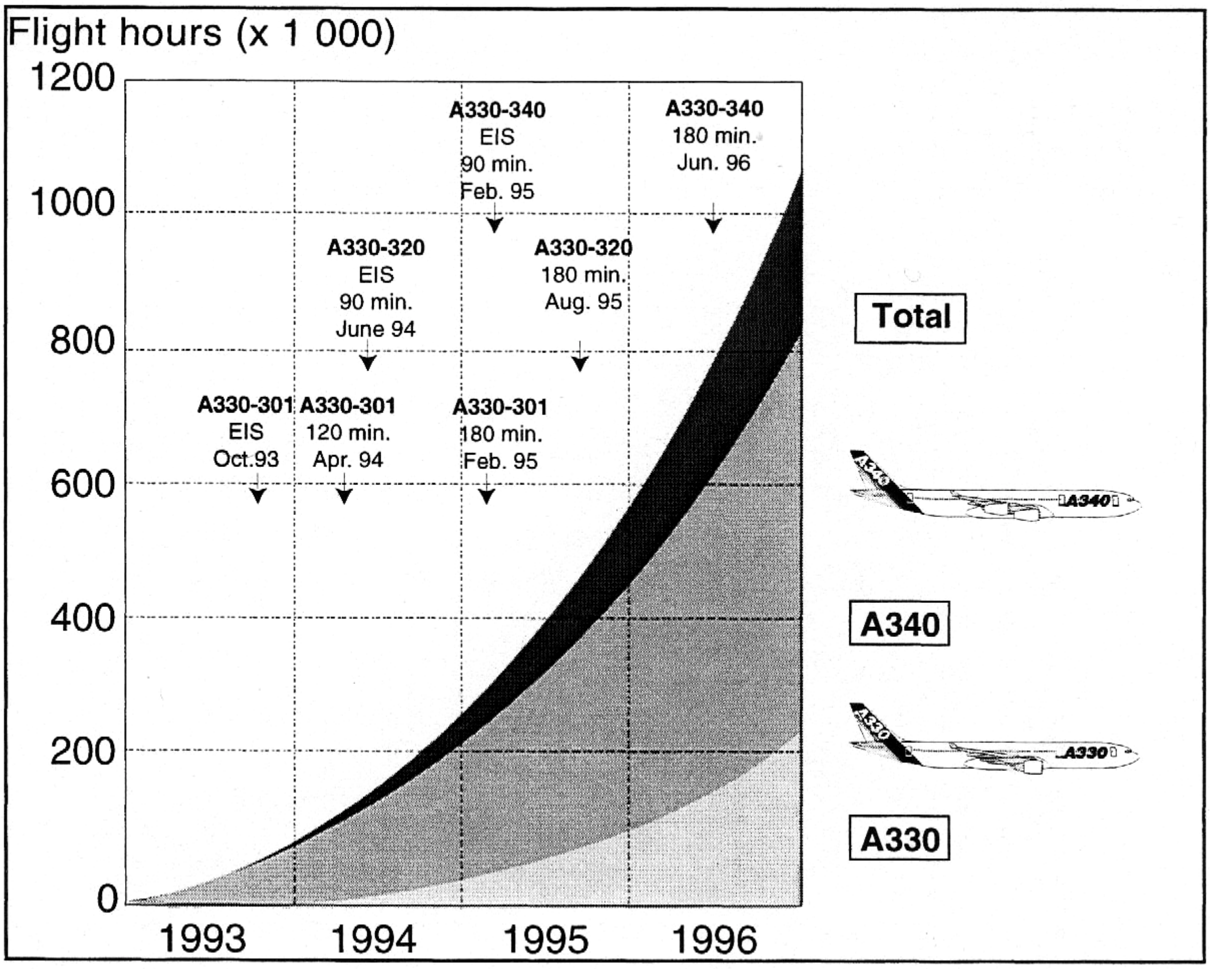
The process is aimed at identifying, reporting and analysing any ETOPS significant service event and defining an appropriate corrective action plan within 30 days if the event affects a system or component which has not yet accumulated sufficient service experience to use a statistical analysis in the assessment. This process may result in temporary revisions of the CMP as necessary to implement control measures.

3 - EXAMPLE: A330-300 ETOPS DESIGN CONCEPT

When ETOPS regulations were first formulated, the manufacturers were required to make small but significant system design modifications to meet the new requirements. These changes included the provision of a fourth independent source of electrical power, additional cargo fire suppression equipment, and better APU reliability. These modifications are now available as standards and have been further enhanced to meet the most stringent possible anticipated design policies envisaged from the authorities.

Of crucial significance is that the A330's sister ship, the four-engined A340, incorporates virtually identical systems, This means that systems experience from the A340, which entered into service one year before the A330, is directly relevant. As we have already seen, the concept is not new. Credit for systems experience has been used to help achieve ETOPS approval of various aircraft, such as the 767 using 747 nacelles experience as well as taking benefit from A310 systems.

In the case of the A330, however, never before has an ETOPS aircraft been designed so closely to another model - the A340. Indeed, it was anticipated that 100% systems read-across would be achieved between the two aircraft. The A330 design commonality is not only with A340 ; electrical and hydraulic systems on the A330 are conceptually similar to those already flying for many years on the A300-600 and A310. Also, A320 experience feeds through to the A330 in terms of flight control system, the human/cockpit interface, maintenance concept, navigation systems, and electronics bay cooling.



A330/A340 revenue service hours

ATA chapter:		LRU commonality
21	Air conditioning	100%
22	Automatic flight control	100%
23	Communication	100%
24	Electrical power	30%
26	Fire protection	70%
27	Flight controls	90%
28	Fuel system	90%
29	Hydraulic power	100%
30	Ice and rain protection	70%
31	Instruments	100%
32	Landing gear	100%
33	Lights	100%
34	Navigation	100%
35	Oxygen	100%
36	Pneumatic	80%
38	Water/waste	100%
49	APU	100%

A330/A340 system commonality

In addition to the wealth of relevant experience available within the Airbus product range, there is always the additional safeguard of allowing a bedding-down period of the A330 in revenue service before granting the ETOPS Type Design Approval. The confidence that the A330 can achieve early ETOPS was based on sound engineering principles.

Airbus believes that the step-by-step approach to ETOPS is the most prudent path to follow. In practical terms:

- the A330-301 (GE engines) obtained the ETOPS Type Design Approval with 120-minute diversion time and was found eligible for 180-minute ETOPS at entry into service, followed by the 180-minute approval after the build-up of sufficient fleet-wide engine hours in February 1995.
- the A330-321/-322 (PW engines) obtained the ETOPS Type Design Approval with 90-minute diversion time and was found eligible for 180-minute ETOPS before entry into service. Following couple of months of operation, the 120-minute approval was obtained, and later 180-minute approval in August 1995.
- the A330-341/-342 (RR engines) obtained in February 1995 the ETOPS Type Design Approval with 90-minute diversion time as well as the eligibility for 180-minute ETOPS prior entry into service. The 180-minute approval was obtained in June 1996.

NOTE*:* *The A330-202 (GE engines) obtained the ETOPS Type Design Approval with 180-minutes diversion time prior entry into service, based on the successful ETOPS experience gained with the A330-200.*

The Airbus philosophy has been endorsed by the airworthiness authorities and the early ETOPS approach of the JAA will include additional requirements at the suggestion of Airbus. These include a strengthening of systems design (more services on the standby generator, such as landing lights and wind-shield de-icing), and a single-engine ceiling of 22 000ft (giving the A330 the same one-engine performance as a four-engined aircraft with one engine failed).

4 - ETOPS CAPABILITY STATEMENT

Once the airworthiness authorities have agreed that the candidate aircraft/ engine combination meets the requirements of the applicable regulations, the authorities declare this aircraft type capable of flying ETOPS for a given maximum diversion time.

The ETOPS capability of the aircraft becomes official, and is declared in the following documents approved by the airworthiness authorities:

– Aircraft Flight Manual (AFM),

– Standards for Extended-Range Operations, Configuration, Maintenance and Procedures Standards (CMP),

  Note*:* The CMP is the reference document for ETOPS operations, and it covers the following items:

  - Configurations Standards,
  - Maintenance Standards,
  - Dispatch Standards,
  - Procedures Standards.

– Type Certification Data Sheet (TCDS),

– Master Minimum Equipment List (MMEL).

The following page shows the relevant page of the A310 Flight Manual. Note that the AFM refers to the latest applicable revision of the CMP.

A310
FLIGHT MANUAL

DGAC APPROVED

SUPPLEMENT 13 – EXTENDED RANGE OPERATIONS (ETOPS)

1. GENERAL

This supplement applies to airplanes operated according to the provisions of FAA Advisory Circular AC 120-42A, Extended Range Operations with Two-Engine Airplanes or according to the french "Conditions Techniques Complémentaires CTC 20 ETOPS".

The type design reliability and performance of this airplane has been evaluated and found to comply with the criteria of Advisory Circular 120-42A according to DGAC interpretations or CTC 20 ETOPS when configured, maintained and operated in accordance with the Airbus Industrie document, reference AI/E-A 3000 : "STANDARDS FOR EXTENDED RANGE OPERATIONS" at the latest approved revision.

This finding does not constitute an approval to conduct Extended Range Operations.

2. LIMITATIONS

The limitations of section 2 of this Flight Manual are applicable and must be observed.

Maximum diversion time may not exceed 180 minutes at one engine cruising speed.

FLIGHT MANUAL SUPPLEMENT EXCLUSION

The use of supplement 6.02.10 of this section is not permitted in conjunction with this supplement.

3. PROCEDURES

The procedures of sections 3 and 4 of this Flight Manual are applicable and must be observed.

4. PERFORMANCE

Refer to page 2 to 10 of this supplement for the single engine net flight path associated with 3 different speed schedules which can be used for the choosen diversion procedure.

A310 AFM extract

The following figures shows an extract of the CMP document. This document reflects the aircraft configuration standards, maintenance standards, procedures standards and dispatch standards.

AIRBUS INDUSTRIE
STANDARDS FOR EXTENDED RANGE OPERATIONS

ATA N° 4[illegible] MODEL A300B4-620 ALTERNATE CONFIGURATION GTCP 331-250-H

FITTED WITH : APU GTCP 331-250-H
MODIFICATION : 8409-BASIC

APPLICABLE STANDARDS	AI REF'S	VENDOR REFERENCES
3 PROCEDURE STANDARDS		
GENERATED POWER THE NUMBER OF START ATTEMPTS IS LIMITED: . ON GROUND: AFTER 3 START ATTEMPTS SEPARATED BY 1 MIN COOL DOWN, 60 MUST BE ALLOWED FOR COOLING; . IN FLIGHT, WITHIN 1 HOUR PERIOD: - BELOW 37,000 FT: 3 START ATTEMPTS - ABOVE 37,000 FT: 5 START ATTEMPTS		
03 PREFLIGHT FUNCTIONAL CHECK OF APU AND APU GENERATING CHANNEL IN CASE OF DISPATCH WITH STBY GEN UNSERVICEABLE		
04 APU MUST BE STARTED BEFORE ENTERING THE ETOPS SECTOR OF THE FLIGHT AND MUST BE KEPT RUNNING UNTIL LEAVING THE ETOPS SECTOR IN CASE OF DISPATCH WITH STBY GEN UNSERVICEABLE. (SEE 24-4-01).		
4 DISPATCH STANDARDS		
01 APU / APU GEN DISPATCH LIMITATIONS.	SEE MMEL	

REVISION 11 - DATE 93/05/17 AC 120 - 42 A 49 - 012
CMP D.G.A.C.

AIRBUS INDUSTRIE
STANDARDS FOR EXTENDED RANGE OPERATIONS

ATA N° 49 MODEL A300B4-620 ALTERNATE CONFIGURATION GTCP 331-250-H

FITTED WITH : APU GTCP 331-250-H
MODIFICATION : 8409-BASIC

APPLICABLE STANDARDS	AI REF'S	VENDOR REFERENCES
1 CONFIGURATION STANDARDS		
21* SCV IMPROVEMENTS.		SB-GARRETT 979806-49-6504 OR SB-GARRETT 979806-49-6506
|22* INTRODUCE ECB -12 (AUTHORIZED MORE ADVANCED STANDARDS ARE NOT LISTED).	SB 49-6019	SB 2117402-49-2219
|23 INTRODUCE FCU -16 (AUTHORIZED MORE ADVANCED STANDARDS ARE NOT LISTED). INCORPORATE NO LATER THAN 30/JUNE/98. (CANCELS THE NEED FOR 49-1-15)		SB 388250-49-6674 OR SB-GTCP-331-49-6778
24 IMPROVED IGV ASSEMBLY. INCORPORATE AT NEXT APU SHOP VISIT, BUT NO LATER THAN 30/JUNE/98.		SB-GTCP-331-49-6948
|25 IMPROVED COOLING FAN SHROUD. INCORPORATE NO LATER THAN 30/JUNE/98.		SB 3644416-49-6845 OR SB-GTCP-331-49-6938
2 MAINTENANCE STANDARDS		
01 CHECK OIL LEVEL. INTERVAL NOT TO EXCEED 100 APU HOURS.		GARRETT M.M. 49-21-00 TABLE 602
02 CHECK STARTER BRUSHWEAR INDICATOR.		GARRETT M.M. 49-21-00 TABLE 602

REVISION 13 - DATE 97/07/30 AC 120 - 42 A 49 - 010
CMP D.G.A.C.

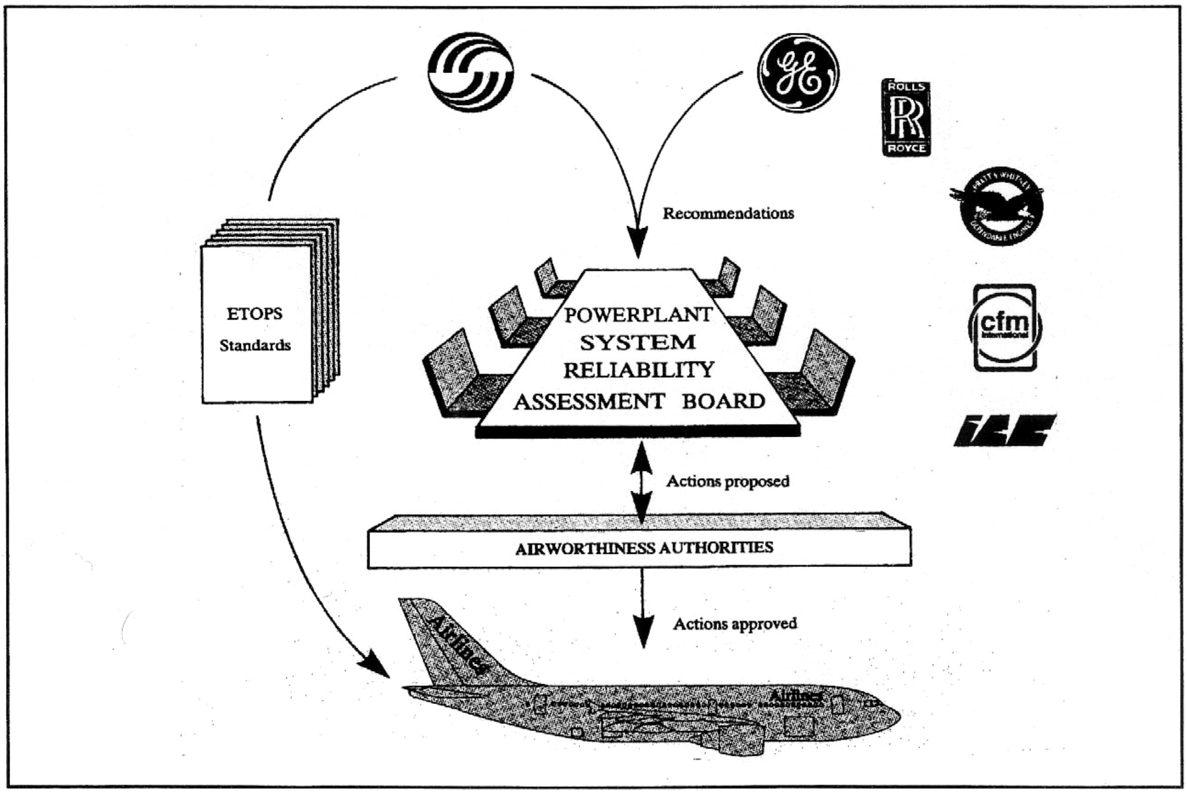
A300B4-620, CMP extract, ATA 49

5 - ETOPS OPERATIONS MONITORING BY THE AUTHORITIES

In order to ensure that the more rigorous ETOPS standards are being met, the European Joint Airworthiness Authority (JAA) has appointed a formal body to monitor ETOPS aircraft reliability. To this end, the Reliability Tracking Board (RTB) meets typically every 24 months. The RTB is hosted and chaired by the European authority, and on demand, other national authorities of countries whose airlines are involved in ETOPS, are invited.

On the other side of the Atlantic, the FAA hosts a similar meeting called the Power plant System Reliability Assessment Board (PSRAB) which, unlike its European counterpart, meets when ever an ETOPS 120-or 180-minute Type Design Approval is sought by an American manufacturer. Moreover, as its name implies, the PSRAB only monitors the engine, nacelle and APU reliability, while the RTB monitors these, as well as other ETOPS-critical aircraft systems and operational procedures.

Both the RTB and PSRAB examine ETOPS "significant events" which are defined as any event which could cause a diversion or impede the safety of the aircraft once a diversion is initiated. These events are presented by the airframe and engine manufacturers but reported by the operators. Then, the data base covers the worldwide twinjet fleet in terms of ETOPS events.



Liaisons AA/engine manufacturers/AI

Actions agreed at RTB/PSRAB meetings are incorporated in the CMP and must be conformed with by ETOPS operators in order to maintain their ETOPS Operational Approval (refer to Chapter 3).

In addition, in Europe, Airworthiness Review Meetings are held to monitor the continuous airworthiness of the various Airbus models. These meetings take place every two months and gather various European authority members delegated by the European Joint Airworthiness Authority. This forum can, if required, initiate urgent ETOPS-related actions without waiting for the next RTB annual meeting.

6 - AIRBUS ETOPS CERTIFICATION STATUS (October 1998)

- **In-service aircraft**

The tables here below give the ETOPS certification status for in-service Airbus models:

Aircraft type/engine	Aircraft model	Engine		Diversion time	
		Basic	Intermix	Europe	USA
A300-600	A300B4-620	JT9D-7R4 H1	-	180	-
Pratt & Whitney	A300C4-620	JT9D-7R4 H1	-	180	-
	A300B4-622	PW4158	-	180	-
	A300B4-622R	PW4158	-	180	-
A300-600	A300B4-601	CF6-80C2A1	-	180	-
General Electric	A300B4-603	CF6-80C2A3	-	180	-
	A300B4-605R	CF6-80C2A5	CF6-80C2A3	180	180
	A300F4-605R	CF6-80C2A5F	-	180	180
	A300B4-605R	CF6-80C2A5F	-	180	-

Aircraft type/engine	Aircraft model	Engine		Diversion time	
		Basic	Intermix	Europe	USA
A310	A310-221	JT9D-7R4 D1	JT9D-7R4 E1 500 JT9D-7R4 E1 500	180	180
Pratt & Wittney	A310-222	JT9D-7R4 E1 500	JT9D-7R4 D1 JT9D-7R4 E1 600	180	180
	A310-222-100	JT9D-7R4 E1 500	JT9D-7R4 D1 JT9D-7R4 E1 600	180	-
	A310-322	JT9D-7R4 E1 500	JT9D-7R4 D1 JT9D-7R4 E1 600	180	-
	A310-324	PW4152	-	180	120
	A310-325	PW4156A	-	180	-
A310	A310-203	CF6-80A3	-	180	-
General Electric	A310-204	CF6-80C2A2	-	180	-
	A310-304	CF6-80C2A2	-	180	-
	A310-308	CF6-80C2A8	CF6-80C2A2	180	-

Aircraft type/engine	Aircraft model	Engine		Diversion time	
		Basic	Intermix	Europe	USA
A320/ CFM	A320-111	CFM56-5A1	-	120	-
	A320-211/-212/-214	CFM56-5A1/-5A3/-5B4	-	120	-
A320/ IAE	A320-231/-232/-233	V2500-A1/ V2527-A5/ V2527-EA5	-	120	-
A321/ CFM	A321-111/-112/-211	CFM56-5B1/-5B2/-5B3	-	120	-
A321/ IAE	A321-131/-231	V2530-A5/V2533-A5	-	120	-
A319/ CFM	A321-111/-112 /-113/-114	CFM56-5B5/ -5B6/-5A4/-5A5	-	120	-
A319/ IAE	A319-131/-132	V2522-A5/ v2524-A5	-	120	-

Aircraft type/engine	Aircraft model	Engine		Diversion time	
		Basic	Intermix	Europe	USA
A330/ General Electric	A330-301 A330-202	CF6-80E1A2 CF6-80E1A4	- -	180 180	- -
A330/ Pratt & Whitney	A330-321/-322 A330-223	PW4164/4168 PW4168A	- -	180 180	- -
A330/ Rolls-Royce	A330-341/-342	Trent 768/772	-	180	-

- **Future aircraft**

  The tables herebelow give the further ETOPS certification target dates:

Aircraft type/engine	Aircraft model	Engine	Diversion time	Authority	Target date
A330/ General Electric	A330-323	PW4168A	180	JAA	Mid 99 (*)
A330/Rolls-Royce	A330-243 A330-343	Trent 772B	180 180	JAA JAA	End 98 (*) Mid 99 (*)

(*): at entry into service.

7 - "GRANDFATHER CLAUSE" FOR A300B2/B4

When ETOPS rules were implemented in 1985, a number of operators had already amassed enormous experience flying Airbus twins under traditional ICAO recommendations which permitted them to fly up to 90 minutes from a diversion airport at twin-engine speed (equivalent to about 105 minutes at single-engine speed). To suddenly revert back to 60 minutes with so much trouble-free experience would have been illogical.

Therefore, operations conducted regularly and safely under these ICAO recommendations were permitted to continue without recourse to the new ETOPS rules.

For example, A300s entered service with Trans Australia Airlines in 1980 and successfully flew from Sydney to Perth under ICAO guidelines. Imposition of 60 minutes diversion time would have rendered this service impossible. So the Australian authorities granted grandfather rights to permit the continuation of what was already a proven transcontinental operation by A300s.

Consequently, most ETOPS regulations currently published contain "grandfather clauses" to allow the continuation of operations engaged upon before the adoption of the ETOPS regulations. (Reference: AC 120-42A, CAP 513, TP 6327, CTC 20, AMJ 120-42 applicability paragraph). In most countries the date of effectivity of new ETOPS rules was November 1986.

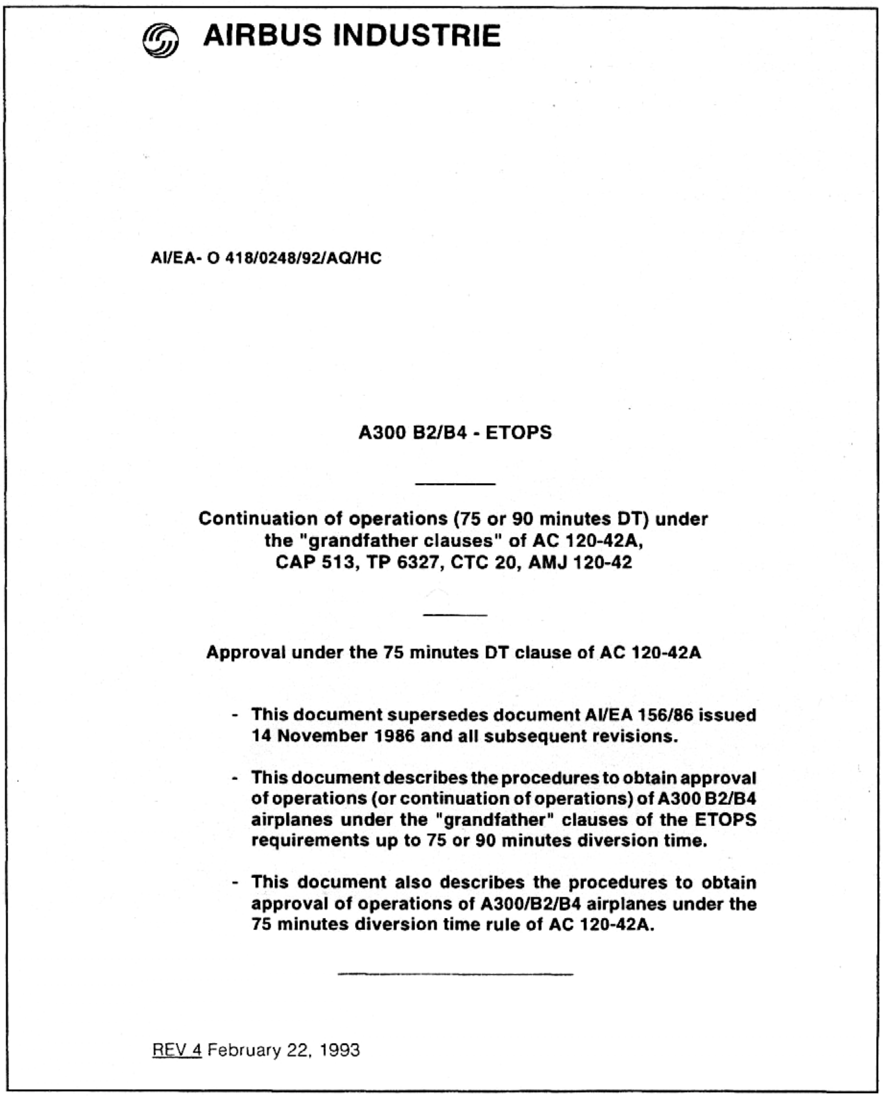
The regulatory interpretations on how to apply the "grandfather clause" vary between countries.

The most frequent interpretations are:

- authorities allow any operator in their country to operate any route on which the diversion time does not exceed the maximum diversion time approved for the aircraft type in their country (or in the country of the manufacturer) prior to November 1986;
- authorities allow all the operators that held an approval prior to November 1986 to continue their operations on the then-approved routes with the same aircraft type (or on any route with a diversion time not exceeding the one then-approved);
- authorities only permit the continuation of operations as described above if extra conservatism is introduced in the MEL, the dispatch conditions, the maintenance, the procedures and/or if an engine/aircraft reliability programme is implemented. (This document describes how to meet such requirements).

The approval to conduct operations under the "grandfather clause" is granted to the operator and not to the aircraft. This means that each time an aircraft is sold, the approval is lost and the new operator needs to launch the process to get a new approval.

Airbus has issued a document titled "A300B2/B4 - ETOPS" (reference: AI/EA-O 418.0248/92/AQ/HC) which gives all relevant information to conduct ETOPS operation with the A300B2/B4 under the grandfather clause. It also describes the procedure to obtain a new operational approval of the A300B2/134 aircraft for 75 or 90 minutes diversion time, whatever is permitted in the country of operations.



AIRBUS INDUSTRIE

AI/EA- O 418/0248/92/AQ/HC

A300 B2/B4 - ETOPS

Continuation of operations (75 or 90 minutes DT) under the "grandfather clauses" of AC 120-42A, CAP 513, TP 6327, CTC 20, AMJ 120-42

Approval under the 75 minutes DT clause of AC 120-42A

- This document supersedes document AI/EA 156/86 issued 14 November 1986 and all subsequent revisions.
- This document describes the procedures to obtain approval of operations (or continuation of operations) of A300 B2/B4 airplanes under the "grandfather" clauses of the ETOPS requirements up to 75 or 90 minutes diversion time.
- This document also describes the procedures to obtain approval of operations of A300/B2/B4 airplanes under the 75 minutes diversion time rule of AC 120-42A.

REV 4 February 22, 1993

A300 B2/B4 ETOPS document

Chapter 3

1 - GENERAL

This paragraph gives precise indications on how to proceed at first, to get relevant data for operational approval purpose.
Details and further information regarding ETOPS operations are given in Chapter 4 of this book.

a) Is ETOPS required ?

Before approaching the Airworthiness Authorities, the operator should clearly define if and where he needs ETOPS operations.
This is obvious for some routes (when crossing the Atlantic Ocean for example), but this could be less obvious when, for example, flying over desert area, and then, a study should be done.

This study can be done in the following order

1. determine the route(s) to be used and clearly draw it (them),
2. determine the `Adequate Airport(s)' (see definition page 75), and add them on the drawing,
3. determine the `Maximum Diversion Distance' with a diversion time of 60 minutes (see below how to proceed),
4. draw circles using the 60min diversion distance centered on each ‘Adequate Airport’,
5. if the route(s) go(es) outside these circles, ETOPS operations are required on the portions of routes located outside these `60min' circles.

60 Min Maximum diversion distance:

2 possibilities to calculate this distance

a.1 First method:

a.1.1: 1er step

– Determine the Maximum takeoff weight (use MTOW from the Flight Manual or take off weight limited by the runway or take off weight limited by max landing weight).

– Using the table of the FCOM (see extract in page 117) and the weight defined above, determine the ‘60 Min’ distance for a given speed schedule (use VMO if no limiting obstacles) and the associated optimum flight level for diversion.

This distance may be used to draw the '60 Min' circle, but it is not optimized (heavy reference weight). If the route is declared as ETOPS (some portions of the route are outside these '60 Min' circles), continue with the 2nd step to extend this '60 Min' distance using a lighter reference weight.

a.1.2: 2nd step (use of a lighter Reference Weight)

– Reference Weight calculation (see page 80): Determine the Critical Point (CP, see definition in page 78) ; if required, use the '60 Min' circles defined above (1 st step) to estimate the location of the CP. Then determine the associated Reference Weight.

NOTE: This will require Flight planning computation considering ETOPS critical fuel scenario (see page 93). To simplify the study (if optimization not required), an heavier Reference Weight may be used (i.e.: an aircraft weight before reaching the Critical Point).

– Using the table of the FCOM (see extract in page 117) and the Reference Weight, choose the speed schedule and check that the optimum Flight Level is suitable for the obstacle clearance. If the obstacles are cleared, determine the new '60 Min' distance.

– If the obstacles are not cleared with the table given in the FCOM, use a performance calculation computerized tool, to find suitable speed schedule, diversion Flight Level and then the '60 Min' distance.

NOTE: The calculation of the Maximum diversion distance is done at ISA conditions with no wind. For some area, ISA + 10 atmospheric conditions may be used (see page 80).

a.2 JAR-OPS 1.245 Method: `Maximum distance from an adequate aerodrome for two-engined aeroplanes without an ETOPS Approval' (March 1998):

The interpretation of this rule gives the following conditions:

– Reference weight: the aircraft gross weight after one hour into flight, having taking off at the MTOW given by the Flight Manual at sea level (ISA conditions, no wind),

– After engine failure, descent down to diversion Flight Level,

– Diversion Flight level after engine failure: FL 170,

– Single engine speed: use speed schedule VMO/MMO.

NOTE: To determine if the route is ETOPS or not, using the JAR-OPS 1.245 method, the obstacles have not to be considered.

With this rule, there is a single '60 Min' diversion distance per aircraft variant as given below:

Aircraft	MTOW (KG X 1000)	Distance (NM)
A300-B4-601	165	415
A300B4-603	165	420
A300B4-605R	167.8	429
A300F4-605R	170.5 to 171.7	427
A300B4-620	165	416
A300B4-622 A300B4-622R	170.5 to 171.7	425
A310-203	142	428
A310-204	142	443
A310-304 A310-308	153	438
	164	432
A310-221	142	438
A310-222	142	443
A310-322	142	443
	153	431
A310-324 A310-325	153	431
	157	427
	160	425
	164	421

Aircraft	MTOW (KG X 1000)	Distance (NM)
A330-202	230	423
A330-301	212 to 218	412
A330-223	230	431
A330-321	212 to 218	420
A330-322	212 to 218	432
A330-341	212 to 218	417
A330-342	212 to 218	431

Aircraft	MTOW (KG X 1000)	Distance (NM)
A319-111 A319-112	70	394
	75.5	387
A319-113 A319-114	70	394
	75.5	386
A319-131 A319-132	70	408
	75.5	405
A320-111 A320-211 A320-212	73.5	383
	75.5	379
	77.0	376
A320-214	73.5	403
	75.5 to 77	400
A320-231	73.5	408
	75.5	405
	77	403
A320-232 A320-233	73.5	405
	75.5 to 77	402
A321-111 A321-112 A321-211	83	394
	85	392
	89	385
A321-131 A321-231	83	389
	85	385
	89	373

b) ETOPS is required, which diversion time ?

After having drawn the 60 min circles as determined above, some routes may not be covered by these circles. Thus these routes are ETOPS and higher diversion time (above 60 min) is required

Process as explained in paragraph ‘a.1.2'.
When using the table of the FCOM, choose a diversion time higher than 60 min (90 min, 120 min, 150 min or 180 min) with the same speed schedule and the same reference weight as used when defining the 60 min diversion distance. If intermediate diversion time is required (for example: 75 min or 105 min), do an interpolation.

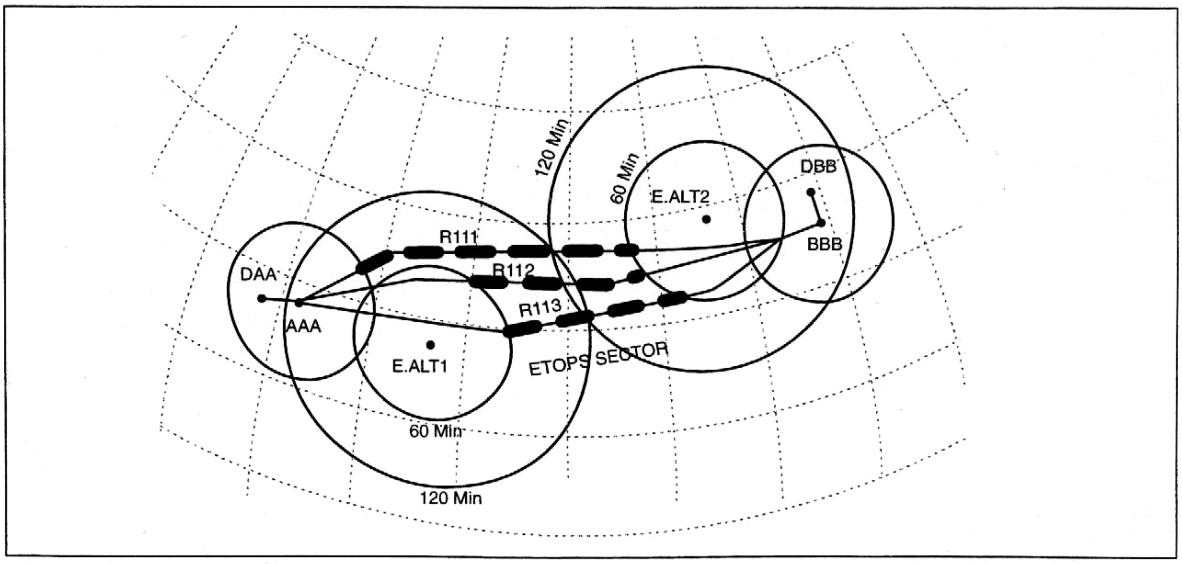
For JAR operators who have used the tables given above in paragraph ‘a.2', the rule as explained in paragraph ‘a.1.2' has to be used for diversion time above 60 min. The speed schedule and the applicable reference weight have to be determined.

NOTE: - For the A310/A320/A321, the maximum diversion time in the Flight Manual is 120 Min. The distances of the tables covering diversion time above 120 Min, are given for information only.

SUMMARY:

For each ETOPS sector, relevant information can be summarized in a table and in a drawings as follows (this example is given for information only and it is not a real ETOPS study):

A330-301 ROUTES R111, R112, R113 Flight AAA / BBB Destination Alternate: DAA, DBB	
Reference Weight:	200 000 Kg
Speed schedule: FL for diversion: Temperature:	MCT / 330 KT FL 140 ISA + 10
Circle Ranges / Diversion time: 60 Min: 120 Min:	 430 NM 837 NM
En route Alternate Airports:	E.ALT1, E.ALT2
ETOPS Entry Points: R111 R112 R113	430 NM, from AAA and E.ALT2 from E.ALT1 and E.ALT2 from E.ALT1 and E.ALT2
ETOPS Sector length: R111 R112 R113	 1450 NM 900 NM 950 NM



c) How to get ETOPS operational approval:

The first consideration for a potential ETOPS operator is to ensure that the candidate aircraft has received an ETOPS Type Design Approval (see chapter 2).

The second step is to get ETOPS Operational Approval from its national operational authority to operate ETOPS.

The ETOPS regulations (listed in page 21) provide guidelines and requirements for operational approval.
In the case a National ETOPS regulation does not exist, the National Airworthiness Authority may select an existing ETOPS rule (e.g.: AMJ / FAA...)

Furthermore, JAA members have to refer also to the JAR OPS regulation.

In any case, the operators should submit their requests, at least **3 months** prior to the proposed start of ETOPS operations (6 months in case accelerated ETOPS approval).

To obtain the ETOPS Operational Approval, the airline must demonstrate its competence to its authority. In other words, the airline has to prove that it has the appropriate experience with the airframe/engine combination under consideration and that it is familiar with the intended area of ETOPS operation.

Although the Operational Approval rules are documented, each operational authority may choose the "means of compliance" stating the exact method that an airline may use to show its readiness.

It is worth noting that the wording "Operational Approval" does not refer only to the approval of the airline's flight operations organization and procedures but, more broadly, to all of the following aspects: aircraft configuration, maintenance practices, ETOPS training and dispatch practices.

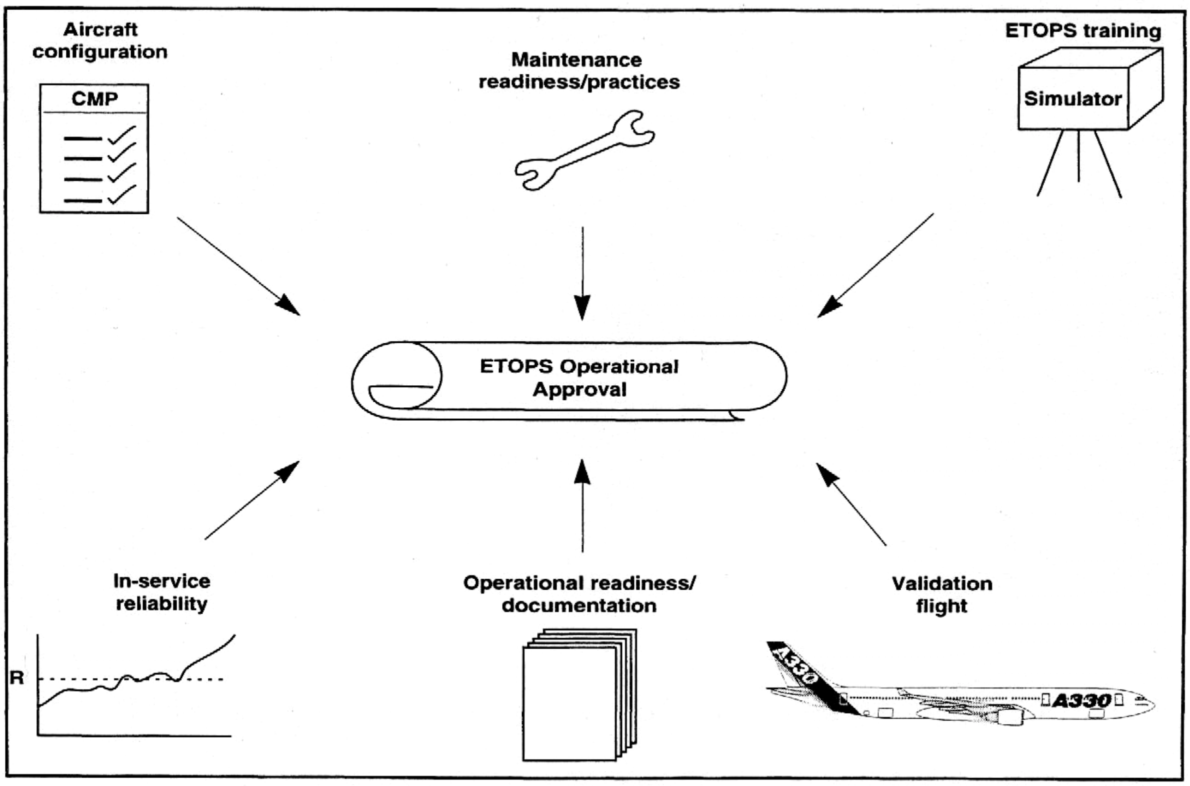
To get approval for 120-minutes diversion time, the regulations require that the candidate airline accumulates 12 months of consecutive in-service experience with the candidate airframe/engine combination, or less if the airline can successfully demonstrate its "ability and competence to achieve the necessary level of reliability" required for ETOPS operations. The latter approach, termed "Accelerated ETOPS Approval", is readily accepted by all authorities and they have published guidelines to the effect.

The accelerated ETOPS approval concept is based on a structured programme of compensating factors and a step-by-step approach which is explained further. This is the same philosophy as the Technical Transfer Analysis used to accelerate the aircraft ETOPS Type Design Approval.

Once the criteria for the operational approval are met, the operator should submit to its national operational authority an ETOPS Operational Approval application, specifying its intended routes an supported by the relevant substantiating data. In response, the authority will grant a maximum diversion time, permitting the airline to start ETOPS operation.

2 - CRITERIA TO OBTAIN OPERATIONAL APPROVAL

A national authority will normally require that the applicant airline for an ETOPS Operational Approval satisfies the criteria listed hereafter and illustrated in the figure below. However, an authority may allow some relaxations from the full ETOPS requirements for those routes with diversion times of less than 75 minutes, especially if the routes have particularly stable weather conditions, numerous adequate airports and highly reliable and available communication, navigation and ATC services. On the other hand, for a diversion time of 180 minutes, the FAA increases the requirements, with particular emphasis on maintenance and experience already accumulated while operating at 120 minutes diversion time.



ETOPS Operational Approval

a) Diversion time required and ETOPS approval plan

The diversion time is a criteria which size up the Operational approval process.
For example: it is easier to get 75 Min diversion time approved than 120 Min.

Furthermore, it is very important to define ASAP the date for the intended start of ETOPS operations. Indeed this will determine the type of approval plan (i.e.: conventional or in fact accelerated) and its content (i.e. how to comply with the relevant requirements).

b) Aircraft configuration

The aircraft should be configured in accordance with the approved CMP document at the latest revision and, ïf appropriate, exemptions should be justified by the intended type of operation. A summary of titles and numbers of all modifications/Service Bulletins, additions and changes implemented to qualify the aircraft for ETOPS should be submitted to the national authority. In addition, details of any non-manufacturer modifications, introduced for initial operation by the operator, should also be submitted in order to assess their possible effects on ETOPS. In a similar way, any proposed modification for subsequent embodiment to the aircraft should be assessed by the operator with the assistance of the aircraft manufacturer for its possible effect on ETOPS.

c) Maintenance practices

Maintenance practices can be divided into the following aspects

- **Maintenance procedures**

  The operator's intended maintenance procedures and limitations for ETOPS should be submitted to the national authority for approval.

- **Reliability reporting**

  A reliability reporting program should be implemented prior to the ETOPS Operational Approval and continued during in-service ETOPS.

- **Modifications and inspections**

  Procedures should be established for the prompt implementation of modifications and inspections which could affect the propulsion and airframe systems reliability.

- **Aircraft dispatch**

  Procedure should be established to preclude an aircraft being dispatched for ETOPS after:

  - an engine shutdown or a primary system failure on a previous flight,
  - significant adverse system performance trend, unless appropriate corrective action has been taken.

- **Maintenance programme**

  The operator's maintenance programme should include all ETOPS maintenance standards listed in the latest approved CMP document.

- **Engine Condition Monitoring (ECM)**

  An ECM program should be developed and used to initiate the inspection of components or modules, the condition of which is not otherwise observable and which could adversely affect failure rates.

- **Oil consumption monitoring**

  An engine and APU oil consumption monitoring program should be developed.

- **Configuration control**

  The operator must ensure that the aircraft's ETOPS configuration is in compliance with the configuration standards listed in the latest approved CMP document. Procedures and practices should be developed to maintain ETOPS parts configuration control.

- **ETOPS service check**

  Maintenance check to address the requirements for an ETOPS dispatch should be proposed to the authorities.

  The ETOPS service check for ETOPS flight can be based on the service check of a normal flight amended by specific ETOPS checks.

  The normal service check is based on Airbus documents:

  - Maintenance Line Check List,
  - Line Check Supporting Data,
  - Maintenance planning and supporting data samples.

  Guidance to develop an ETOPS service check is provided in the following Airbus documents

  - ETOPS Maintenance and Documentation
    Ref: AI/EA-O 418.0126/96 dated 23 April 1996

d) ETOPS training

The operator's ETOPS training programme should instruct flight crews, maintenance personnel and dispatchers with the specifics of ETOPS requirements, dispatch criteria, maintenance procedures and the operational guidelines, so that they can effectively and safely operate and support aircraft operations in the ETOPS environment.

One of the most important objectives of such a training programme is to increase and maintain general ETOPS awareness within the airline. The training course can be in the form of written material and briefings, supported by simulator training sessions for the flight crew.

ETOPS training can be provided either by the Airbus Training and Flight Operations Support Division, by an approved training organization, or set up by the operator's own training department under the approval of its national authority.

The ETOPS course should concentrate on the following areas:

- **Maintenance training**
  - ETOPS regulations/Operational Approval
  - Dispatch considerations: MMEL constraints
  - Aircraft configuration: additional maintenance tasks (CMP)
  - Engine and systems review
  - ETOPS service checks:
    - Spare parts control
    - Engine/APU preventive maintenance
    - IFSD prevention program
    - Use of on-board maintenance facilities

- **Flight crew and dispatcher training**
  - ETOPS regulations/Operational Approval
  - Aircraft performance/diversion strategies
  - Area of operation
  - Fuel requirements
  - Dispatch considerations: MMEL, CDL, weather minima
  - Flight crew documentation
  - Flight crew procedures

Standard ETOPS training can be defined as follows:

- Initial training for flight crews and dispatchers
- line training and recurrent training for flight crews

I) Initial training: Airbus ETOPS course syllabus:

The Airbus ETOPS course provides a combination of academic knowledge and practical applications. The academic phase follows a logical progression to enable trainees to understand the operating constraints in an ETOPS environment.

- Flight crew ETOPS course:

  Courses from two to four days, depending on the airline's experience with both ETOPS and the aircraft, including:

  - classroom briefing: one day or none,
  - full flight simulator sessions (2 or 3) with briefings and debriefings.

– Dispatcher ETOPS course

Four-day courses, including:

- classroom briefing (two days) to describe the various aspects of ETOPS,
- practical exercises (two days).

II) Line training and recurrent training:

This training has to be set up by each operator in agreement with its national authority.

The following table provides a cross-section of the Line Training and Recurrent Training concepts adopted by four Airbus ETOPS operators:

	Line Training	**Recurrent Training**
Airline A	One leg in an operating seat with one check-airman	Every year with a check-airman
Airline B	Four ETOPS sectors	Every year
Airline C	One leg in the jump seat	Every two years
Airline D	-	Based on a LOFT (Line Orientated Flight Training)

e) In-service reliability

In making their assessment on whether an airline's fleet reliability is acceptable for ETOPS or not, the national authority compares the airlines submitted in-service reliability data trends with those of other operators, as well as with the world fleet average values, and applies a qualitative judgement considering all relevant factors. Moreover, the airline's past history of propulsion system reliability with the same or related engines is also reviewed. However, for a small fleet a statistical approach may not be relevant.

f) Operational readiness/documentation

The airline should submit the following documentation for approval to its national operational authorities:

- **Company's Operations Specification/Operations Manual amendment:**

  Depending on the national operational authorities, the operator should produce either Operations Specification or an Operations Manual amendment regarding ETOPS flight operations procedures, for approval.

  The ETOPS Operations Manual should include:

  - identification of ETOPS aircraft (model, serial numbers, particular airframe/ engine combination),
  - reference to the current CMP document,
  - reference to the approved ETOPS Maintenance Procedures Manual,
  - maximum diversion time,
  - area of operation with data relative to the calculation,
  - declared adequate en-route alternate airports for the considered routes,
  - ETOPS dispatch and normal / company en-route weather minima for each alternate airport,
  - minimum en-route and diversion altitudes,
  - diversion strategy (altitude and speed schedules),

- fuel requirement policy,
- minimum crew qualifications and recent experience to allow them to operate unsupervised on ETOPS,
- pre-flight and in-flight crew procedures,
- guidelines for diversion decision-making (FCOM guidelines can be supplemented by airlines own in-house policy).

The appropriate ETOPS Operations Manual chapter should be held by each person directly involved in the flight operations of ETOPS aircraft. Any revision would be advised to each person together with a description of the implications of the change.

- **Flight Crew Operating Manual / Aircraft Operating Manual**

The Operating Manual should incorporate the aircraft single-engine performance data for the speed schedules being considered for an ETOPS diversion:

- altitude capability (en-route gross flight paths),
- descent, cruise and holding performance data (including fuel, time and distance as well as correction factors for the effect of anti-ice systems),
- data relative to any other conditions relevant to ETOPS which could cause significant deterioration of performance; for example ice accretion on non-heated surfaces, RAT deployment etc.,
- data relative to altitude, airspeed and distance used in establishing the ETOPS area of operations.

- **Minimum Equipment List (MEL)**

The operator's MEL is based on the Master Minimum Equipment List (MMEL) established by the aircraft manufacturer.

More information on MEL is given in Chapter 4.

- **Fuel requirement policy**

  The operator should demonstrate that its fuel requirement policy is in line with the critical fuel scenario requirements as described in the ETOPS regulations. Chapter 4 of this brochure provides all relevant information to determine the critical fuel scenario.

- **Flight documentation**

  Flight documentation includes those documents transmitted by the dispatch office to the flight crew at departure of any ETOPS flight such as:

  - ETOPS release statement,
  - a computerized flight plan including ETOPS data for route and fuel requirements,
  - MEL / CDL status,
  - navigation and plotting charts clearly identifying the ETOPS area of operations plus the ETOPS Entry Point (EEP) and the Equitime Points (ETPs),
  - weather dossier with forecast and reports for the route and the suitable alternate airports,
  - any other documents normally provided for a normal flight such as:
    - load and trim sheet
    - reclearance data (as applicable)
    - applicable NOTAMs
    - navigation data in case of FMS loss
    - departure / alternate / destination airports remarks
    - departure, en-route and terminal area briefings

g) Validation flight

A validation flight conducted in either the ETOPS capable aircraft and/or an approved simulator should be performed in order to demonstrate that the operator is competent to safely operate and support the intended ETOPS operations. It permits the validation of the overall airline procedures and its readiness in all applicable fields.

It is worth noting that the ETOPS validation flight (also referred to as ETOPS proving flight) is not meant to judge the performance of the flying crew but to demonstrate and validate the effectiveness of the overall company procedures for ETOPS.

Airbus therefore recommends that all procedures conducted following aircraft system failures be demonstrated in a simulator and, if necessary, that a proving flight with the actual aircraft be conducted to verify normal ETOPS flight routines/monitoring. Simulator demonstrations should include the following emergency conditions:

- total loss of thrust of one engine,
- total loss of engine-generated electrical power,
- any other condition considered to be equivalent in terms of airworthiness.

3 - ACCELERATED ETOPS APPROVAL

General

The accelerated ETOPS concept has been established to allow airlines to get ETOPS approval quicker than the regulations previously permitted. The process is based on a structured program of compensating factors.

This concept represents a major change from the previous approval concept which was primarily based on a review of the operator's direct experience with the candidate aircraft. However, the means to obtain Operational Approval with reduced in-service experience does not imply that a reduction of existing reliability standards will be tolerated but rather acknowledges the fact that an operator may be able to satisfy the existing standards specified in the current regulations by demonstrating its capability in less than 12 months of operation. The configuration standards required for 120-minute ETOPS approval are considered the minimum acceptable standards for any Operational Approval, including lower diversion times, 75- or 90-minute approvals.

For the time being, the accelerated ETOPS concept is included in the Appendix 7 of the JAA - AMJ/IL20, and in Appendix 7 of the FAA-AC 120-42B. Non JAA applicant operators may approach their operational authorities using the Appendix 7 (JAA or FAA) as guidelines.

Requirements

The operator should submit an "Accelerated ETOPS" Operational Approval plan to its national authority. This plan, which is in addition to the normally required ETOPS Operational Approval plan, fully defines the operator's proposals for accelerated ETOPS and the factors which it is claiming as compensating for the normally required in-service experience.

Factors which may be considered include:

- the record of the airframe/engine combination, if it is better than the reliability objectives of the regulations and, in particular, if it is well established that there were no cases of ETOPS events linked with maintenance errors or crew errors,

- the operator's maintenance and operational experience:
  - as a previous ETOPS operator,
  - as a previous long-range operator,
  - with similar technology aircraft,
  - with other aircraft made by the same manufacturer,
  - with similar technology engines,
  - with other engines made by the same manufacturer.
- the support to be given by airframe, engine and APU manufacturers after start-up of operations,
- maintenance or operational support from established ETOPS operators, ETOPS maintenance organizations or vendors of computerized flight planning and operational services,
- the experience gained by flight crews, maintenance personnel and dispatch staff whilst working with other ETOPS-approved operators.

In addition, to support the above-mentioned factors, the operator should establish the appropriate procedures including:

- simulated ETOPS operation on applicant or other aircraft,
- additional MEL restrictions,
- extensive health monitoring procedures for propulsion systems,
- commitment to incorporate CMP quick-action items.

Operational Approval considerations

When considering an application for an accelerated ETOPS Operational Approval, the authority must be satisfied that the standards established by the operator are equivalent to those operating standards which would normally be expected after 12 months of in-service experience. Particular attention will be paid to:

- the operator's overall safety record,
- past performance,
- flight crew training,
- dispatch training,
- maintenance training,
- maintenance programmes,

- control procedures when maintenance support is provided by some other organization,
- control and checking procedures when flight dispatch (including computerized flight planning, meteorological information, load and balance data) is provided by some other organization.

Operator's propulsion system reliability

The propulsion system will have demonstrated over the world-wide fleet an established IFSD rate consistent with the Operational Approval sought. The operator will demonstrate, to the satisfaction of the authority, how it will maintain this level of propulsion system reliability.

Engineering modification and maintenance programme

Maintenance and training procedures, practices and limitations established for extended-range operations must be considered suitable.

A reliability reporting procedure must be in place and demonstrated.

The operator must show an established procedure for prompt implementation of modifications and inspections which could affect propulsion system and airframe system reliability.

The engine condition monitoring programme must be demonstrated to be established and functioning.

The oil consumption monitoring programme must be demonstrated to be established and functioning.

Flight dispatch

The operator must demonstrate to the satisfaction of the authority that dispatch procedures are in place and are satisfactory for the operation being conducted. An operator with no previous ETOPS experience may obtain support from an established ETOPS operator or vendor of computerized flight planning and operational services to facilitate ETOPS dispatch, but this does not in any way absolve it from the responsibilities for control and checking of such procedures. Flight crews must demonstrate their ability to cope with pre-departure and en-route changes to planned route, en-route monitoring and diversion procedures. Both flight dispatch staff and flight crews must demonstrate familiarity with the routes to be flown, in particular the requirements for and the selection of en-route alternates.

Flight crew training and evaluation programme

The operator must demonstrate a training and evaluation programme that fulfils all the requirements. The authority will be satisfied, by simulated ETOPS operations using the normal dispatch procedures and an approved flight simulator, that the crew members nominated as ETOPS-qualified by the operator are properly trained and capable of dealing with any situation which might be encountered during extended-range operations. Such demonstrations must include a change of planned route, emergency procedures, diversions to an en-route alternate, following both an engine failure and, on a separate occasion, a total pressurization failure, and the flight profile to meet the critical fuel scenario requirements.

Operational limitations

Operational Approvals which are granted after taking advantage of reduced in-service experience will be limited to specified routes. The routes approved will be those demonstrated to the authority during the execution of the Accelerated ETOPS Operational Approval Plan. When an operator wishes to add routes to the approved list, additional demonstrations associated with maintenance capability at the new destination and dispatch and en-route procedures for the new route must be conducted to the satisfaction of the authority.

ETOPS operations start-up

Operators who successfully demonstrate a capability consistent with the standards required for an Operational Approval with 120-minute diversion time may be required to progress to this level of approval in steps.

Examples of a "step" approval and the associated conditions are given below:

- Operators who have experience as ETOPS operators and experience with similar technology aircraft and similar technology engines can apply for a 120-minute diversion time Operational Approval at entry into service.
- Operators who have previous long-range experience and experience with similar technology aircraft and similar technology engines can apply for a 90-minute diversion time Operational Approval at entry into service, and must complete a three-month period and a minimum of 200 sectors with a measured operational reliability of 98% before progressing to a 120-minute approval.

- Operators who have no previous long-range experience but who obtain appropriate maintenance and operational support from an established ETOPS-approved organization can apply for a 90-minute Operational Approval and must complete a three-month period and 300 sectors with a measured operational reliability of 98% before progressing to a 120-minute approval.
- Operators who intend to commence ETOPS operations with staff who have gained appropriate experience with other ETOPS-approved operators can apply for a 75-minute diversion time Operational Approval and must complete 200 sectors with a measured operational reliability of 98% before progressing to a 90-minute approval, and then must complete a further three-month period and 300 sectors with a measured operational reliability of 98% before progressing to a 120-minute approval.
- Operators who intend to progress to a 138-minute diversion time Operational Approval (120 minutes plus 15% on the basis of the 120-minute ETOPS CMP) must demonstrate their suitability and must complete a minimum of 200 sectors with a measured operational reliability of 98% under the 120-minute approval.
- Operators who intend to progress to a 180-minute diversion time Operational Approval must demonstrate one year's satisfactory and extensive operation at a maximum diversion time of not more than 138-minutes.

Operations Manual

The Operations Manual should include a section explaining the special nature of the Accelerated ETOPS Operational Approval and emphasize the limitations of the process, in particular the restricted 75/90 minutes diversion time and restricted ETOPS MEL if applicable.

Accelerated ETOPS surveillance

Operators must be aware that any deficiencies associated with engineering and maintenance programmes, flight dispatch or flight crew performance may result in the rejection of, or amendment to, the claimed credit for reduced in-service experience.

Therefore, an accelerated programme leading to an Operational Approval is considered feasible so long as the operators retain commitment to the standards which are contained in their ETOPS Operational Approval Plan and associated programmes, and the first year of operation will be closely monitored.

4 - SIMULATED ETOPS DURING PROVING PERIOD

As already mentioned, an operator can claim a reduction in the proving phase to get operational approval by simulating ETOPS operations over non-ETOPS routes. (see Appendix 7 of IL20 / AMJ 120-42).

Simulating ETOPS consists of applying ETOPS requirements for a normal flight. Maintenance staff, dispatcher and crews are concerned and must completely play their respective rotes to validate the process.

Simulating ETOPS will help all involved people of the airline to get familiar with ETOPS requirements. This training in real conditions will permit the airline to be ready at the start of ETOPS operations, and to be confident in the procedures tested during the simulation.

Maintenance staff will apply, whenever possible, the CMP documents requirements. Of course, an on-time flight departure should not be jeopardized in applying the complete ETOPS requirements. Moreover, the complete ETOPS service check should be performed at the airline's main base but may be more difficult to apply at outstations.

During this simulation period, the airline will embody, as applicable, all the Service Bulletins indicated with an asterisk (*) in the CMP document. These Service Bulletins are mandatory to start ETOPS operation.

The airline's ETOPS MEL will also be applied and will allow the airline to become familiar with ETOPS items. The airline will not cancel or postpone a flight if an ETOPS item is not completed.

Dispatchers will prepare the flight, as if it was to be an ETOPS flight, with all the specific ETOPS requirements. Their specific tasks will be more fully explained in a specific chapter of this brochure.

Finally, the flight crews will also apply the specific ETOPS requirements. Before the flight departure they will perform the specific cockpit tests in conjunction with maintenance personnel (for example, on A310, the standby generator test, etc.). They will pay particular attention to the ETOPS dispatch minima requirements for the simulated adequate diversion airports.

During the flight, they will have to be provided with the latest weather forecasts (for example, using ACARS) along the route. Also, fuel and oil consumption will be monitored. At the end of the flight, all items relevant to ETOPS operation may be inserted in the logbook.

However, it should be highlighted that during that period of simulated ETOPS it is neither required nor advisable that the crew simulate an engine or system failure or simulate a diversion to the destination airport. These exercises will be done in the simulator during the ETOPS training course.

Simulated ETOPS should be understood as a "role playing" exercise, and should not unduly interfere with the normal flight conduct and crew workload (as a function of the route being flown).

At the end of such a period of simulated ETOPS flights, the airline should be familiar with the whole ETOPS procedure and ready to start ETOPS operations in good conditions. This experience should be very helpful to get ETOPS Operational Approval and to give confidence to the national authorities in the airline's ability to conduct ETOPS operations.

5 - 138-MINUTE ETOPS APPROVAL CRITERIA

It has been determined that a need exists for an optional ETOPS approval between 120 and 180 minutes. JAA, first, has given 138-minute (120+15%) approval to European operators conducting 120-minute ETOPS operations. FAA now gives this approval to applicant operators and has issued a policy letter (reference EPL 95/1).

The ETOPS approval with 138-minute diversion time is obtained on the basis of the approval with 120-minute diversion time, this means without having to comply with all the extra requirements applicable for approval with 180-minute diversion time.

The increased diversion time up to 138 minutes allows the removal of any operational constraints that may exist with 120 minutes and offers greater operational flexibility. In addition, wherever 138 minutes is sufficient, it allows significant benefits as compared with the 180-minute ETOPS requirements, in particular for fuel reserves, for MEL and for the capacity of the cargo fire protection systems.

In addition, an increased number of adequate en-route alternate airports could be offered in certain areas.

Both JAA and FAA agree on the application of the 120-minute CMP requirements and that the MEL should be reviewed for the slight increase in diversion time.

In addition, with regard to the aircraft equipment, and more particularly for the capacity of the cargo fire protection system, the JAA requires the application of the basic rules. This means 138 plus 15 minutes, whereas the FAA is less stringent by requiring 120 plus 15 minutes only.

It is worth noting that, to take credit of the 120-minute extension, the operator should ensure that the candidate aircraft has obtained the ETOPS Type Design Approval with at least a 138-minute diversion time.

Airlines with existing 120-minute or greater approval may apply for 138-minute ETOPS approval by application letter which must include the following information:

- summary of present approval,
- airframe/engine combination presently being used by the airline,
- airframe/engine combination for which 138-minute ETOPS application applies,
- engine shutdown rates for existing airframe/engine combinations included in the 138-minute ETOPS application,
- area of operations requested for 138-minute ETOPS operations (Atlantic, Pacific, etc.),
- training curriculum to be used identifying 120 versus 138-minute ETOPS criteria.

6 - GRANTING THE ETOPS OPERATIONAL APPROVAL

Following the ETOPS Type Design Approval for the aircraft and a satisfactory application of the Operational Approval criteria by the applicant airline, the national operational authorities will grant to the airline an Operational Approval to conduct ETOPS flight with a given maximum diversion time.

This Operational Approval can be in the form of either:

- an approved Operations Specification containing the appropriate limitations or,
- an approved Operations Manual amendment for ETOPS.

7 - CONTINUED ETOPS OPERATION SURVEILLANCE

As previously mentioned, ETOPS aircraft reliability trends are continuously monitored by the RTB in order to ensure that they remain at the necessary levels. The operator should therefore provide the following reliability data (events and analysis) to the national authority:

- in-flight engine shutdowns,
- diversions and air turn backs,
- uncommanded power changes and engine surges,
- inability to control the engine or obtain the desired thrust level,
- ETOPS critical system malfunctions.

In addition, the following general information should be provided:

- aircraft identification,
- engine identification,
- total time, cycles and time since last shop visit (for engines),
- time since overhaul or last inspection (for systems),
- corrective action.

Therefore, the operator must keep in mind that the ETOPS Operational Approval is not granted for ever. Although not subject to a format renewal procedure, the Operational Approval is continually reviewed by the operational authorities and, if necessary, can be withdrawn. This can be the case if the airline overall reliability is not sufficient. Therefore, the airline must take the necessary actions to recover an acceptable reliability level and then to apply for a new operational approval.

8 - JAA/FAA RULES HARMONIZATION

Current ETOPS regulations are constantly harmonized or up-dated in order to further improve the airlines operation efficiency.

For that purpose:

- JAA and FAA meet every six months,
- FAA and ATA meet regularly.

Airbus is allowed to attend these meetings as an active member or observer. During these meetings the agreed interpretations of the current rules are also defined for the benefit of the operators.

As examples, in 1994, the following rules were harmonized or amended:

- consideration of the statistical delta ISA condition to determine the area of operation,
- single-engine speed definition,
- for the ETOPS critical fuel scenario, consideration of the anti-ice and ice accretion fuel reserves based on icing conditions forecast and the corresponding exposure time,
- Accelerated ETOPS Approval Procedures,
- 75- and 90-minute diversion time approval criteria,
- diversion time increase to 138 minutes,
- ETOPS transit service check,
- evolution of the CMP document.

A significant example of an agreed rule interpretation is the consideration of the descent phase for computation of the maximum diversion distance. This interpretation was first proposed by Airbus.

Pending the official issue of revised circulars, FAA and JAA issue draft papers or policy letters reflecting the amendments which are directly applicable by the operators after agreement of their respective local operational authorities.

9 - AIRBUS ETOPS SUPPORT

In order to support operators in obtaining the ETOPS Operational Approval, Airbus is in a position to provide complete assistance on the basis of a commercial agreement:

- **Engineering and operational assistance**

  This assistance includes mainly the following services:

  - review of airline schedule,
  - assessment of airline organization,
  - presentation of current ETOPS regulations and policies,
  - proposal for an ETOPS approval programme,
  - supply of all necessary documents to support this ETOPS approval programme (see detailed list hereafter),
  - establishment of a customized maintenance and operational documentation (see detailed list hereafter),
  - assistance during negotiations with local operational authorities.

Airbus assistance comprises the supply of the following documents to support the airline application for ETOPS:

- application letter,
- airline intended area of operation,
- route study,
- airline organization for ETOPS operation,
- analysis of airline Airbus fleet experience,
- programme of compensating factors (for accelerated approval),
- programme schedule.

The following customized technical documentation to support the airline ETOPS operation is also supplied:

- ETOPS Flight Operations Procedure Manual,
- ETOPS Maintenance and Engineering Procedures Manual,
- ETOPS Minimum Equipment List,
- Daily, Weekly and Transit Checks (work packages),
- Technical Log Form,
- Dispatcher Check List,
- Flight Watch Check List,
- Fleet Configuration Compliance Status Report,
- Compliance Record against ETOPS rules,
- Retrofit Programme and justification of any extension of compliance,
- ETOPS Parts List,
- ETOPS CMP.

- **Training**

Airbus basic ETOPS training package contains the following courses:

- ETOPS flight crew training,
- ETOPS dispatcher training,
- ETOPS line maintenance training,
- ETOPS flight crew line training.

- **Retrofit programme**

Should a retrofit of the fleet be required to obtain the ETOPS approval, the assistance covers the supply of all necessary Airbus Service Bulletins and kits as well as on-site technical assistance if requested.

Chapter 4

1 - GENERAL

This chapter gives details regarding ETOPS flight operations.
It may be necessary to review this chapter before using the recommendations of Chapter 3 'General', when determining the 60 min circles and the required diversion time.
Indeed, the choice of the Adequate airports, of the speed schedule and of the reference weight will determine what diversion time is required and must be approved by the National Airworthiness Authorities.

2 - DEFINITIONS

ETOPS operations

ETOPS operations apply to all flights conducted in a twin-engined aircraft over a route that contains a point further than 60 minutes flying time from an adequate airport. Calculation of the corresponding '60 min' circles must be done in line with the applicable regulation (see chapter 3 paragraph 1).

ETOPS operations requires specific regulations and operational procedures application.

Adequate airport

An airport is considered "adequate" for the operator when it satisfies the aircraft performance requirements applicable at the expected landing weight. It must then be acknowledged by the local operational authorities.

It is worth noting that it is not necessary to meet the runway pavement requirements normally to be considered for the regular use of an airport. In accordance with the provisions of the ICAO Convention - Annex 14 and ICAO Airport Manual (Document 9157 - AN/91), the aircraft ACN (Aircraft Classification Number) is allowed to exceed the runway PCN (Pavement Classification Number), when an airport is used in case of emergency.

The amount of possible exceedance can be obtained from the above referenced ICAO document or from each individual national or local airport authority.

The following considerations should be met at the expected time of use:

– availability of the airport,
– overflying and landing authorizations,
– capability of ground operational assistance (ATC, meteorological and air information services offices, lighting.),

- availability of navaids such as ILS, VOR, NDB (at least one let-down navaid must be available for an instrument approach),
- airport category for rescue and fire fighting (ICAO Doc 9137 - AN/898 Part 1).

The following criteria may also be considered:

- capability of technical assistance,
- capability of handling and catering (fuel, food, etc.),
- ability to receive and accommodate the passengers,
- other particular requirements applicable to each individual operator.

Suitable airport

A suitable airport for dispatch purposes is an airport confirmed to be adequate which satisfies the ETOPS dispatch weather requirements in terms of ceiling and visibility minima (refer to weather reports and forecasts) within a validity period. This period opens one hour before the earliest Estimated Time of Arrival (ETA) at the airport and closes one hour after the latest ETA. In addition, cross-wind forecasts must also be checked to be acceptable for the same validity period.

Field conditions should also ensure that a safe landing can be accomplished with one engine and / or airframe system inoperative (refer to possible NOTAMs, SNOWTAMs, approach procedure modification).

Diversion / en-route alternate airport

A "diversion" airport, also called "en-route alternate" airport, is an adequate / suitable airport to which a diversion can be accomplished.

Maximum diversion time

The maximum diversion time (75, 90, 120, 138 or 180 minutes) from an en-route alternate airport is granted by the operator's national authority and is included in the individual airline's operating specifications.

It is only used for determining the area of operation, and therefore is not an operational time limitation for conducting a diversion which has to cope with the prevailing weather conditions.

Maximum diversion distance

The maximum diversion distance is the distance covered in still air and ISA (or delta ISA) conditions within the maximum diversion time at the selected one-engine-out diversion speed schedule and at the associated cruise altitude (including the descent from the initial cruise altitude to the diversion cruise altitude). It is used for dimensioning the area of operations.

ETOPS area of operation

The ETOPS area of operation is the area in which it is authorized to conduct a flight under ETOPS regulations and is defined by the maximum diversion distance from an adequate airport or set of adequate airports. It is represented by circles centred on the adequate airports, the radius of which is the defined maximum diversion distance.

ETOPS Entry Point (EEP)

The ETOPS Entry Point is the point located on the aircraft's outbound route at one hour flying time, at the selected one-engine-out diversion speed schedule (in still air and ISA conditions), from the last adequate airport prior to entering the ETOPS segment. It marks the beginning of the ETOPS segment.

ETOPS segment

The ETOPS segment starts at the EEP and finishes when the route is back and remains within the 60-minute area from an adequate airport.
An ETOPS route can contain several successif ETOPS segments well separated each other.

Equitime Point (ETP)

An Equitime Point is a point on the aircraft route which is located at the same flying time (in forecasted atmospheric conditions) from two suitable diversion airports. The ETP position can be determined using a computerized flight planning, or graphically on a navigation or plotting chart. On A330 aircraft, the flight crew may update in flight the position of the ETP using the Flight Management function.

Critical Point (CP)

The Critical Point is one of the Equitime Point (ETP) of the route which ïs critical with regard to the ETOPS fuel requirements if a diversion has to be initiated from that point. The CP is usually, but not always (depending on the configuration of the area of operation and of the weather conditions), the last ETP within the ETOPS segment. Therefore, the CP has to be carefully determined by computation: the ETOPS fuel scenario must be applied to each ETP.

One-engine-out diversion speed schedule

The one-engine-out diversion speed schedule is a Mach/IAS speed combination selected by the operator and approved by the operational authority. The Mach is selected at the beginning of the diversion descent down to the transition point where the Indicated Airspeed (IAS) takes over.

The one-engine-out diversion speed schedule for the intended area of operations shall be a speed, within the certified operating limits of the aircraft which are Green Dot speed (best lift/drag ratio speed) and V_{MO} / M_{MO} (maximum certified operating speed), considering that the remaining engine thrust is at Maximum Continuous Thrust (MCT) or less.

NOTE: When reaching diversion cruise level, the selected IAS might not be maintained and might be limited to a lower speed due to thrust limitation (MCT), until it increases due to weight decrease. However, this should not be a criterion to select a lower speed schedule.

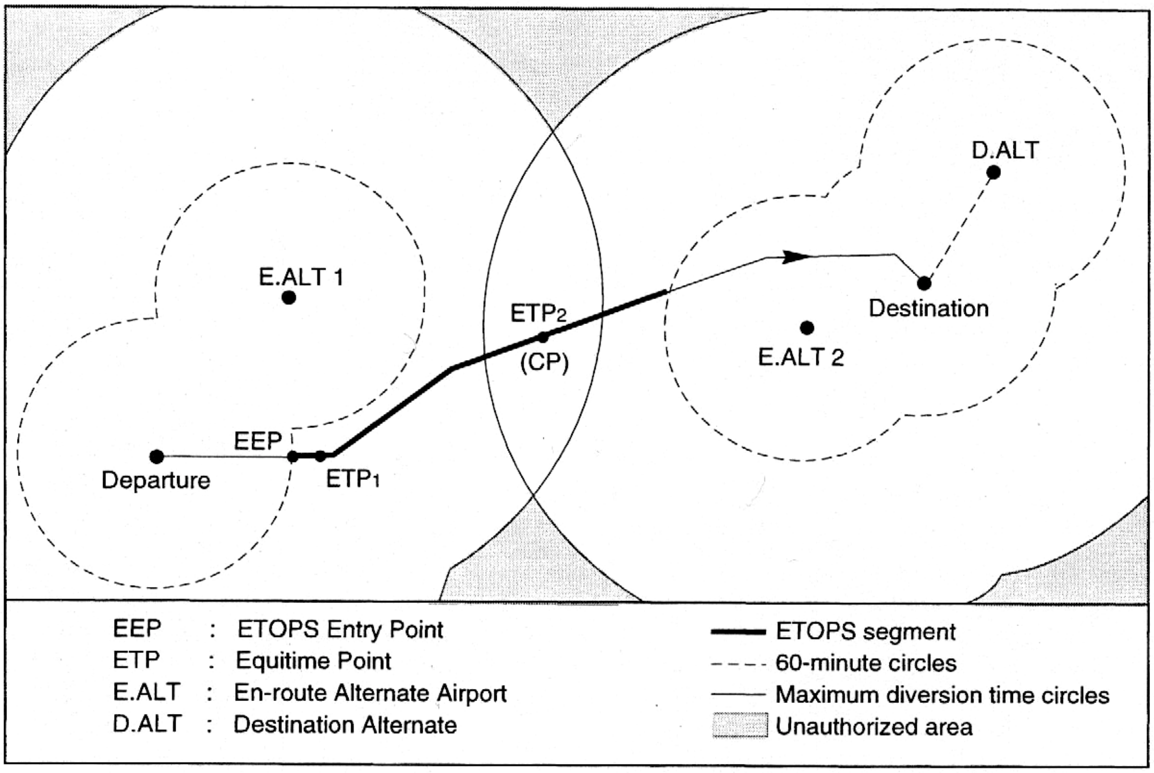
The operator shall use the same diversion speed schedule in:

– establishing the area of operation,

– establishing the critical fuel scenario for the single-engine diversion,

– establishing the net level-off altitude to safely clear any en-route obstacle by the appropriate margin as specified in applicable operational rules.

An operator is expected to use this speed schedule in case of diversion following an engine failure. However, as permitted by operational regulations, the pilot in command has the authority to deviate from this planned speed after completion of the assessment of the actual situation.



Area of operation

3 - POSSIBLE ADEQUATE DIVERSION AIRPORTS

In order to support operators in establishing the list of adequate airport for their intended zone of operation, a list of possible adequate diversion airports by geographical region, together with some remarks, is given in the appendices to this Chapter.

The list is not exhaustive and inclusion of an airfield does not mean that an airline or operational authorities will necessarily agree to its adoption. Most of the airfields listed have, at one time or another, been both airline and operational authorities approved.

4 - AREA OF OPERATION

The ETOPS Area of Operation is the area in which it is permitted to conduct a flight under the ETOPS regulations. It is defined by the declared maximum diversion distance from an adequate airport - or set of adequate airports - and is represented by the area enclosed within the circles centered on the selected adequate airports, the radius of which is the declared maximum diversion distance.

The area of operation (hence the maximum diversion distance) is defined in still air and, generally, in ISA conditions. However, whenever for a given area of operation the temperature deviation is essentially constant throughout the year, credit can be taken for a positive temperature deviation from ISA in order to take benefit of the corresponding higher TAS (at given IAS) and, thus, of the higher maximum diversion distance (at given diversion time).

a) Aircraft reference weight

The concept of reference weight has evolved with time. Previously, according to CAA regulations (CAP 513), the aircraft reference weight was the aircraft weight after two flight hours considering a take-off at the maximum take-off weight.

At present, JAA and FAA have agreed not to give a definition of the reference weight, but to leave the operator free to determine its own reference weight having regard to the ETOPS routes structure. This weight should be as realistic as possible and submitted for approval to the airline's operational authority.

NOTE: With the JAR OPS (1.245), a specific reference weight must be calculated when establishing the 60 Min circles (refer to page 46).

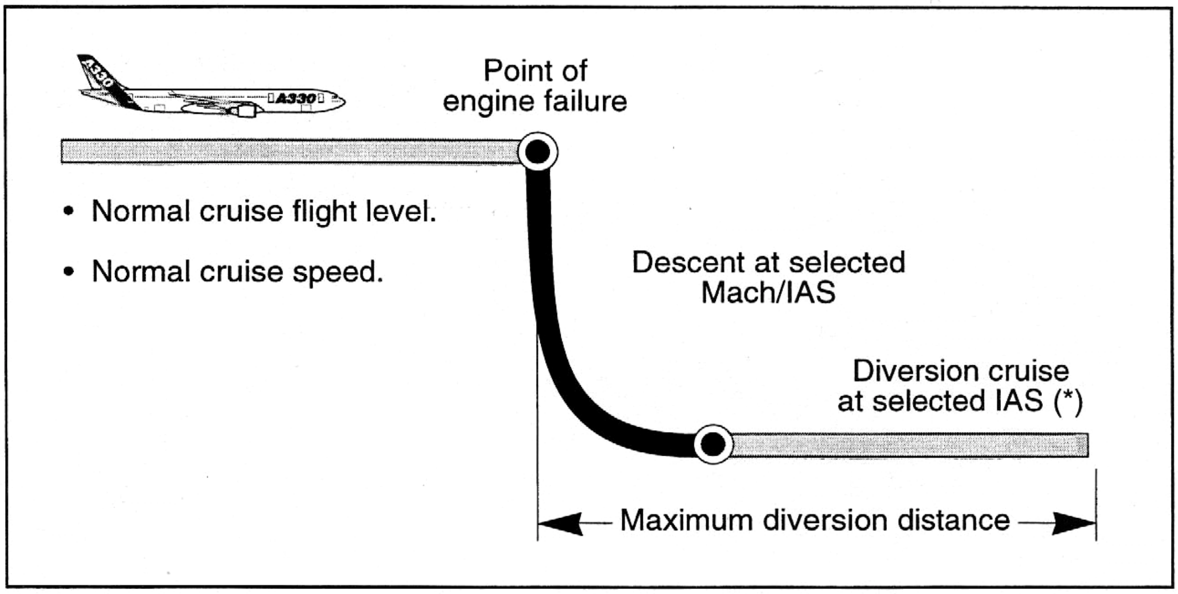
It is suggested that the aircraft reference weight should be defined as the highest of the estimated gross weight values at the critical points of the various routes being considered within the given area of operation. The computation will be done considering a take-off at the maximum take-off weight (structural or runway limitation or landing weight limitation) and a standard speed schedule, in still air and ISA (or delta ISA) conditions.

Whenever applicable, the above computation should be conducted considering that a given route may be supported by different sets of declared en-route alternates (thus resulting in different CP locations).

b) Diversion speed schedule and maximum diversion distance

Considering the aircraft reference weight and the selected one-engine-inoperative diversion speed schedule, it is possible to determine the optimum diversion cruise flight level, providing the best True Air Speed (TAS).

Basically the resulting TAS at the diversion flight level, combined with the maximum diversion time allowed, provides the maximum diversion distance. However, an agreed interpretation of the regulation is to take benefit of the descent (during which the TAS is higher than during the diversion cruise) to increase the maximum diversion distance as represented in the following figure.

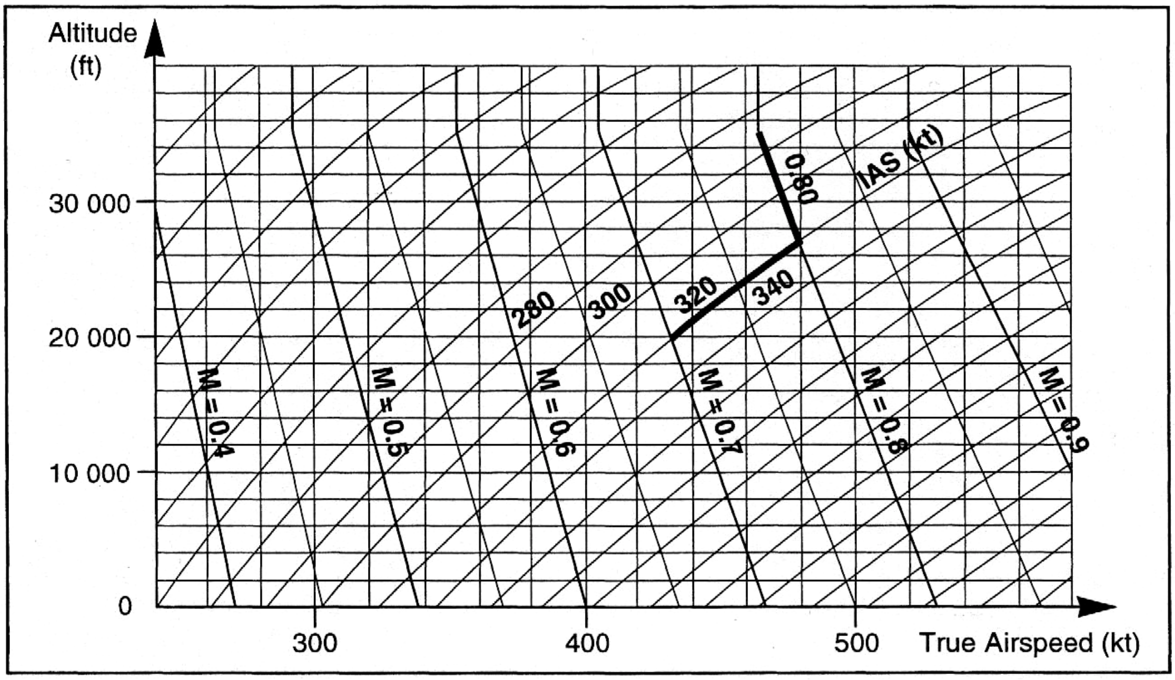


Diversion profil

(*) When reaching diversion cruise level, the selected IAS might not be maintained and might be limited to a lower speed due to thrust limitation (MCT).

The diversion descent profile is the following: the descent is initiated at cruise Mach number down to the altitude at which the scheduled IAS takes over. The following Mach/speed diagram points out a descent at M0.80/320kt from FL350 down to FL200. Thus, the first segment at given Mach number results in an increasing TAS whereas the second segment at given IAS results in a decreasing TAS, with decreasing altitude.

Consequently, the TAS varies throughout the descent, requiring an integrated computation of the distance covered throughout the descent.



Mach/speed diagram

The Flight Crew Operating Manual (FCOM) provides a table which gives the maximum diversion distance for a sample of diversion times, several reference weights and either two or three selected diversion speed schedules.

An example is given here below. In all the cases, the chosen initial cruise flight level is FL330 and the diversion flight level is the one which gives the highest TAS (More explanations are provided in sub-section 5 "Diversion Strategies" page 84).

Speed schedule	Reference weight (kg)	Optimum FL for diversion	Diversion time (minutes)				
			60	90	120	150	180
M0.80/300kt	85 000	260	440	660	880	1100	1320
	100 000	250	435	650	870	1085	1300
	115 000	240	430	640	855	1065	1280
	130 000	220	420	630	835	1040	1245
	145 000	200	415	615	815	1015	1215
	160 000	180	405	600	790	985	1180
M0.80/320kt	85 000	240	450	675	895	1120	1340
	100 000	230	445	665	885	1110	1330
	115 000	210	440	655	870	1090	1305
	130 000	**200**	435	650	**860**	1075	1285
	145 000	180	425	635	840	1045	1255
	160 000	160	420	620	820	1020	1220
M0.80/340kt	85 000	210	455	680	905	1135	
	100 000	200	450	675	900	1125	1350
	115 000	190	445	665	890	1110	1335
	130 000	180	440	655	875	1090	1310
	145 000	160	435	645	855	1070	1280
	160 000	150	425	650	835	1040	1250

Maximum distance (still air) to diversion airport in nautical miles (ISA conditions)

Considering the following example:

- maximum diversion time: 120 minutes
- reference weight: 130 000kg
- speed schedule: M0.80/320kt,

the results are:

- optimum flight level: FL200
- maximum distance: 860nm (average TAS = 430kt)

The resulting maximum distance allowed from an adequate airport will be used to draw on a navigation or plotting chart the area of operation. It will be taken as radius for the circles centred on each adequate airport supporting the considered route.

NOTE: The above table is provided in appendices at the end of this chapter (page 118) for all in-service Airbus models.

5 - DIVERSION STRATEGIES

a) General

As set out in the previous chapter, the determination of the area of operation is based on a diversion at a selected single-engine Mach/IAS speed schedule (in still air and ISA or delta ISA conditions).

In practice this speed can vary in a range between Green Dot speed and V_{MO}/M_{MO}. Indeed, the aircraft has been designed, flight tested and certified to safely fly within this range of speeds even with one engine inoperative. The choice of the ETOPS diversion speed will be made by each individual operator as a function of its route structure and associated constraints.

Therefore a diversion at high speed will maximize the maximum diversion distance and hence the area of operation, whereas a diversion at low speed will reduce the maximum diversion distance during the allowed maximum diversion time. But, at the same time, this will allow a higher level-off and will minimize the fuel consumption.

So,

which strategy should the airline select ?

For non-ETOPS operations, in case of an engine failure, either the standard strategy or the obstacle clearance strategy are considered for diversion.

The standard strategy corresponds to a descent at cruise Mach/300kt down to an altitude close to the LRC ceiling, and a diversion cruise at LRC speed.

The obstacle clearance strategy corresponds to a drift-down at Green Dot speed until the obstacles are cleared. Once the obstacles are cleared, the standard strategy is applied. Both strategies are explained in detail in the FCOM (see FCOM cross-reference table page 136).

For ETOPS operations, in case of an engine failure, there is no prescribed objection to applying either the standard strategy or the obstacle clearance diversion strategy. However, the associated diversion speed, respectively LRC speed and Green Dot speed, which are substantially low speeds, would restrict the maximum diversion distance. Consequently it would result in a restricted area of operation, in contradiction to the ETOPS objectives which are to increase the operational capabilities.

Therefore, for ETOPS operations, the one-engine-inoperative diversion speed will be higher than the one used in standard operation so as to extend the area of operation. The typical ETOPS diversion strategy is called "Fixed Speed Strategy" in the FCOM in order to differentiate it from the standard and obstacle strategies.

The word "fixed" is used to emphasize the fact that a selected speed schedule is followed during both the diversion descent and cruise phases, (except in case of cabin pressurization loss) whereas standard and obstacle strategies consider during descent M 0.80/300kt and Green Dot respectively and during diversion cruise LRC speed which is a function of the aircraft weight and flight altitude.

For each aircraft type, the Flight Manual proposes either a sample of single-engine speeds with the relevant graphs for the related aircraft performance or reference to the performance program to compute the single-engine aircraft performance (for the A319/A321/A330, the program is called Octopus). The FCOM issues, for each single-engine speed associated to the Fixed Speed Strategy, all related aircraft performance data. Depending on the aircraft, speeds out of 300/310/320/330/340kt are proposed, having in mind that LRC speed is usually less than 300kt. With this speed range, most airline's requirements are covered. However, should an airline select an intermediate diversion speed, all relevant aircraft performance data should be established and incorporated in its Operations Manual.

The following table gives the A310-300 (PW4000, reference weight:
130 000kg) performance data related to the Fixed Speed Strategy, for a diversion with one engine out.

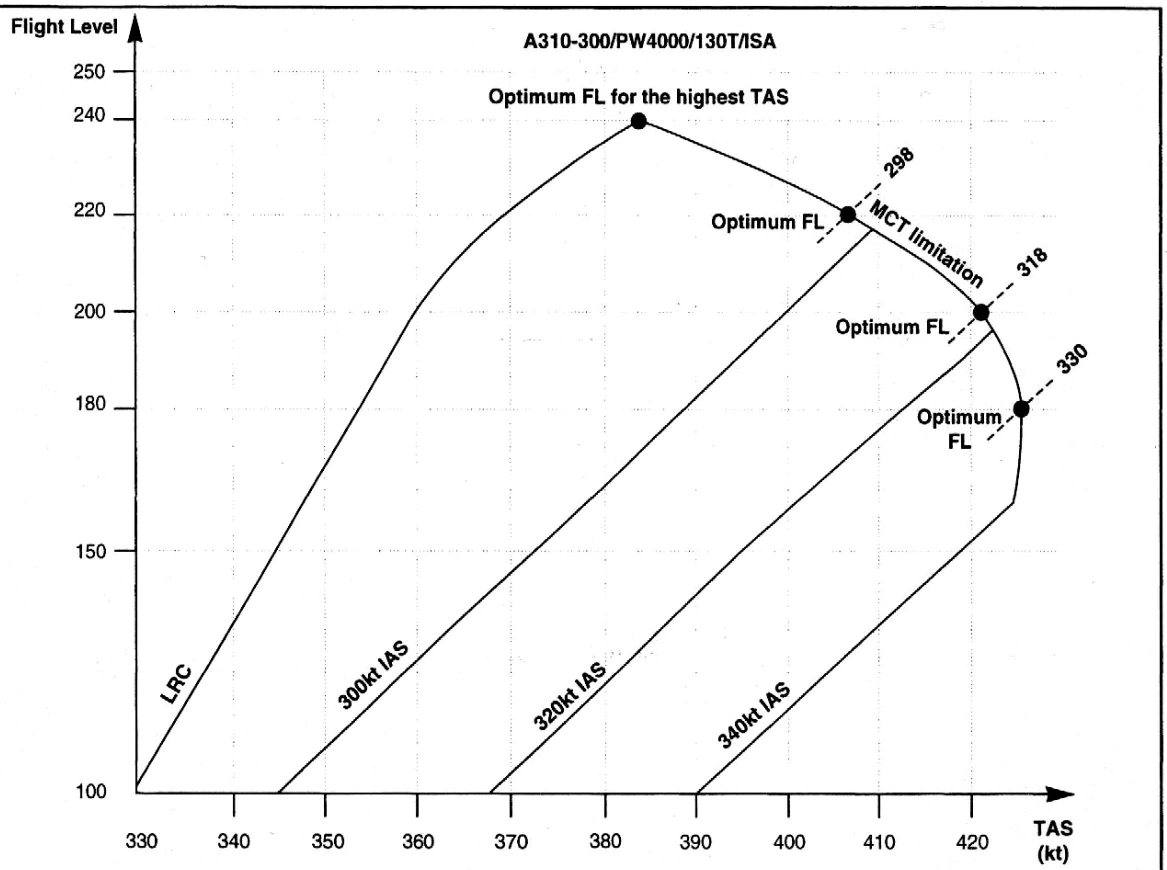
		Fixed Speed Strategy/speed schedule		
		300kt	320kt	340kt (V_{MO})
Initial descent	Thrust Mach/IAS selected	MCT 0.80 / 300kt	MCT 0.80 / 320kt	MCT 0.80 / 340kt
Cruise	Thrust limit Initial IAS optimum FL Initial TAS (ISA)	MCT 298 220 407	MCT 318 200 422	≤ MCT 330 180 426

A310-324 diversion performance data

In the above table, the discrepancy between the actual IAS and the selected IAS is due to the thrust limitation at altitude (speed limited by MCT as illustrated hereafter). However the optimum TAS may be reached at a FL where the IAS is MCT limited.

NOTE: After having reached the diversion FL, the actual IAS will increase due to weight decrease.

The following figure shows the relationship between TAS and FL (A310-300/ PW4000, reference weight = 130 000kg) related to four speed schedules: LRC, 300, 320 and 340kt.



	LRC	/ 300	/ 320	/ 340
Optimum FL for highest TAS	240	220	200	180
TAS (kt) at optimum FL	384	407	422	426
Specific range (nm/1 000kg)	81.1	78.3	74.8	71.9
Fuel flow (kg/h)	4727	5187	5651	5924

Flight level - TAS relation ship

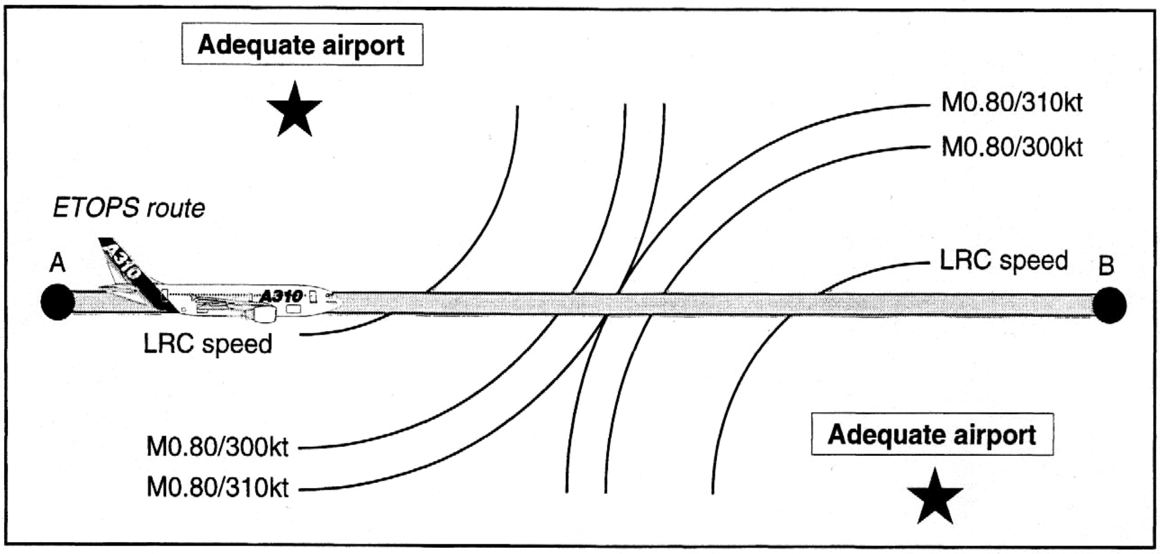
In addition, the operator must ensure that the net flight path and net ceiling for the selected ETOPS diversion speed clear any en-route obstacle by the appropriate margin as specified in the applicable operational regulations.

b) Criteria for selecting the diversion strategy

The main criteria for selecting an ETOPS diversion strategy, in terms of speed schedule, are the route structure and the maximum diversion time allowed. The route structure will indicate the obstacles to be cleared and the location of the selected adequate airports which should be well distributed along the route.

The maximum diversion time allowed will permit the definition of the minimum speed schedule required to ensure a minimum overlap of the circles centred on each adequate airport.

The following figure (for A310-300, PW4000, reference weight = 130 000kg) shows three circles, associated with two adequate airports, for three speed schedules: at LRC speed, the corresponding circles are substantially small, at 300kt IAS the circles are wider but do not provide a continuous area of operation; finally at 310kt IAS the circles just join each other to ensure the feasibility of the ETOPS operation.



Effect of single-engine speed selection on the ETOPS area of operation (at a given maximum diversion time)

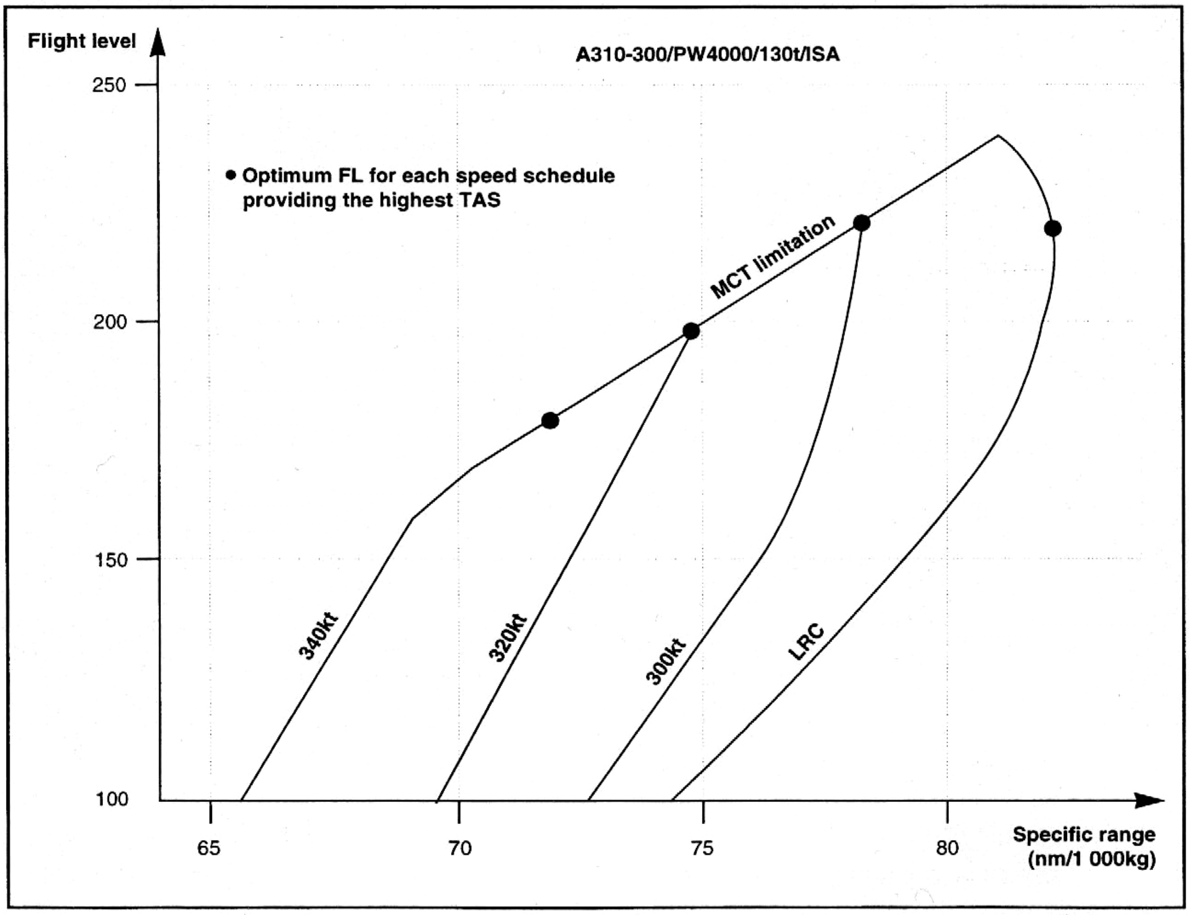
Therefore, 310kt IAS is the minimum speed schedule required. In practice, a speed higher than this minimum speed schedule is desirable to provide a sufficient overlapping of circles, thus ensuring a better flexibility in the aircraft routing to avoid an adverse weather zone, to trace a more direct route or to cover the possible variations of an organized track system (North Atlantic).

Thus the selected diversion speed schedule will be chosen between the defined minimum diversion speed and V_{MO}.

The diversion strategy should also be determined having regard to the diversion fuel requirement. Indeed, the ETOPS regulations require consideration of the same diversion speed strategy to determine both the area of operation and the diversion fuel. Therefore, a compromise between speed and fuel should be found: for example, a diversion at V_{MO} will give the widest area of operation but with the highest fuel requirement. In this case, a reduction of the diversion speed which reduces the area of operation and the diversion fuel may be a better option, provided that the flight routing is not modified.

In other words, the one-engine-out diversion speed schedule can also be determined with regard to the fuel burn during the diversion.

It is worth recalling that the fuel burn (kg) is mathematically equal to the distance covered (nm) divided by the specific range (nm/kg). Therefore, to optimize the selection of the diversion speed schedule, the following typical graph provides the specific range versus flight level for different speed schedules.



Flight level - specific range relationship

With reference to Figure - "Flight level-TAS relationship" (page 86), it can be seen that a diversion at either 340kt (V_{MO}) or 320kt gives nearly the same result in terms of TAS - 426kt and 422kt respectively. With reference to the table given in the previous chapter "Area of operation" (page 83) which gives the maximum diversion distance at a speed schedule for a given diversion time, taking, for example, 120-minute diversion time, the maximum diversion distances are 875nm and 860nm respectively (for 130 000kg). With the benefit of the descent, this represents a variation in the area of operation of less than 2%.

At the same time, using the same diversion strategies from the critical point to a given diversion airport (thus for a fixed distance) the diversion time will vary by less than 2% but the diversion fuel will vary by 4%.

The following table summarizes, for the three proposed speed schedules, when compared to each other, the variations in terms of distance, time and fuel, for a specific aircraft: A310-300, PW4000, 130 000kg.

	Speed schedule (kt)			**Variations (%)**		
	300	**320**	**340**	**300 → 320**	**320 → 340**	**300 → 340**
Max. diversion distance (nm) - 90 minutes - 120 minutes	 630 835	 650 860	 655 875	 + 3.2 + 3.0	 + 0.8 + 1.7	 + 4.0 + 4.8
Average TAS during diversion including descent	418	430	438	-	-	-
Diversion time (fixed distance)	-	-	-	- 2.8	- 1.8	- 4.6
Specific Range (SR) (nm/1000kg)	78.3	74.8	71.9	- 4.5	- 3.9	- 8.2
Fuel burn (fixed distance)	-	-	-	+ 4.7	+ 4.0	+ 8.9

Diversion speed schedule comparison
(A310-300, PW4000, weight 130t, ISA)

The above figures and tables represent a particular case for a particular aircraft, so they cannot be generalized. However, the tendencies can be generalized. One of them is that a speed schedule of 340kt should be used only when required to provide the desired area of operation.

Consequently, to define the ETOPS diversion strategy, all the above considerations should be taken into account for those routes for which the ETOPS fuel requirements could be a limiting factor.

c) Airline's final choice

After assessing all the relevant criteria to determine the best strategy for each ETOPS route, the airline should now consider another criterion which is the harmonization of the diversion strategies for all the ETOPS routes within a given area of operation.

Therefore, and to follow the operational authorities requirements, the operator will propose for approval to its national operational authorities a speed strategy applicable to all the ETOPS routes included in a given area of operation.

The purpose of this unique speed schedule is also to simplify the crew training and thus not to impose a specific training for each individual route.

However, on a case-by-case basis, the national operational authorities may allow the operator to use a specific strategy for a well-determined route. This could apply, for example, to clear obstacles. Thus, the operator should develop for approval the relevant specific strategy in justifying all the choices by prevailing operational requirements.

Finally, and despite the greatest attention applied to define the best diversion strategy, the pilot in command has the authority to deviate from the pre-established diversion strategy, based on his evaluation of the actual situation and fuel status.

NOTE: The above-mentioned considerations are illustrated by an example in Chapter 7.

6 - ETOPS FUEL REQUIREMENTS

An aircraft is allowed to be dispatched provided sufficient fuel is loaded to conduct the intended flight. The fuel quantity required is determined by the applicable operational regulations.

Unlike the area of operation which is determined in still air and ISA conditions (or prevailing delta ISA), the fuel planning must consider the expected meteorological conditions along the considered routes (forecast wind component and temperature).

For dispatching an aircraft for an ETOPS flight, the dispatcher must determine, for the considered route, both a standard and an ETOPS fuel planning. The highest of both fuel requirements shall be considered as being the minimum required block fuel for the flight.

a) Performance factor

For determining a dependable fuel planning, the operator should always consider the latest updated aircraft performance factor.

The performance factor reflects the airframe/engines deterioration with time and is used to determine the real fuel consumption. It is determined by the processing of in-flight manual (or automatic) recordings of engines and aircraft parameters. Hence, for a brand new aircraft whose performance is equivalent to the baseline, the performance factor is equal to one. The performance factor should be defined for each individual aircraft within the operator's fleet.

The FCOM and the in-flight performance computer programs (IFP and FLIP) provide the fuel consumption data for a baseline aircraft. To determine the real fuel consumption, the baseline data should be multiplied by the performance factor ; for example, a performance factor equal to 1.03 is representative of a fuel consumption increase by 3%.

b) Standard fuel planning

This fuel planning is the one used for a non-ETOPS operation. Thus, the standard block (ramp) fuel requirements are as follows:

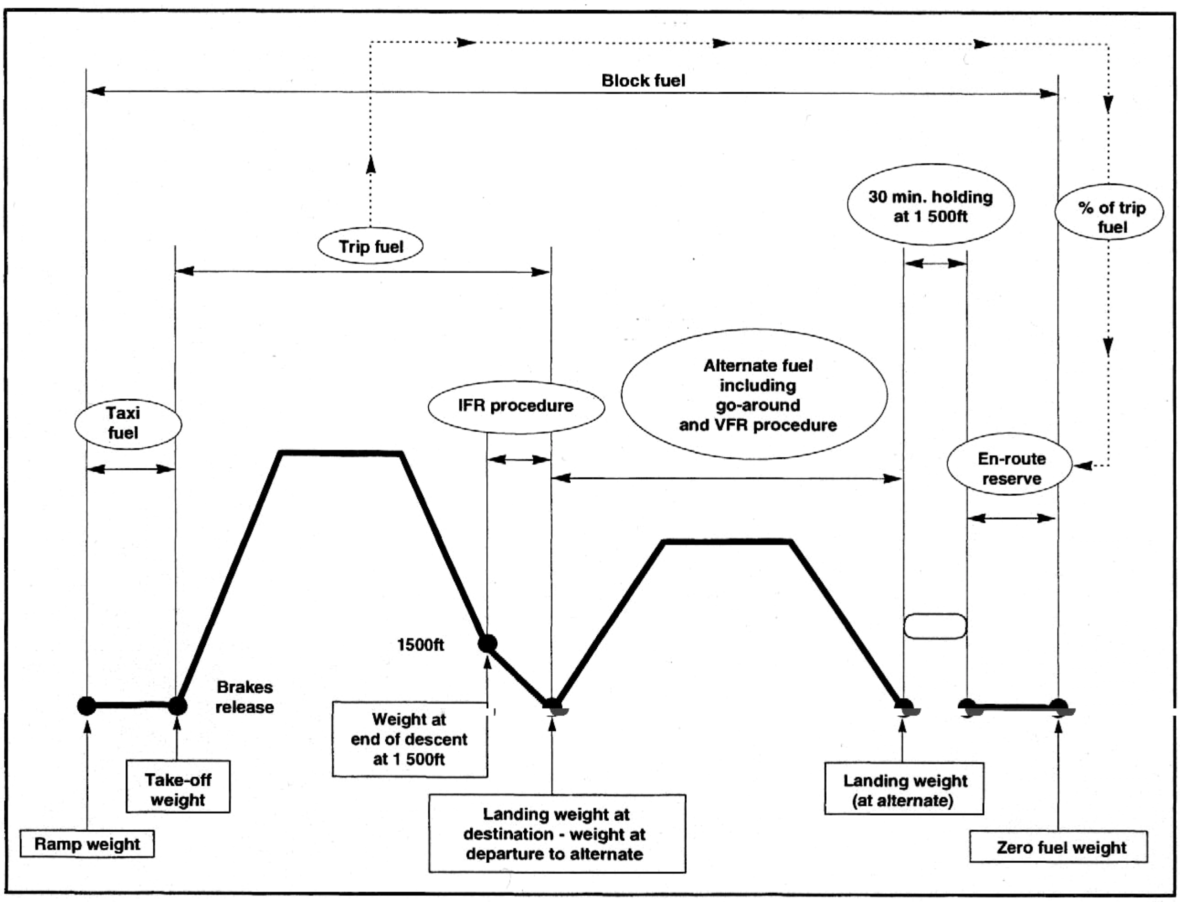
– fuel for taxi-out,

– trip fuel from departure to destination,

- alternate fuel (including go-around),
- 30 minutes holding at alternate,
- en-route reserves in percentage of trip fuel (generally 3% or 5%) or trip time (generally 10%),
- extra fuel reserves (airline's requirements).

The sum of the above fuel quantifies constitutes the block fuel which should be corrected by the relevant performance factor.

The following graph gives a schematic of a standard fuel planning. The details of all relevant fuel data are given in the FCOM.



Standard fuel planning

c) ETOPS fuel planning

For ETOPS operations, a specific ETOPS fuel planning - also called Critical Fuel Reserves in the regulations - should be established.

The ETOPS fuel planning is split into two parts: the first part corresponds to a standard fuel scenario from the departure airport to the Critical Point (CP) and the second part corresponds to the critical fuel scenario from the CP to the diversion airport.

The ETOPS critical fuel scenario is based on the separate study of two failure cases, occurring at the critical point, with their respective diversion profiles.

Critical fuel scenario

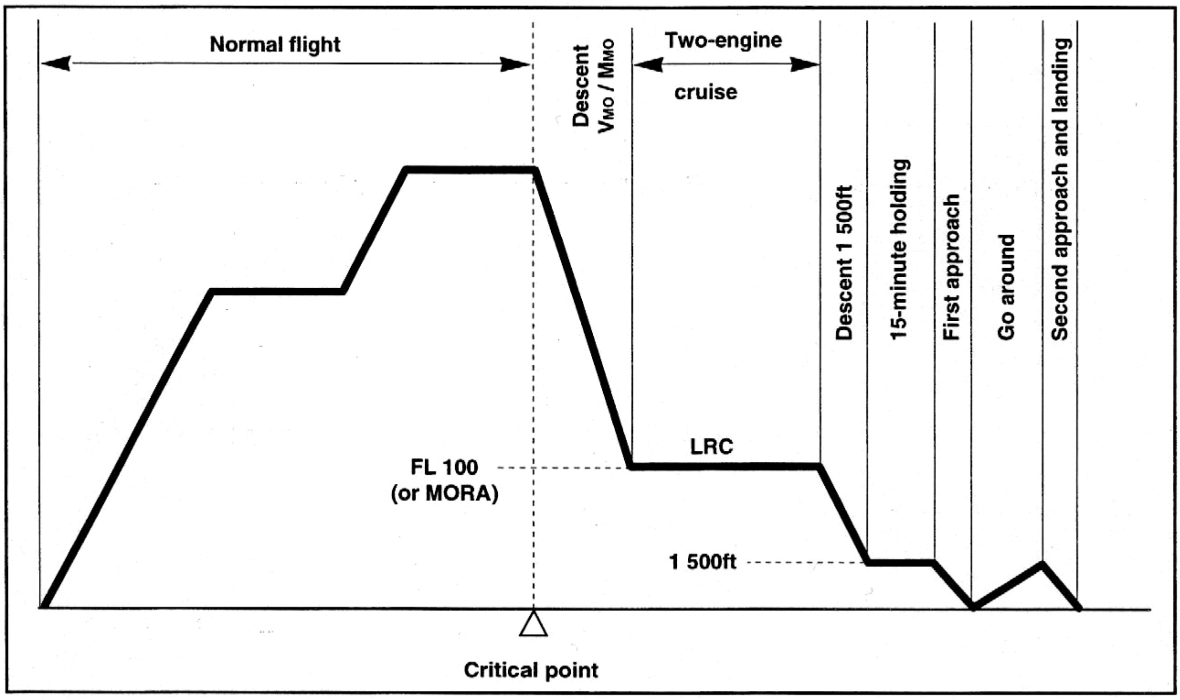
This scenario is based on a failure case occurring at the CP and requiring a diversion. The point of occurrence is so-called 'critical' because in terms of fuel planning a diversion at this point is the least favourable.

The diversion profile is defined as follows:

- descent at a pre-determined speed strategy to the required diversion flight level,
- diversion cruise at the pre-determined speed,
- normal descent down to 1 500ft above the diversion airport,
- 15 minutes holding at this altitude,
- first approach (IFR) and go-around,
- second approach (VFR) and landing.

The two separate failure cases to be reviewed are the following with their respective diversion profile:

- **aircraft depressurization**
  - emergency descent at VMO/MMO (speed brakes extended) down to FL100 (or MORA),
  - diversion cruise performed at Long Range Cruise (LRC) speed.



Flight profile: depressurization

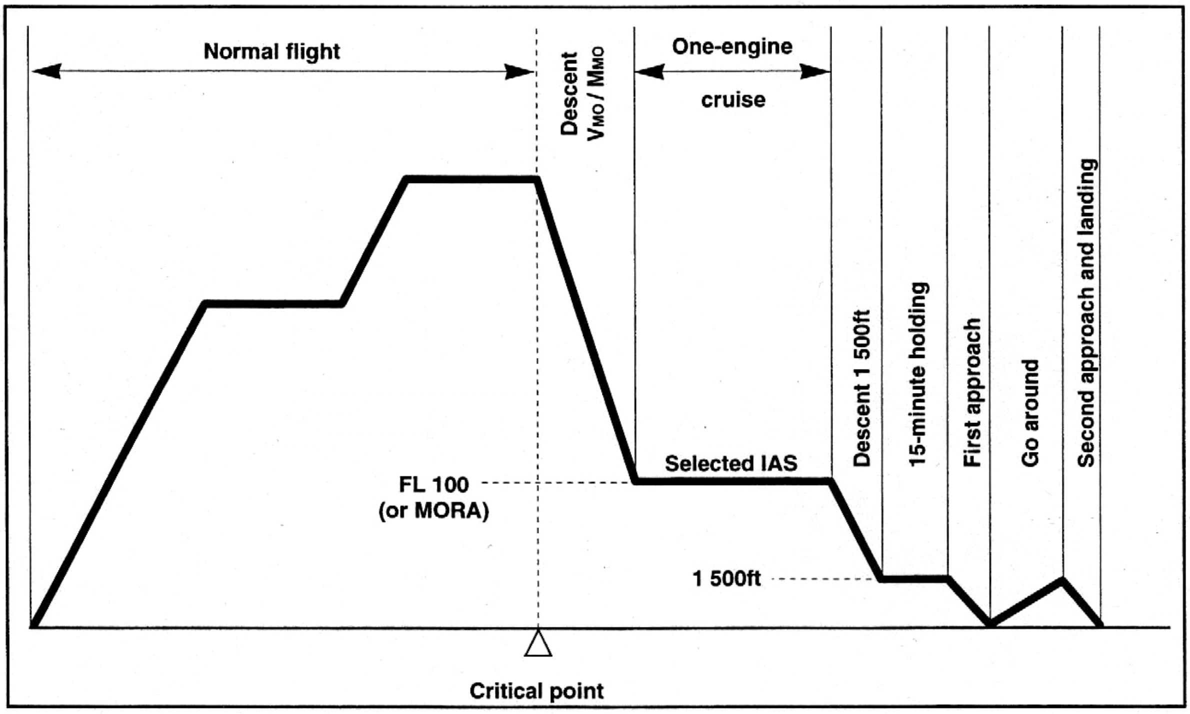
However, flight above FL100 may be desired or required, and is allowed if the aircraft is equipped with supplemental oxygen for the flight crew and a required percentage of passengers in accordance with applicable Airworthiness Authorities requirements and could be mandatory in case of obstacles. In that case the diversion cruise may be allowed above FL100.

The following table summarizes the regulatory requirements:

Reference	FAR 121.329	JAR OPS 1.5.043	ICAO Annex 6 ◊ 4.3.8
Flight crew (cockpit + cabin)	All flight crew members for max. diversion time	All flight crew members for max. diversion time	All flight crew members for max. diversion time
Passengers	30% of passengers for max. diversion time at 15 000ft or 10% of passengers for diversion time in excess of the first 30 minutes at 14 000ft	30% of passengers for max. diversion time at 15 000ft or 10% of passengers for diversion time in excess of the first 30 minutes at 14 000ft	10% of passengers for max. diversion time at 13 000ft

Oxygen requirements

- **engine failure and aircraft depressurization:**
  - emergency descent at V_{MO}/M_{MO} (speed brakes extended) down to FL 100 (or MORA: Minimum Of Route Altitude),
  - diversion cruise performed at the speed schedule adopted for the determination of the area of operation.



Flight profile: one-engine out and depressurization

However, flight above FL100 is allowed if the aircraft is equipped with supplemental oxygen as mentioned above.

For each scenario, the required block fuel must be computed in accordance with the operator's ETOPS fuel policy and with the regulatory ETOPS critical fuel reserves described hereafter.

Depending on the strategy and on the one-engine-out speed selected for the single-engine diversion scenario, any one of these two scenarios may result in the highest fuel requirement.

The scenario resulting in the highest fuel requirement is referred to as the ETOPS critical fuel scenario, the associated block fuel requirement is referred to as the ETOPS critical fuel planning.

Fuel reserves

ETOPS regulations require the addition of specific fuel reserves to the ETOPS diversion fuel.

For the computation of the ETOPS critical fuel reserves and of the complete ETOPS critical fuel planning, the diversion fuel shall include the following fuel provisions:

- fuel barn-off from the CP to the diversion airport (understood to be 1500ft overhead the airport),
- 15 minutes holding at 1500ft at Green Dot speed (best lift/drag speed),
- first (IFR) approach/Go-Around / second (VFR) approach,
- 5% of the above fuel burn-off, as contingency fuel,
- 5% fuel mileage penalty or a demonstrated performance factor,
- effect of any CDL and/or MEL item,
- if icing conditions are forecast (refer to following paragraph) for the determination of icing forecast):
    - effect of NAI + WAI systems,
    - effect of ice accretion on the unheated surfaces of the aircraft.

The fuel provisions associated with the effects of NAI/WAI systems and the ice accretion on the unheated surfaces are adjusted as a function of the horizontal extension of the forecast icing areas (exposure time).

The fuel provision for ice accretion on the unheated surfaces is (in percentage) three times the forecast exposure time (in hours) (except for A319/A320/A321: five times). For example, assuming a one-hour exposure time en-route or at the diversion airport , the fuel provision is 3% of the fuel burnt during the considered exposure time (5% for A319/A320/A321). However, in case of moderate icing forecast, the above-mentioned fuel provision is divided by two.

- For operations above 138 minutes diversion time, if the effect of ice accretion is less than 5%, this effect should be rounded-up to 5% to provide a provision for weather avoidance,
- APU fuel consumption, if required as a power source (MEL).

Based on experience, Airbus recommends consideration of the following non-mandatory fuel provisions:

- effect of a demonstrated performance factor for all standard and ETOPS fuel requirement computations,
- carriage of 2 to 3% contingency fuel from the departure to the CP, as dictated by the specific aspects of the route or the operator's fuel policy, when computing the ETOPS critical fuel planning.

The fuel factors to be considered for standard and ETOPS fuel plans (before and after the CP) are summarized in the two tables below:

Fuel Factors	**Standard Fuel Planning**	**ETOPS Fuel Planning**	
		From Departure to CP	**From CP to Diversion**
Performance factor	X	X	X
Contingency Fuel	X	Per company policy	X
Effect of MMEL	X	X	X
Effect of CDL	X	X	X
Effect of WAI + NAI	Note 1		Note 1
Effect of ice accretion			Note 1
Provision for weather avoidance			If diversion ≥ 138'

Note 1: if forecast icing conditions.

Fuel factors summary

Fuel Factors	
Performance factor / Fuel Mileage Penalty	Demonstrated value or 5%
Contingency Fuel	5%
Effect of WAI + NAI	Published % effect over forecast exposure time
Effect of ice accretion	Published % effect over forecast exposure time
Weather avoidance	If ice accretion factor < 5% take a total of 5% covering ice accretion and weather avoidance
Effect of MEL/CDL/APU	As applicable

ETOPS fuel reserves factors after CP

As part of an accelerated ETOPS process, the operational authorities may require additional fuel reserves until the operator has demonstrated the accuracy of its fuel predictions.

The complete ETOPS critical fuel planning for the ETOPS critical fuel scenario (i.e. from the departure to the CP and then from the CP to the diversion airport) must be compared to the standard fuel planning (i.e. from the departure to the destination and destination alternate) computed in accordance with the company fuel policy and applicable operational requirements. The highest of both fuel requirements shall be considered as the required block fuel for the flight. Therefore, the pilot is then assured of safely completing the flight whatever the flight scenario is (normal flight or diversion).

d) Determination of icing conditions

As a result of safe, highly successful ETOPS operations and the commitment to continuing the process of improvement, FAA and JAA have agreed to reexamine or modernize ETOPS requirements. For example, based on icing studies completed in the aviation industry and as a refinement to ETOPS operations, it was determined that the operational authorities would consider proposals from individual airlines regarding icing forecast procedures which may be used to determine applicability of icing fuel reserves requirements.

Therefore, any airline operating with an ETOPS approval may request approval of specific procedures for the forecasting of icing conditions in order to determine fuel requirements associated with the use of anti-ice systems as well as the performance loss associated with ice accretion on unheated surfaces.

Once an ETOPS operator's icing forecast procedure is approved, fuel provisions associated with engine/airframe anti-ice systems and ice accretion on unheated surfaces will apply only when icing is forecast rather than for all flights. There is no specific icing forecast methodology that an airline must adopt. Thus, an operator is allowed to apply for icing fuel penalty relief based on icing forecast procedures.

Following are two examples of icing forecast methods:

- **Total Air Temperature (TAT) method**

  This method does not consider the icing scenario when the TAT is at or above 10°C . For example , fuel for icing is to be included in the ETOPS critical fuel scenario calculation only when the Outside Air Temperature (OAT) at 10 000ft is forecast to be below the OAT values shown in the table below. At this OAT, the ram rise due to the airspeed effect results in 10°C TAT.

Airspeed (KCAS)	250	260	270	280	290	300	310	320	330	340	350
OAT °C (equivalent to 10°C TAT)	-1.1	-2.0	-2.9	-3.8	-4.7	-5.7	-6.6	-7.6	-8.7	-9.7	-10.6

  The method of forecasting the above OATs is to be demonstrated by the operator.

- **Relative humidity method**

  Icing forecast can be determined using 700mbar (FL100) temperature and relative humidity forecast to determine the icing area bounded by temperatures ranging from 0°C to - 20°C and relative humidity of more than 70%.

  The aforementioned icing area forecast will be further refined based on:

  – frontal analysis,
  – satellite analysis,
  – other available forecasts.

Using either method, an airline may seek approval to apply relevant fuel provisions only when icing is forecast for a particular flight. In addition, an operator may seek approval to apply an icing penalty factor based on the percentage of time the flight is forecast to be in icing conditions.

NOTE: The results of ongoing studies being conducted by aircraft manufacturers on ice sublimation and ice collection could have a further positive impact on this process in the future.

7 - DISPATCH WEATHER MINIMA

Due to the natural variability of weather conditions with time, as well as the need to determine the suitability (during a defined period of validity) of a particular en-route alternate airport prior to departure for an ETOPS flight, the en-route alternate dispatch weather minima are generally higher than the normal weather minima necessary to initiate an instrument approach. This is necessary to assure that the instrument approach can be conducted safely if the flight has to divert to this en-route alternate airport.

NOTE: The ETOPS dispatch minima apply until the aircraft is airborne. Once in flight, the normal minima apply.

a) ETOPS dispatch weather minima

The ETOPS dispatch weather minima may slightly differ from one regulation to another:

– For the FAA (AC 120-42 A), higher than normal ETOPS dispatch weather minima are meant to account for the possible degradation of the weather conditions at the diversion airports,

– For the JAA (AMJ 120-42/IL 20), in addition to the FAA definition, the ETOPS dispatch weather minima also account for the possible degradation of the let-down aids capability.

FAA - ETOPS dispatch weather minima:

	Ceiling (ft)	**Visibility (m)**
• **Precision approach:**		
- 1 ILS/MLS	DH + 400	max of: $\begin{cases} -3200 \\ -PM+1600 \end{cases}$
- 2 ILS/MLS (separate runways)	DH + 200	max of: $\begin{cases} -1600 \\ -PM+800 \end{cases}$
• **Non-precision approach**	max of: $\begin{cases} -800 \\ -MDH+400 \end{cases}$	max of: $\begin{cases} -3200 \\ -PM+1600 \end{cases}$

Notes:
- PM = published minima
- DH = decision height
- MDH = minimum descent height
- Separate runways have no intersection

JAA - ETOPS dispatch weather minima

<table>
<tr><th>Approach Facility Configuration</th><th>Alternate Airfield Ceiling</th><th>Weather Minima Visibility</th></tr>
<tr><td>For aerodrome with at least one operational navigation facility, providing a precision or non-precision runway approach procedure or a circling manœuvre from an instrument approach procedure.</td><td>A ceiling derived by adding 400 feet to the authorized DH, MDH (DA/MDA) or circling minima.</td><td>A visibility derived by adding 1 500 meters to the authorised landing minima.</td></tr>
<tr><td colspan="3">The weather minima below apply at airports which are equipped with precision or non precision approaches on at least two separate runways (two separate landing surfaces).</td></tr>
<tr><td>For airports with at least two operational navigation facilities, providing a precision or non-precision runway approach procedure to separate suitable runways.</td><td>A ceiling derived by adding 200 feet to the higher of the two authorised DH/MDH (DA/MDA) for the approaches.</td><td>A visibility derived by adding 800 meters to the higher of the two authorised landing minima.</td></tr>
</table>

For the FAA, circling minima are not taken into account for ceiling minima. However, if the weather forecast requires the consideration of a circling approach, refer to airport approach chart to determine the relevant ETOPS dispatch ceiling minima by adding 400ft to the published circling minima.

For geographical areas where weather conditions are very stable, this means that the variations are well known and occur at a low rate, a decrease of the dispatch minima could be considered after agreement with the operator's operational authorities.

It is worth recalling that all Airbus twin engine aircraft are category C for the determination of the normal minima. Minima are normally provided in the approach and landing charts.

b) Example

In the case Djibouti is selected as en-route alternate airport, the normal and ETOPS dispatch weather minima are defined as indicated in the following table for ceiling and visibility (FAA minima).

City/Airport	RWY	Navigation Aid	Minima: Normal (use in-flight) ceiling (ft)/visibility (m)		Minima: ETOPS (for dispatch) ceiling (ft)/visibility (m)	
DJIBOUTI	27	VOR ILS	246	1200	646	3200
	27	VOR ILS (GS out)	277	1600	800	3200
	27	NDB ILS	246	1200	646	3200
	27	NDB ILS (GS out)	437	2100	837	3700
	27	VOR DME	567	2600	967	4200
	09	VOR DME	437	2100	837	3700

Djibouti weather minima

c) Lower than published weather minima

Lower than published weather minima at alternate airports may be considered for aircraft certified for CAT 2 and/or CAT 3 approach and landing operations, after suffering any failure in the airframe and/or propulsion systems which would result in a diversion to an en-route alternate airport. This is subject to approval for certain operators by the national authorities on a case-by-case basis.

The FAA-AC and the JAA-AMJ / IL have the same wording originated by the FAA requiring that the loss of the approved approach capability be "improbable" during a single-engine diversion.

In principle, an aircraft approved for lower than standard minima will be dispatched with the next highest level of approach minima to which it is type design approved on one engine (for example, an aircraft approved for CAT 2 approach will be dispatched considering CAT 1 minima).

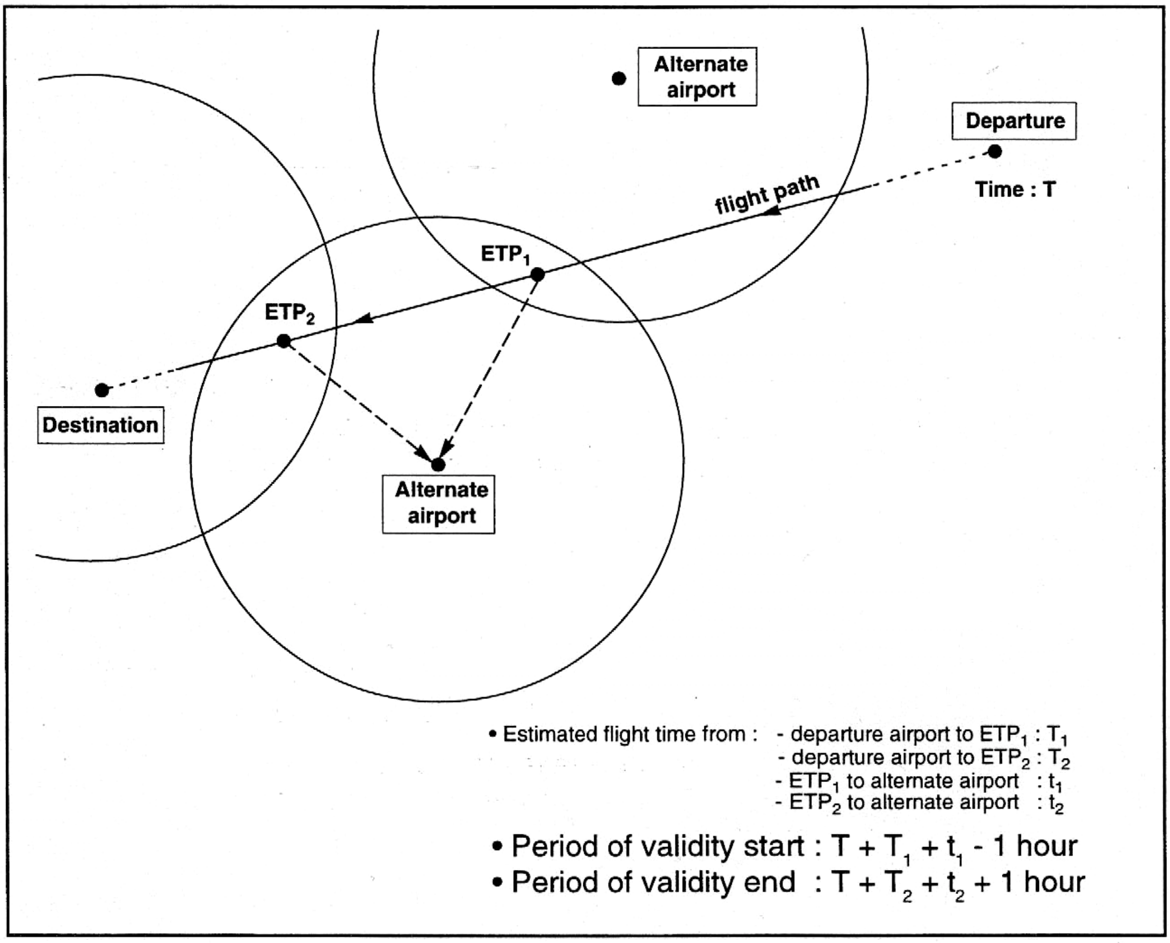
d) Period of validity

For each alternate airport, the dispatch weather minima must be ensured during a certain time period. This period of validity starts one hour before the earliest Estimated Time of Arrival (ETA) at this airport and finishes one hour after the latest ETA.

The earliest ETA at an alternate airport is, in practice, the departure time plus the normal flight time to reach the ETP between the considered alternate and the previous alternate airport along the route, plus the diversion flight time from this ETP to this alternate airport, considering a diversion at the normal cruise speed and flight level.

The latest ETA at an alternate airport is, in practice, the departure time plus the normal flight time to reach the ETP between the considered alternate and the next alternate airport along the route, plus the diversion flight time from this ETP to this alternate airport, considering a diversion at LRC and FL100 or MORA.

The validity period can be illustrated by the following figure.



Weather minima, period of validity

8 - MINIMUM EQUIPMENT LIST (MEL)

The operator's MEL is based on the Master Minimum Equipment List (MMEL) established by the aircraft manufacturer. The MMEL is approved by the JAA/ FAA for all Airbus models certified for ETOPS and includes the required additional restrictions for ETOPS operations. These restrictions have been established in accordance with the aircraft's maximum certified diversion time (for example, for operations beyond 120 minutes diversion time, the APU is required to be operative for A310 and A300-600 models).

The prevailing criteria in establishing MMEL for ETOPS are mainly:

– effect of increased average diversion time on the safety analysis,
– availability of certain functions or equipment in emergency electrical configuration,
– in case of additional failure in flight:
  - effect on crew workload,
  - effect on cockpit, cabin environment control,
  - consideration that icing conditions are more likely during a diversion at low altitude.

An example of a typical A330 MMEL page is given hereafter.

Therefore, in establishing its own airline's MEL, the operator must introduce these additional ETOPS restrictions which must be approved by its national authority.

As for a normal MEL, the ETOPS MEL must not be less restrictive than the MMEL. In addition, the airline's MEL must take into consideration:

– the national operational regulations,
– the network specific aspects, such as:
  - maximum and average diversion time,
  - equipment of en route alternate airports,
  - navigation and communication means,
  - average meteorological conditions,
– the flight crew procedures and training.

The operator can take advantage of the provisions of ETOPS regulations, relaxing the requirements for shorter diversion time (typically 75 or 90 minutes). This will need to be negotiated by the operator with its national authorities for each particular route.

ETOPS additional restrictions are identified in the MMEL through the column "REMARKS OR EXCEPTIONS" by "For ER" or "Except for ER" .

A330 MASTER MINIMUM EQUIPMENT LIST	MASTER MINIMUM EQUIPMENT LIST	01-22	Pg 1
	AUTO FLIGHT	REV 05	SEQ 001

ITEM 1	2. NUMBER INSTALLED	3. NUMBER REQUIRED FOR DISPATCH	4. REMARKS OR EXCEPTIONS
22-10 AUTOPILOT/FLIGHT DIRECTOR (AP/FD)			
10-01 Autopilot (AP)			As required by operational regulations for the intended flight. For ER operations AP1 must be operative.
10-02 Flight Director (FD)			As required by operational regulations for the intended flight.

A330 MASTER MINIMUM EQUIPMENT LIST	MASTER MINIMUM EQUIPMENT LIST	01-24	Pg 3
	ELECTRICAL POWER	REV 05	SEQ 002

ITEM 1	2. NUMBER INSTALLED	3. NUMBER REQUIRED FOR DISPATCH	4. REMARKS OR EXCEPTIONS	
24-20 AC-GENERATION 25-01 AC ESS FEED Control				
B) Manual Transfer to AC BUS 2 (ALTN Function)	1	0	* **(0)**	Except for ER operations may be inoperative provided : 1) AC ESS FEED pb sw is selected Norm, and 2) The three DC tie contractors are operative.
26-01 Galley Supply System	1	1	*	a) Automatic load shed system may be inoperative provided GALLEY pb sw and GALLEY FAULT light in the cockpit are operative.

A330 MMEL extracts

9 - A300B2/B4 ETOPS OPERATIONS

All above-mentioned operational guidelines apply for any A300B2 / B4 ETOPS operation. Pending the availability of an ETOPS Chapter in the A300B2/B4 FCOM, Airbus Flight Operations Support department had issued a specific brochure entitled "A300B2 / B4, ETOPS Operations, Flight Operations Aspects", referenced AI/ST-F2 472.1368/94, May 30/94.

10 - AIRBUS RECOMMENDATIONS FOR AN ETOPS COMPUTERIZED FLIGHT PLAN

Any commercial company providing a Computerized Flight Plan (CFP) and computer services is in a position to provide a CFP for ETOPS, provided that the following conditions are met and the following precautions are taken:

- The company must receive the FCOM performance tables and / or the IFP Performance Data Bases from the operator or from Airbus, on behalf of the operator.
- A provision must be considered by the operator to ensure that any revision to the said performance data are forwarded to the selected contractor without delay.
- The operator must ensure that the selected contractor is fully acquainted with and implementing the standard and ETOPS operational rules, and agreed interpretations thereof, as applicable and set out in the AFM and FCOM, in terms of:
  - standard flight profile for standard fuel planning,
  - diversion flight profiles and speed strategies for ETOPS diversion and diversion fuel planning,
  - operator's standard and ETOPS fuel policy,
  - operator's policy for cruise speed (fixed MN or cost index),
  - operator's policy for diversion speed (single-engine diversion speed),

- provision for the consideration of a trimmable performance factor,
- provisions for the consideration of the various air conditioning modes and their effect on the fuel consumption (as applicable),
- provisions for the consideration of variable fuel provisions and reserves during the ETOPS diversion,
- provision of a computation routine capable of determining the required validity period for the dispatch weather minima at each designated en-route alternate (window of airport suitability),

– The operator should request the selected contractor to provide a CFP format encompassing the following information

- **Flight Plan Data**

A field should be considered in order to indicate the data used in establishing and computing the flight plan fuel and time predictions:

```
FLIGHT PLAN DATA

CRZ M80 or CRZ ECON CI = 40

PERFORMANCE FACTOR = 3.0 PCT

AIRCON = NORM (*)

(*) or ECON (A310 / A300-600)

    or LO  / HI ( A320 / A321 / A330 / A340 )
```

- **Average trip wind and temperature data**

```
AVG W/C = M010 ( P010 )

or

TRIP WIND = HD010 ( TL010 )

AVG ISA DEV = P05
```

- **Fuel burn summary**

  A field should be considered in order to clearly indicate the required additional fuel reserves for ETOPS, as applicable, for example as follows:

```
                          FUEL BURN / TIME SUMMARY

                             FUEL          TIME

TRIP
CONTINGENCY
ALTERNATE
HOLDING
ETOPS RESERVES              001100
COMPANY
TAKE-OFF
TAXI
BLOCK
```

In order to define the above ETOPS reserves, the CFP software usually compare, at each ETP:

– the fuel required to divert to either one of the two associated en-route alternates, for the two ETOPS diversion scenarios,

to

– the standard fuel and reserves expected to be on board when over flying the ETP.

As a result of this comparison, a fuel surplus may be required for some ETP, when considering the ETOPS diversion scenarios. The ETP exhibiting the highest surplus is considered as the ETOPS Critical Point. The highest fuel surplus (as applicable) is considered as the required additional ETOPS fuel reserves.

- **Fuel burn adjustment data**

A field should be considered in order to provide fuel burn adjustment figures for typical deviations (in terms of take-off weight, cruise altitude and wind component) relative to the CFP operational assumptions, for example as follows:

```
FUEL BURN ADJUSTMENT FOR 1000 KG INCR/DECR IN TOW : XX/XX KG
FUEL BURN ADJUSTMENT FOR 4000 FT DECR IN CRZ ALT  : XXX KG
FUEL BURN ADJUSTMENT FOR 20 KTS INCR/DECR IN WIND : XX/XX KG
```

- **ATC flight plan**

The ATC flight plan should be inserted, as filed, including the requested initial FL and step-climbs, for example as follows:

```
VHHH0700
NO476F330 ELAT01 ELATO ....TROUT/M081F330 ......
AKN/M081F370...............J502 ARRUE J500
CYVR1151
```

- **Dispatch weather minima**

  To assist the flight crew in checking the required dispatch weather minima and windows of suitability against the terminal forecast, a field could be added to recall the dispatch weather minima applicable to the en-route alternate airports declared to support the flight.

```
              ETOPS ALTERNATES - MINIMA FOR FILING


ALTN         RWY      CEILING (ft) / VISIBILITY (km)

                     PRECISION APP   NON-PRECISION APP


NZAA         05        600 / 3.0       800 / 3.0
             23        600 / 3.0       900 / 3.0

....         ..        ... / ...       ... / ...

RPMM         06        700 / 3.2       800 / 3.5
             24        700 / 3.2       900 / 4.3

VHHH         31        600 / 3.0       800 / 3.0
             13        600 / 3.0      1000 / 3.5
```

- **Alternate airports window of suitability**

The airport window of suitability, for each declared en-route alternate, should be indicated, clearly stating that the given validity window is to be checked against the forecast, as follows:

```
            ENROUTE ALTERNATES SUITABILITY WINDOW

      EINN TO BE SUITABLE FROM 1300 UTC TO 1816 UTC
      BIKF TO BE SUITABLE FROM 1404 UTC TO 1758 UTC
      BGSF TO BE SUITABLE FROM 1550 UTC TO 1946 UTC
      .... .. .. ........ .... .... ... .. .... ...
```

- **Equitime points (ETP data)**

  ETP data should be provided in a synthetic manner, for example as follows:

ETP DATA SUMMARY

	<---DEP-ETP--->		<-------- ETP TO DIVERSION ALTN ------ >		
	TIME	DIST	WIND COMP	FUEL BURN	G/C DIST
ETP1 EINN/BIKF	01/10	0522NM	M024/M002	09428/09350	0390/0415
ETP2 BIKF/BGSF	02/53	1272NM	M001/P014	08872/08841	0404/0420
......../....	../..	....NM	..../....	...../.....	..../....

ETP'S BASED ON XXX KTS TAS @ FLXXX

CRITICAL POINT AT ETP2 : 1100KG ETOPS FUEL RESERVES ADDED

Note: On A330 aircraft, the flight crew may update the position of the ETP using the Flight Management function.

- **Diversion summary**

  For each ETP, and for a possible diversion from this ETP to any one of the two associated en-route alternates, a complete diversion summary should be provided, for example as follows:

```
DIVERSION FROM ETP1 - EINN/BIKF - NXX XX.X / WXXX XX.X


                              TO EINN           TO BIKF
 G/C DIST                      0390              0415
 AVG WIND @ FL100              M010              M005
 AVG TEMP @ FL100              M005              P002

                           1 ENG   2 ENG     1 ENG   2 ENG
                           340KT    LRC      340KT    LRC
 DIVERSION TIME            XX.XX   XX.XX     XX.XX   XX.XX
 BURN SUMMARY
 DIVERSION                 XXXXX   XXXXX     XXXXX   XXXXX
 CONTINGENCY               .....   .....     .....   .....
 HOLD                      .....   .....     .....   .....
 ANTI ICE                  .....   .....     .....   .....
 ICE DRAG                  .....   .....     .....   .....
 APU                       .....   .....     .....   .....
 APPR/GA/APPR              .....   .....     .....   .....
 ADD RES                   .....   .....     .....   .....
 TOTAL                     09428   XXXXX     09530   XXXXX
 REQUIRED         09530
 EFOB             11700 (INCLUDING ADDITIONAL ETOPS FUEL)
 DIFFERENCE      +02170
```

DIVERSION FROM **ETP2** - AAAA/BBBB - NXX XX.X / WXXX XX.X

	TO AAAA		TO BBBB	
G/C DIST	0410		0390	
AVG WIND @ FL100	M005		M010	
AVG TEMP @ FL100	P005		M002	
	1 ENG 340KT	2 ENG LRC	1 ENG 340KT	2 ENG LRC
DIVERSION TIME	XX.XX	XX.XX	XX.XX	XX.XX
BURN SUMMARY				
DIVERSION	XXXXX	XXXXX	XXXXX	XXXXX
CONTINGENCY	.....	.....	.....	.....
HOLD	.....	.....	.....	.....
ANTI ICE	.....	.....	.....	.....
ICE DRAG	.....	.....	.....	.....
APU	.....	.....	.....	.....
APPR/GA/APPR	.....	.....	.....	.....
ADD RES	.....	.....	.....	.....
TOTAL	**09600**	XXXXX	09550	XXXXX

REQUIRED **09600**
EFOB **09600** (INCLUDING ADDITIONAL ETOPS FUEL)
DIFFERENCE **00000**

- **Weather data**

The weather summary should provide wind and temperature data at or between key way points and at the planned cruise FL, as well as at 4000ft below and above this planned cruise FL, for example as follows:

EN-ROUTE WINDS AND TEMPERATURES SUMMARY

WPT	FL	WIND	W/C	OAT	ΔISA
TOC	370	294/027	P015	-44	P012
	330	310/025	P010	-47	P005
	290	325/025	P007	-49	M002
ETP1	**330**	....	....	...	....
	180	....	....	...	....
	100	....	....	...	....
TOD	330	270/072	....	...	....
	290	250/058	....	...	....
	150	210/035	....	...	....

Weather data should be also provided for each declared en-route alternate, including the normal destination alternate, for example as follows:

WINDS AND TEMPERATURES FROM ETP'S TO ALTERNATES

ETP--ALTN	FL	WIND	W/C	OAT	ΔISA
ETP1-EINN	**330**	270/080	P065	-47	P005
	180	230/025	P010	-22	M001
	100	180/030	M005	-03	P002
ETP1-BIKF	330	300/060	....	...	....
	...	....	....	...	....
ETP2-BIKF	...	....	....	...	....
ETP2-BGSF	...	....	....	...	....
....-....	...	....	....	...	....

WINDS AND TEMPERATURES AT ALTERNATES

ALTN	FL	WIND	W/C	OAT	ΔISA
EINN	**330**	270/080	P065	-47	P005
	180	230/025	P010	-22	M001
	100	180/030	M005	-03	P002
BIKF	330	300/060	....	...	....
	...	....	....	...	....
BGSF	...	....	....	...	....
CYYR	...	....	....	...	....

- **Miscellaneous CFP log options**

  A non-ETOPS or ETOPS CFP log may also include the following sections:

  – ETOPS release statement,

  – MEL / CDL status,

  – ship remarks (e.g. FMS navigation data base remarks, PIREPS),

  – reclearance data (as applicable),

  – departure / destination airports remarks / NOTAMs,

  – en-route NOTAMs,

  – navaids briefing,

  – departure, en-route and terminal area briefings,

  – navigation data in case of loss of FMS,

  – weather briefing (e.g. surface and upper air synoptic weather, turbulence forecast, freezing levels / icing forecast, thunderstorm forecast, terminal forecast, volcanic activity and volcanic ash clouds reports).

11 - APPENDICES

a) FCOM cross-reference table (all models)

	A310/A300-600	A319/A320/A321 /A330
Extended range operations	2.18.70	2.04.40
Standard fuel planning	2.17	2.05
Fuel monitoring	2.17 2.12.10	2.05 3.05
Standard strategy	2.16.30	3.06.30
Obstacle strategy	2.16.40	3.06.40
Minimum diversion time strategy	2.16.50	3.06.50
Flight without pressurization	2.18.20	2.04.20 3.05.20
Cruise - 2-engine long-range	2.12.10	3.05.20
Drift down gross ceilings	2.16.20	3.05.20
Ground distance/air distance conversion	2.16.70	3.06.70 3.05.20

b) Maximum distance to diversion airport (current models):

These tables are published in the FCOM 'Extended Range Operations' Chapter (2.18.70 or 2.04.40).
Depending on the chosen speed schedule and on the aircraft reference gross weight, these tables provide the Optimum Flight Levels for diversion and the distances after 60, 90, 120, 150, 180 minutes (see diversion profile in page 81).
The table published in the FCOM at the latest revision should be used preferably than the one published in this document.

- ***A300B4-601, GE CF6-80C2A1***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
M.78/300 kt	95 000	230	420	630	835	-	-
	110 000	220	420	625	830	1 035	1 240
	125 000	210	415	615	820	1 020	1 225
	140 000	200	410	610	810	1 010	1 210
	155 000	190	405	600	800	995	1 190
	170 000	170	395	590	780	970	1 160
M.78/320 kt	95 000	190	430	635	-	-	-
	110 000	180	425	630	840	1 045	1 250
	125 000	180	425	630	835	1 040	1 245
	140 000	170	420	625	825	1 030	1 235
	155 000	160	415	615	815	1 015	1 215
	170 000	150	410	610	805	1 005	1 200
M.78/335 kt	95 000	170	435	645	-	-	-
	110 000	170	430	640	855	1 065	1 280
	125 000	160	430	640	850	1 060	1 270
	140 000	150	425	635	840	1 045	1 250
	155 000	150	425	630	835	1 040	1 245
	170 000	140	420	620	825	1 025	1 230

- ***A300B4-603, GE CF6-80C2A3***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
M.78/300 kt	95 000	230	425	635	-	-	-
	110 000	220	420	625	835	1 040	1 245
	125 000	210	415	620	820	1 025	1 230
	140 000	200	410	610	810	1 010	1 210
	155 000	180	400	595	790	985	1 180
	170 000	170	395	590	780	970	1 165
M.78/320 kt	95 000	200	430	645	-	-	-
	110 000	190	430	640	850	1 060	1 270
	125 000	180	425	635	840	1 045	1 250
	140 000	180	420	630	835	1 040	1 245
	155 000	170	420	625	825	1 030	1 235
	170 000	160	415	615	815	1 015	1 215
M.78/335 kt	95 000	180	440	655	-	-	-
	110 000	170	435	650	860	1 075	1 285
	125 000	170	435	645	855	1 070	1 280
	140 000	160	430	640	850	1 060	1 270
	155 000	160	425	630	840	1 050	1 260
	170 000	160	420	620	825	1 030	1 235

- ***A300B4-605R, or A300F4-605R, GE CF6-80C2A5/CF6-80C2A5F***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
M.78/300 kt	95 000	250	435	645	860	-	-
	110 000	230	425	635	845	1 055	1 265
	125 000	220	420	625	835	1 040	1 245
	140 000	210	415	620	820	1 025	1 230
	155 000	200	410	610	810	1 010	1 210
	170 000	180	400	595	790	985	1 180
M.78/320 kt	95 000	220	440	660	875	-	-
	110 000	210	435	655	870	1 085	1 300
	125 000	200	435	645	860	1 070	1 285
	140 000	190	430	640	850	1 060	1 270
	155 000	180	425	630	835	1 045	1 250
	170 000	170	415	615	815	1 020	1 220
M.78/335 kt	95 000	190	445	665	-	-	-
	110 000	190	445	660	880	1 100	1 315
	125 000	180	440	655	870	1 090	1 305
	140 000	170	435	650	860	1 075	1 285
	155 000	170	430	645	855	1 065	1 280
	170 000	160	430	635	845	1 055	1 265

- ***A300B4-620, PW JT9D-7R4H1***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
M.78/300 kt	95 000	250	435	650	865	-	-
	110 000	240	430	640	855	1 065	1 280
	125 000	220	420	625	835	1 040	1 245
	140 000	200	410	610	810	1 010	1 210
	155 000	180	400	595	790	985	1 180
	170 000	150	390	575	760	950	1 135
M.78/320 kt	95 000	230	450	670	-	-	-
	110 000	220	440	660	880	1 100	1 320
	125 000	200	435	645	860	1 070	1 285
	140 000	180	425	630	840	1 045	1 250
	155 000	160	415	615	815	1 015	1 215
	170 000	140	405	600	800	990	1 185
M.78/335 kt	95 000	210	455	695	-	-	-
	110 000	200	450	670	890	1 115	1 335
	125 000	180	440	655	870	1 085	1 305
	140 000	160	430	640	850	1 060	1 270
	155 000	140	425	625	830	1 035	1 240
	170 000	120	415	615	810	1 010	1 210

- ***A300B4-622 or -622R, PW 4158***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
M.78/300 kt	95 000	270	445	665	890	-	-
	110 000	250	435	650	865	1 080	1 300
	125 000	240	430	640	855	1 065	1 280
	140 000	220	420	625	830	1 035	1 245
	155 000	200	410	610	810	1 010	1 210
	170 000	180	400	595	790	975	1 180
M.78/320 kt	95 000	250	455	685	915	-	-
	110 000	230	450	670	895	1 115	1 340
	125 000	220	445	660	880	1 100	1 320
	140 000	210	440	655	870	1 085	1 300
	155 000	200	430	645	855	1 070	1 280
	170 000	180	420	625	830	1 040	1 245
M.78/335 kt	95 000	230	465	695	-	-	-
	110 000	220	460	690	915	1 145	1 375
	125 000	210	455	680	905	1 130	1 355
	140 000	200	445	670	890	1 115	1 335
	155 000	180	440	655	870	1 085	1 300
	170 000	160	430	640	850	1 060	1 270

- ***A310-203, GE CF6-80A3***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
M.80/300 kt	85 000	240	430	645	855	-	-
	100 000	230	425	635	845	1 055	1 265
	115 000	220	420	630	835	1 040	1 245
	130 000	200	415	615	815	1 015	1 215
	145 000	190	410	605	800	1 000	1 195
M.80/320 kt	85 000	210	435	650	865	-	-
	100 000	200	435	650	860	1 075	1 285
	115 000	200	430	640	855	1 065	1 275
	130 000	180	425	635	840	1 045	1 250
	145 000	160	420	620	820	1 020	1 220
M.80/340 kt	85 000	200	440	660	-	-	-
	100 000	200	435	650	865	1 080	1 295
	115 000	200	435	645	855	1 065	1 280
	130 000	170	430	640	845	1 055	1 265
	145 000	160	425	625	830	1 035	1 240

- ***A310-204 or A310-304 or A310-308, GE CF6-80C2A2 or CF6-80C2A8***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
M.80/300 kt	85 000	270	440	660	-	-	-
	100 000	260	435	650	865	1 080	1 300
	115 000	230	425	635	845	1 055	1 265
	130 000	220	420	630	835	1 040	1 245
	145 000	210	415	620	820	1 025	1 230
	160 000	190	410	605	800	1 000	1 195
M.80/320 kt	85 000	230	445	665	-	-	-
	100 000	220	440	660	880	1 100	1 315
	115 000	210	435	655	870	1 085	1 300
	130 000	200	435	645	860	1 070	1 285
	145 000	190	430	635	850	1 060	1 265
	160 000	170	420	625	830	1 030	1 235
M.80/340 kt	85 000	190	450	670	-	-	-
	100 000	190	450	670	890	1 110	1 330
	115 000	180	445	665	885	1 105	1 320
	130 000	180	445	660	875	1 095	1 315
	145 000	170	440	655	870	1 085	1 300
	160 000	160	435	650	860	1 075	1 285

- ***A310-221, PW JT9D-7R4D1***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
M.80/300 kt	85 000	240	430	645	855	-	-
	100 000	230	425	635	845	1 055	1 265
	115 000	220	420	630	835	1 040	1 245
	130 000	210	415	620	825	1 025	1 230
	145 000	190	410	605	800	1 000	1 195
M.80/320 kt	85 000	230	450	670	895	-	-
	100 000	220	445	665	880	1 100	1 320
	115 000	210	435	650	865	1 085	1 300
	130 000	190	430	640	850	1 060	1 270
	145 000	170	420	625	830	1 030	1 235
M.80/340 kt	85 000	210	460	685	-	-	-
	100 000	190	450	675	895	1 115	1 340
	115 000	180	445	665	885	1 105	1 320
	130 000	170	440	655	870	1 085	1 300
	145 000	150	435	645	850	1 060	1 270

- ***A310-222, PW JT9D-7R4E1***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN) 60	90	120	150	180
M.80/300 kt	85 000	250	435	655	870	-	-
	100 000	240	430	645	855	1 070	1 280
	115 000	230	425	635	840	1 050	1 260
	130 000	210	420	620	825	1 025	1 230
	145 000	200	410	610	810	1 010	1 210
M.80/320 kt	85 000	230	450	675	-	-	-
	100 000	220	445	665	885	1 100	1 320
	115 000	210	440	655	870	1 085	1 305
	130 000	200	435	645	860	1 070	1 285
	145 000	180	425	635	840	1 045	1 250
M.80/340 kt	85 000	210	460	690	-	-	-
	100 000	200	455	680	905	1 130	1 355
	115 000	190	450	675	895	1 120	1 340
	130 000	180	445	665	885	1 105	1 320
	145 000	170	440	655	870	1 085	1 300

- ***A310-322, PW JT9D-7R4E1***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN) 60	90	120	150	180
M.80/300 kt	85 000	260	440	655	875	1 095	1 315
	100 000	240	430	645	855	1 070	1 280
	115 000	230	425	635	845	1 055	1 265
	130 000	220	420	630	835	1 040	1 245
	145 000	200	415	615	815	1 015	1 215
	160 000	190	405	605	800	1 000	1 195
M.80/320 kt	85 000	230	450	670	895	1 115	1 340
	100 000	220	445	665	885	1 105	1 320
	115 000	210	440	655	870	1 090	1 300
	130 000	200	435	650	860	1 075	1 285
	145 000	190	430	640	850	1 060	1 270
	160 000	180	425	630	840	1 045	1 250
M.80/340 kt	85 000	210	455	680	910	1 135	-
	100 000	200	455	680	905	1 130	1 355
	115 000	190	450	675	895	1 120	1 340
	130 000	180	450	670	890	1 115	1 335
	145 000	180	445	665	885	1 105	1 320
	160 000	170	440	650	865	1 080	1 295

- ***A310-324 or -325, PW 4152 or 4156A***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
M.80/300 kt	85 000	260	440	660	880	1 100	1 320
	100 000	250	435	650	870	1 085	1 300
	115 000	240	430	640	855	1 065	1 280
	130 000	220	420	630	835	1 040	1 245
	145 000	200	415	615	815	1 015	1 215
	160 000	180	405	600	790	985	1 180
M.80/320 kt	85 000	240	450	675	895	1 120	1 340
	100 000	230	445	665	885	1 110	1 330
	115 000	210	440	655	870	1 090	1 305
	130 000	200	435	650	860	1 075	1 285
	145 000	180	425	635	840	1 045	1 255
	160 000	160	420	620	820	1 020	1 220
M.80/340 kt	85 000	210	455	680	905	1 135	-
	100 000	200	450	675	900	1 125	1 350
	115 000	190	445	665	890	1 110	1 335
	130 000	180	440	655	875	1 090	1 310
	145 000	160	435	645	855	1 070	1 280
	160 000	150	425	650	835	1 040	1 250

- ***A319-111 or -112, CFM56-5B5 or -5B6***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
MCT/VMO	50 000	140	403	597	792	988	1184
	55 000	110	404	597	791	985	1180
	60 000	110	403	595	788	982	1175
	65 000	110	402	593	784	977	1169
	70 000	100	401	590	781	972	1163
	75 000	100	400	589	779	970	1160
MCT/320 kt	50 000	140	402	597	792	987	1183
	55 000	140	401	594	788	982	1177
	60 000	130	400	592	785	978	1172
	65 000	120	398	589	781	973	1165
	70 000	120	396	585	775	965	1156
	75 000	120	394	583	773	962	1150

- ***A319-113 or -114, CFM56-5A4 or -5A5***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
MCT/VMO	50 000	130	415	618	820	1023	1226
	55 000	130	414	615	816	1018	1219
	60 000	130	412	611	811	1011	1211
	65 000	130	409	606	804	1002	1201
	70 000	120	406	601	796	991	1188
	75 000	120	402	594	786	979	1173
MCT/320 kt	50 000	150	407	605	803	1000	1198
	55 000	150	407	605	803	1000	1198
	60 000	140	404	599	794	988	1183
	65 000	140	404	599	793	988	1183
	70 000	130	400	592	784	976	1168
	75 000	120	397	586	775	965	1154

- ***A319-131 or -132, IAE V2522-A5 or V2524-A5***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
MCT/VMO	50 000	130	411	612	812	1012	1214
	55 000	130	411	611	812	1011	1211
	60 000	130	411	610	809	1009	1209
	65 000	130	410	609	807	1006	1205
	70 000	130	410	607	804	1003	1201
	75 000	130	408	604	801	998	1195
MCT/320 kt	50 000	160	409	609	810	1010	1211
	55 000	150	405	603	800	998	1196
	60 000	150	405	603	800	998	1196
	65 000	150	405	603	800	998	1196
	70 000	140	402	597	792	987	1182
	75 000	140	402	597	792	987	1181

- ***A320-111 or -211 or -212, CFM56-5A1 or -5A3***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN) 60	90	120	150	180
MCT/VMO	50 000	110	413	611	809	1008	1207
	55 000	110	412	609	807	1004	1202
	60 000	110	411	607	803	999	1196
	65 000	110	409	603	798	993	1188
	70 000	110	407	599	791	985	1178
	75 000	090	406	597	788	979	1172
MCT/320 kt	50 000	150	410	607	805	1002	1200
	55 000	140	406	601	796	991	1186
	60 000	130	403	595	787	979	1171
	65 000	130	403	595	787	979	1171
	70 000	120	400	590	779	968	1157
	75 000	110	397	584	770	957	1144

- ***A320-214, CFM56-5B4***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN) 60	90	120	150	180
MCT/VMO	50 000	160	409	609	809	1010	1210
	55 000	160	408	607	806	1006	1205
	60 000	150	407	604	802	1000	1198
	65 000	140	405	601	796	993	1189
	70 000	140	403	597	791	986	1181
	75 000	140	400	592	785	978	1172
MCT/320 kt	50 000	150	407	605	802	1000	1198
	55 000	150	407	605	802	1000	1198
	60 000	140	404	599	794	988	1183
	65 000	130	401	593	785	977	1169
	70 000	120	398	587	776	966	1155
	75 000	110	395	581	768	955	1141

- ***A320-231, IAE V2500-A1***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN) 60	90	120	150	180
MCT/VMO	50 000	140	425	632	839	1047	1255
	55 000	130	424	629	835	1041	1248
	60 000	130	422	626	830	1035	1241
	65 000	130	420	622	825	1028	1232
	70 000	130	417	617	818	1019	1222
	75 000	120	414	611	809	1008	1207
MCT/320 kt	50 000	170	417	621	824	1028	1231
	55 000	170	417	621	824	1028	1231
	60 000	160	413	614	815	1015	1216
	65 000	150	410	608	805	1003	201
	70 000	140	406	601	796	991	1186
	75 000	140	406	601	796	990	1185

- ***A320-232 or -233, IAE V2527-A5 or V2527E-A5***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
MCT/VMO	50 000	130	413	613	813	1013	1213
	55 000	130	413	612	812	1011	1211
	60 000	130	413	612	810	1009	1208
	65 000	130	413	611	809	1007	1205
	70 000	130	412	609	806	1003	1201
	75 000	130	411	606	802	999	1195
MCT/320 kt	50 000	160	412	612	813	1013	1214
	55 000	150	408	606	804	1001	1199
	60 000	150	408	606	804	1001	1199
	65 000	140	406	601	796	990	1185
	70 000	140	406	601	796	990	1185
	75 000	130	403	595	787	979	1171

- ***A321-111 or -112 or -211, CFM56-5B1 or -5B2 or -5B3***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
MCT/VMO	60 000	120	424	629	835	1041	1247
	65 000	120	423	627	832	1037	1243
	70 000	110	422	625	829	1032	1236
	75 000	110	421	623	825	1028	1232
	80 000	100	419	620	820	1021	1222
	85 000	100	417	616	816	1016	217
MCT/320 kt	60 000	160	414	614	815	1015	1216
	65 000	160	414	614	815	1015	1216
	70 000	150	410	608	806	1004	1201
	75 000	150	410	608	806	1004	1201
	80 000	140	407	602	797	991	1186
	85 000	130	404	596	788	980	1172

- ***A321-131 or -231, IAE V2530-A5 or V2533-A5***

SPEED SCHEDULE	REFERENCE GROSS WEIGHT (KG)	OPTIMUM FL FOR DIVERSION	DISTANCE (NM) DIVERSION (MIN)				
			60	90	120	150	180
MCT/VMO	60 000	120	413	612	810	1010	1209
	65 000	110	412	608	806	1003	1201
	70 000	110	410	605	801	997	1194
	75 000	110	409	602	796	990	1185
	80 000	100	406	598	790	983	1176
	85 000	100	404	593	783	974	1166
MCT/320 kt	60 000	150	409	607	804	1002	1200
	65 000	140	406	600	795	990	1185
	70 000	130	402	594	786	978	1171
	75 000	130	402	594	786	978	1170
	80 000	120	399	588	778	967	1156
	85 000	110	396	583	769	956	1142

- ***A330-202, GE 80E1A4***

ISA							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	190	440	653	867	1081	1296
	160000	190	438	650	863	1076	1289
	170000	180	438	650	862	1075	1287
	180000	170	436	646	857	1068	1280
	190000	170	436	645	855	1064	1274
	200000	170	433	641	850	1059	1269
	210000	170	433	637	844	1051	1259
	220000	160	430	636	842	1049	1255
	230000	150	428	632	836	1039	1243
MCT/310 KT	150000	220	434	645	857	1070	1282
	160000	210	432	641	851	1060	1270
	170000	210	430	638	847	1056	1266
	180000	200	428	634	840	1047	1253
	190000	200	428	630	835	1041	1248
	200000	190	424	627	831	1034	1237
	210000	190	421	622	825	1029	1232
	220000	180	420	620	820	1021	1221
	230000	170	416	614	811	1008	1206

Note : For temperatures higher than ISA + 10, use ISA values

ISA + 10							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	180	449	666	883	1099	1316
	160000	180	448	665	882	1098	1315
	170000	180	446	662	878	1094	1311
	180000	180	445	659	873	1086	1300
	190000	170	444	657	871	1085	1298
	200000	170	442	653	866	1078	1292
	210000	170	442	649	859	1070	1282
	220000	160	439	648	857	1068	1279
	230000	150	437	644	852	1059	1267
MCT/310 KT	150000	220	442	657	873	1090	1307
	160000	210	440	654	868	1082	1295
	170000	210	438	650	863	1076	1290
	180000	200	436	646	857	1067	1278
	190000	200	433	641	851	1060	1271
	200000	200	432	635	842	1049	1258
	210000	180	429	633	838	1042	1246
	220000	180	428	632	836	1041	1245
	230000	170	425	626	827	1029	1230

- ***A330-301, GE 80E1A2***

ISA							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	160	430	636	843	1050	1256
	160000	160	430	634	841	1047	1254
	170000	160	429	631	836	1042	1247
	180000	160	427	628	831	1035	1239
	190000	150	425	625	827	1029	1232
	200000	150	424	621	821	1022	1233
MCT/310 KT	150000	190	422	626	829	1032	1236
	160000	190	421	623	826	1030	1233
	170000	180	419	619	819	1020	1220
	180000	180	417	618	818	1018	1219
	190000	170	415	613	810	1007	1205
	200000	170	414	612	809	1006	1204

Note : For temperatures higher than ISA + 10, use ISA values

ISA + 10							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	160	438	648	859	1070	1280
	160000	160	437	646	856	1066	1276
	170000	160	435	643	851	1060	1270
	180000	150	434	640	847	1054	1262
	190000	150	432	636	842	1048	1254
	200000	140	430	633	837	1042	1246
MCT/310 KT	150000	190	431	638	845	1053	1260
	160000	190	429	635	841	1049	1256
	170000	180	427	632	836	1040	1244
	180000	180	426	629	833	1038	1242
	190000	170	424	625	826	1027	1229
	200000	170	422	623	824	1026	1227

- ***A330-223, PW4168A***

ISA							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	200	446	665	884	1103	1322
	160000	200	444	662	880	1099	1318
	170000	190	443	658	874	1090	1306
	180000	190	441	656	872	1088	1303
	190000	180	439	651	864	1077	1289
	200000	180	437	650	863	1075	1288
	210000	170	435	644	854	1063	1273
	220000	170	433	643	852	1062	1272
	230000	160	431	637	844	1050	1257
MCT/310KT	150000	220	437	651	866	1081	1296
	160000	220	434	646	858	1071	1285
	170000	210	437	649	863	1077	1292
	180000	210	433	643	854	1066	1279
	190000	200	435	646	859	1072	1286
	200000	200	430	639	848	1059	1271
	210000	190	430	638	847	1057	1268
	220000	190	425	629	835	1042	1250
	230000	180	425	629	834	1040	1248

Note : For temperatures higher than ISA + 10, use ISA values

ISA + 10							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	200	455	678	901	1125	1348
	160000	200	453	674	896	1119	1342
	170000	190	452	672	892	1112	1332
	180000	190	449	668	888	1108	1328
	190000	180	448	664	881	1098	1315
	200000	180	446	662	879	1096	1312
	210000	170	443	657	871	1084	1298
	220000	170	441	655	869	1082	1296
	230000	160	439	650	860	1071	1282
MCT/310KT	150000	220	446	663	882	1100	1320
	160000	220	442	658	874	1091	1308
	170000	210	448	661	878	1096	1315
	180000	210	441	655	870	1086	1302
	190000	200	443	658	874	1091	1309
	200000	200	438	650	864	1078	1293
	210000	190	438	650	862	1076	1291
	220000	190	433	640	850	1060	1272
	230000	180	433	640	849	1059	1270

- ***A330-321, PW4164***

ISA							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	180	433	644	855	1067	1278
	160000	170	433	643	852	1062	1271
	170000	170	432	642	852	1061	1271
	180000	170	430	638	847	1056	1265
	190000	160	429	636	843	1050	1256
	200000	160	428	634	840	1047	1253
MCT/310 KT	150000	200	425	631	838	1044	1250
	160000	200	423	628	834	1040	1247
	170000	190	421	624	828	1031	1234
	18000	190	420	623	827	1030	1233
	190000	180	417	617	817	1018	1218
	200000	180	417	617	817	1018	1218

Note : For temperatures higher than ISA + 10, use ISA values

ISA + 10							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	170	442	655	869	1083	1296
	160000	170	442	655	869	1083	1296
	170000	170	440	654	867	1081	1294
	180000	160	438	649	859	1070	1280
	190000	160	438	648	859	1070	1280
	200000	160	436	645	855	1066	1276
MCT/310 KT	150000	200	433	644	854	1065	1275
	160000	200	431	640	849	1059	1270
	170000	190	430	637	844	1052	1259
	180000	190	428	635	842	1050	1257
	190000	180	426	630	834	1038	1243
	200000	180	425	629	833	1037	1242

- ***A330-322, PW4168***

ISA							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	200	443	661	879	1097	1316
	160000	190	442	658	873	1089	1305
	170000	190	440	655	871	1087	1303
	180000	190	438	651	865	1080	1295
	190000	180	437	650	862	1075	1288
	200000	170	434	643	853	1063	1272
MCT/310 KT	150000	220	432	644	856	1069	1281
	160000	210	429	639	848	1058	1267
	170000	210	429	639	848	1058	1267
	180000	200	425	632	858	1044	1251
	190000	200	425	631	838	1044	1251
	200000	190	421	624	828	1031	1234

Note : For temperatures higher than ISA + 10, use ISA values

ISA + 10							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	190	451	671	891	1111.3	1331
	160000	180	447	664	880	1097	1314
	170000	180	447	664	880	1097	1314
	180000	170	443	657	870	1084	1298
	190000	170	443	656	870	1084	1297
	200000	160	439	650	860	1071	1281
MCT/310 KT	150000	220	440	656	872	1089	1306
	160000	210	438	652	866	1079	1293
	170000	210	438	652	865	1079	1293
	180000	200	434	644	855	1065	1276
	190000	200	434	644	855	1065	1276
	200000	190	430	637	844	1052	1259

- ***A330-341, RR TRENT 768***

ISA							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	170	431	638	846	1054	1263
	160000	160	430	637	843	1050	1256
	170000	160	429	634	840	1046	1252
	180000	160	427	631	835	1040	1245
	190000	160	425	627	830	1034	1237
	200000	150	423	624	825	1027	1229
MCT/310KT	150000	200	426	632	839	1045	1251
	160000	190	423	626	830	1033	1236
	170000	190	422	626	829	1032	1236
	180000	180	419	620	820	1020	1221
	190000	180	418	619	819	1019	1220
	200000	170	416	613	811	1008	1205

Note : For temperatures higher than ISA + 10, use ISA values

ISA + 10							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	170	439	650	862	1073	1286
	160000	160	438	648	859	1069	1280
	170000	160	437	646	855	1065	1275
	180000	160	435	643	851	1059	1268
	190000	160	433	639	845	1052	1260
	200000	160	431	635	839	1045	1251
MCT/310 KT	150000	200	434	644	855	1065	1276
	160000	190	432	639	846	1054	1261
	170000	190	431	638	845	1052	1260
	180000	180	428	632	837	1041	1245
	190000	180	426	630	835	1039	1243
	200000	170	424	626	827	1028	1229

- ***A330-342, RR TRENT 772***

ISA							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	180	438	651	863	1076	1289
	160000	180	438	651	863	1076	1289
	170000	180	438	650	863	1075	1288
	180000	170	434	644	853	1063	1273
	190000	170	434	644	853	1063	1273
	200000	170	434	643	853	1063	1272
MCT/310 KT	150000	210	430	640	849	1059	1268
	160000	200	426	633	839	1045	1252
	170000	200	426	633	839	1045	1252
	180000	190	422	626	829	1033	1236
	190000	190	422	626	829	1032	1236
	200000	190	422	625	829	1032	1235

Note : For temperatures higher than ISA + 10, use ISA values

ISA + 10							
SPEED SCHEDULE	A/C WEIGHT AT CRITICAL POINT (KG)	FL FOR DIVERSION	DIVERSION TIME (MIN)				
			60	90	120	150	180
MCT/330KT	150000	180	447	664	880	1097	1314
	160000	180	447	664	880	1097	1314
	170000	180	446	663	879	1096	1313
	180000	170	443	657	870	1084	1298
	190000	170	443	657	870	1084	1298
	200000	170	442	656	869	1083	1297
MCT/310 KT	150000	210	439	652	866	1080	1294
	160000	200	435	646	856	1067	1277
	170000	200	435	646	856	1067	1277
	180000	190	431	639	846	1053	1261
	190000	190	431	638	846	1053	1260
	200000	190	430	638	845	1053	1260

A330 FCOM extract

This extract is given for information. Operators should refer to their FCOM at the latest revision.

A330 FLIGHT CREW OPERATING MANUAL	SINGLE ENGINE OPERATIONS	3.06.10	P 1
	GENERAL	SEQ 001	REV 06

INTRODUCTION

This chapter provides the single engine performance data to be used for the conduct and monitoring of the flight following an engine failure.
The diversion strategy (descent and cruise speed schedules) shall be selected, and specified in the operator's routes specifications, as a function of the prevailing operational factors (e.g. obstacles clearance requirements and/or ETOPS operation).

FLIGHT PREPARATION

In readiness for a possible engine failure occurring during the flight, any flight shall be planned so as to comply with any of the following requirements, as applicable :
- obstacle clearance,
- oxygen,
- maximum diversion distance (ETOPS operation).

The following FCOM sections provide flight preparation and fuel planning information :
- 2.05.10 thru 2.05.60, for Standard Fuel Planning,
- 2.04.40, for Extended Range Operation (ETOPS) and associated fuel requirements.

STRATEGY

Depending on the prevailing operational constraints, the most appropriate diversion strategy shall be selected, out of the following options :

R

	STANDARD STRATEGY	OBSTACLE STRATEGY	FIXED SPEED STRATEGIES	
			310KT	VMO
DESCENT TO CEILING	. M.82/300KT . MCT	. Green Dot Speed . MCT	. M.82/310KT . MCT	. M.82/330KT . MCT
CRUISE	LR ceiling LR speed	– Obstacle not cleared: Maintain Green Dot Speed at MCT – Obstacle cleared : Revert to standard strategy	FL per 2.04.40 MCT/310KT	FL per 2.04.40 MCT/330KT
DESCENT TO LANDING	IDLE/M.82/300KT/250KT			
Approx. increase in fuel consumption compared with both engines operative	+ 30 %			

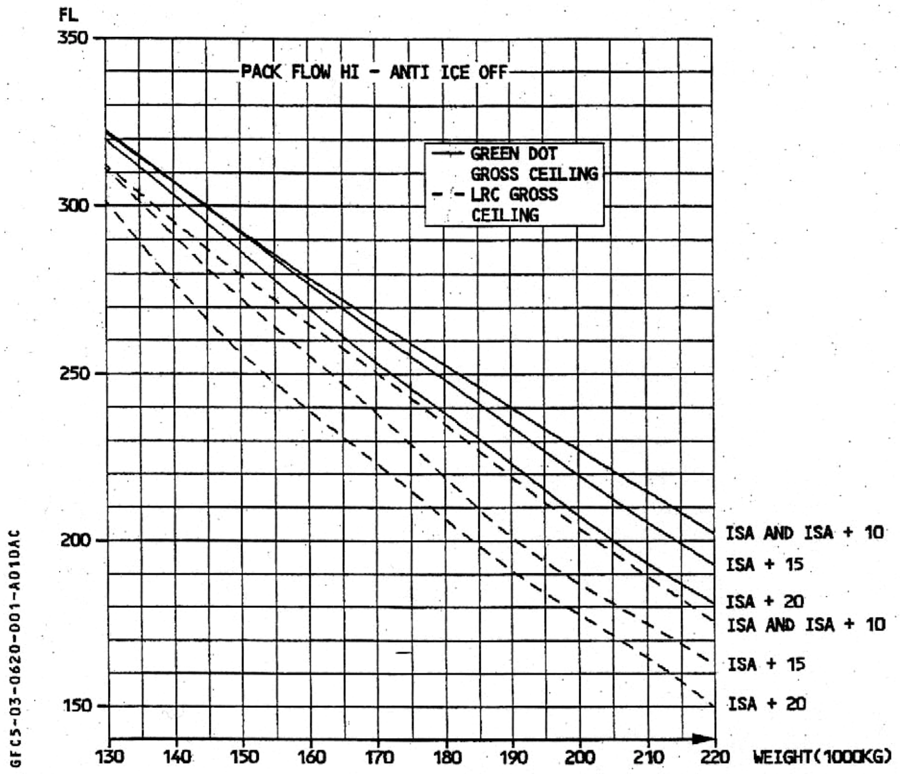
A330 FLIGHT CREW OPERATING MANUAL	SINGLE ENGINE OPERATIONS	3.06.10	P 2
	GENERAL	SEQ 001	REV 06

For ETOPS operations, any of the above diversion strategies can be used provided that the selected strategy and speed schedule is used in :
- establishing the area of operation (maximum diversion distance), as described in Section 2.04.40,
- calculating the diversion fuel requirements for the single engine ETOPS critical scenario, as provided in section 2.04.40,
- demonstrating the applicable obstacle clearance requirements (net flight path and net ceiling).

During the diversion, the flight crew is expected to use the planned speed schedule. However, based on the evaluation of the actual situation, the pilot in command has the authority to deviate from this planned one engine inoperative speed.

A330 FLIGHT CREW OPERATING MANUAL	SINGLE ENGINE OPERATIONS	3.06.20	P 1
	CEILINGS	SEQ 010	REV 06

R R **GROSS CEILINGS AT LONG RANGE AND GREEN DOT SPEEDS**



R *Note : If severe icing conditions are encountered, ice formation may build up on non*
R *heated structure and therefore the ceiling will be reduced by 2500 feet.*

	ENGINE ANTI ICE ON	TOTAL ANTI ICE ON
LONG RANGE	– 700 FT	– 1800 FT
GREEN DOT	– 400 FT	– 1400 FT

NET CEILING AT GREEN DOT SPEED

To obtain the net ceiling at green dot speed, apply the following corrections to the gross ceiling at green dot speed :

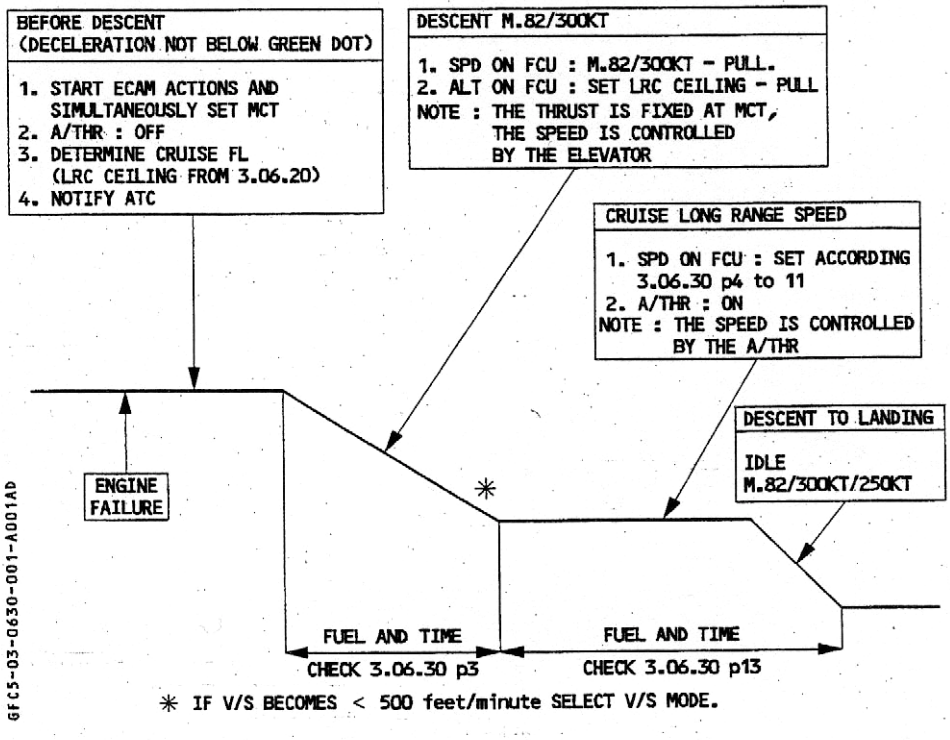
	WEIGHT (1000 KG)				
	130	150	170	190	210
≤ ISA + 10	– 5400 FT	– 5400 FT	– 5800 FT	– 5900 FT	– 6200 FT
ISA + 20	– 5800 FT	– 6300 FT	– 6500 FT	– 6500 FT	– 7500 FT

A330 FLIGHT CREW OPERATING MANUAL	SINGLE ENGINE OPERATIONS	3.06.30	P 1
	STANDARD STRATEGY	SEQ 001	REV 07

PROCEDURE

Unless a specific procedure has been established before dispatch (ETOPS, mountainous areas) the recommended procedure is as follows :

R



A330 FLIGHT CREW OPERATING MANUAL	SINGLE ENGINE OPERATIONS	3.06.30	P 4
	STANDARD STRATEGY	SEQ 010	REV 07

R

LONG RANGE CRUISE - 1 ENGINE OUT

MAX. CONTINUOUS THRUST LIMITS PACK FLOW HI ANTI-ICING OFF							ISA CG=30.0%		N1 (%) KG/H NM/1000KG			MACH IAS (KT) TAS (KT)
WEIGHT (1000KG)	FL100		FL120		FL140		FL160		FL180		FL200	
130	82.6	.425	83.7	.435	85.0	.447	86.8	.465	88.4	.484	90.0	.500
	3809	235	3742	231	3699	229	3722	229	3738	229	3736	228
	71.2	271	73.7	276	75.9	281	78.0	290	80.1	299	82.3	307
140	84.2	.435	85.4	.446	87.2	.464	88.8	.482	90.4	.499	91.8	.512
	4047	240	3992	237	4022	238	4038	238	4036	237	3997	233
	68.6	278	70.7	282	72.6	292	74.6	301	76.6	309	78.7	314
150	85.7	.444	87.5	.462	89.1	.480	90.7	.496	92.1	.510	93.7	.525
	4286	245	4315	246	4331	246	4333	245	4304	242	4297	240
	66.1	283	67.8	293	69.7	302	71.5	310	73.4	316	75.1	323
160	87.6	.459	89.3	.477	90.8	.493	92.3	.508	93.8	.522	95.6	.538
	4607	254	4631	254	4630	253	4609	251	4591	248	4605	246
	63.6	293	65.3	302	67.0	310	68.7	317	70.3	323	71.8	331
170	89.4	.473	90.9	.489	92.5	.505	93.8	.517	95.5	.532	97.4	.550
	4928	262	4931	261	4919	259	4879	255	4884	253	4923	252
	61.3	302	62.9	310	64.5	317	66.1	322	67.5	330	68.6	338
180	90.9	.484	92.4	.500	93.8	.513	95.4	.528	97.2	.544	99.8	.574
	5222	268	5221	267	5182	263	5188	261	5210	259	5376	263
	59.2	309	60.7	317	62.2	322	63.5	330	64.7	337	65.6	353
190	92.4	.495	93.8	.509	95.3	.523	97.1	.540	99.3	.565	101.9	.590
	5523	274	5498	272	5484	269	5511	267	5638	269	5778	271
	57.2	316	58.7	323	60.0	329	61.1	337	62.0	350	62.7	363
200	93.8	.505	95.1	.517	96.7	.532	98.6	.549	101.2	.579	103.9	.603
	5815	280	5773	276	5782	273	5829	272	6025	276	6151	277
	55.4	322	56.7	327	57.8	334	58.8	343	59.5	359	60.2	370
210	94.9	.512	96.5	.527	98.2	.543	100.6	.571	103.3	.597	104.5	.586
	6087	284	6094	281	6119	279	6310	283	6471	285	6185	269
	53.7	327	54.8	334	55.8	341	56.5	357	57.1	370	58.2	360
220	96.2	.520	97.8	.535	99.7	.554	102.2	.580	104.6	.598	104.8	.539
	6384	288	6400	286	6479	285	6652	288	6706	286	6063	247
	52.0	332	53.0	339	53.8	349	54.4	362	55.2	370	54.7	331
ENGINE ANTI ICE ON ΔFUEL = + 1.5 %							TOTAL ANTI ICE ON ΔFUEL = + 3.5 %					

10E -08F0A330-301 CF6-80E1A2 12200010C6KG300 0 018590 0 0 3 1.0 .0 .00 0 01 .990 .000 .000 0 FCOM-G0-03-06-30-004-010

A330 FLIGHT CREW OPERATING MANUAL	SINGLE ENGINE OPERATIONS	3.06.40	P 1
	OBSTACLE STRATEGY	SEQ 001	REV 07

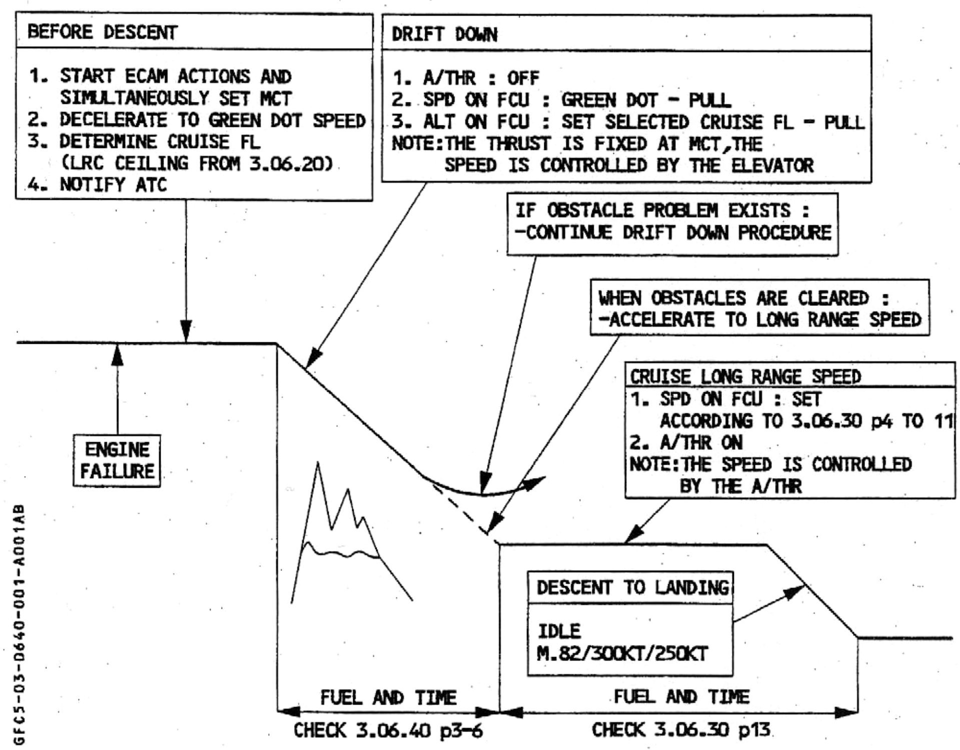
PROCEDURE

In order to maintain the highest possible level, the drift down procedure must be adopted. This requires maximum continuous thrust on the remaining engine at green dot speed.

- If, having reached drift down ceiling altitude, an obstable problem remains the drift down procedure must be maintained so as to fly an ascending cruise profile.
- If, after drift down, no obstacle problem remains, the speed should be allowed to increase to long range speed and maintained. The subsequent cruise should be made using either the long range speed by adjusting it as a function of aircraft weight or by maintaining the initial cruise speed.

Note : Due to the fact that the long range speed is higher than the green dot speed, the cruise will be made at an altitude lower than the drift down ceiling.

R



A330 FLIGHT CREW OPERATING MANUAL	SINGLE ENGINE OPERATIONS OBSTACLE STRATEGY	3.06.40 P 3 SEQ 010 REV 07

R

GROSS FLIGHT PATH DESCENT AT GREEN DOT SPEED

MAX. CONTINUOUS THRUST PACK FLOW HI ANTI-ICING OFF	ISA CG=30.0%	DISTANCE (NM) TIME (MIN) INITIAL SPEED(KT) FUEL(1000KG) LEVEL OFF (FT)

INIT. GW (1000KG)	250	270	290	310	330	350	370	390	410
130					150 29 188 1.6 32500	250 47 190 2.6 32600	298 56 192 3.0 32700	334 62 194 3.3 32700	361 66 196 3.5 32800
140				74 14 192 .9 30800	234 44 194 2.7 31100	288 54 196 3.2 31200	324 60 198 3.5 31200	353 65 200 3.7 31300	379 69 202 3.9 31300
150				207 40 198 2.6 29600	270 51 200 3.2 29800	312 59 202 3.6 29800	342 64 204 3.9 29800	368 68 206 4.1 29900	391 71 208 4.2 29900
160			171 33 202 2.3 28200	256 49 204 3.3 28400	302 57 206 3.8 28400	333 62 208 4.1 28500	360 67 210 4.3 28500	384 70 212 4.5 28500	404 73 214 4.6 28500
170		102 20 206 1.5 26800	235 45 208 3.3 27000	289 55 210 3.9 27100	324 61 212 4.3 27100	353 66 214 4.6 27200	376 69 216 4.7 27200	398 73 218 4.9 27200	417 75 220 5.0 27200
180		206 39 212 3.1 25700	273 52 214 4.0 25800	313 59 216 4.4 25900	344 64 218 4.7 25900	369 68 220 5.0 25900	390 71 222 5.2 26000	411 74 224 5.3 26000	428 77 226 5.4 26000
190	163 31 216 2.6 24400	257 49 218 4.0 24500	303 57 220 4.6 24600	337 63 222 5.0 24700	364 67 224 5.2 24700	387 71 226 5.4 24700	407 74 228 5.6 24800	425 77 230 5.7 24800	443 79 232 5.9 24800
200	232 44 222 3.8 23200	291 55 224 4.7 23300	331 62 226 5.2 23400	360 67 228 5.5 23400	384 71 230 5.8 23500	405 74 232 5.9 23500	424 77 234 6.1 23500	442 79 236 6.2 23500	
210	274 52 228 4.7 22100	318 60 230 5.3 22100	351 65 232 5.7 22200	377 69 234 6.0 22200	400 73 236 6.2 22300	420 76 238 6.4 22300	438 79 240 6.5 22300	454 81 242 6.6 22300	
220	303 57 234 5.3 20900	339 63 236 5.8 21000	369 68 238 6.2 21000	391 72 240 6.4 21100	413 75 242 6.6 21100	434 78 244 6.8 21100	450 80 246 6.9 21100		

CORRECTIONS	DISTANCE	TIME	FUEL	LEVEL OFF
ENGINE ANTI ICE ON	+ 4 %	+ 2 %	+ 4 %	−400 ft
TOTAL ANTI ICE ON	+ 10 %	+ 10 %	+ 10 %	−1400 ft

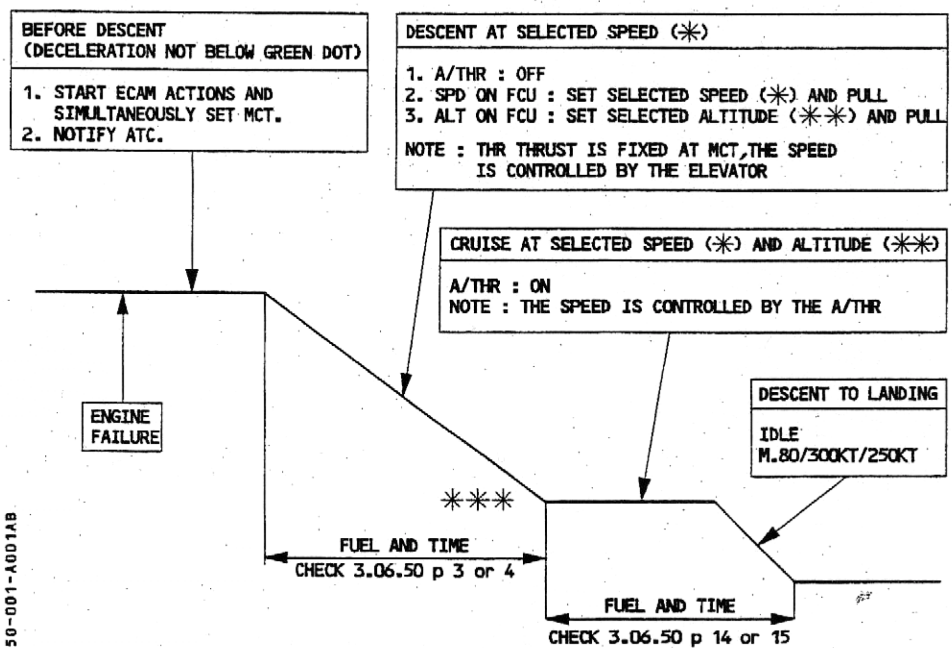
10E -08F0A330-301 CF6-80E1A2 23500010C6KG300 0 018590 0 0 3 .0 .0 .00 0 02 0 02 1.000 1.000 .000 0 FCOM-G0-03-06-40-003-010

A330 FLIGHT CREW OPERATING MANUAL	SINGLE ENGINE OPERATIONS	3.06.50	P 1
	FIXED SPEED STRATEGIES	SEQ 001	REV 06

PROCEDURE

This section provides single engine performance data for two fixed speed diversion strategies (fixed descent and cruise speed schedules) recommended for ETOPS operation, provided that the requirements set forth in section 3.06.10, GENERAL, are complied with.

R



✳ USE M.82/330KT OR M.82/310KT AS ESTABLISHED BEFORE DISPATCH.

✳✳ SET 17000 feet OR VALUE ESTABLISHED BEFORE DISPATCH.

✳✳✳ IF V/S BECOMES < 500 feet/minute SELECT V/S MODE.

GFC5-03-0650-001-A001AB

A330 FLIGHT CREW OPERATING MANUAL	SINGLE ENGINE OPERATIONS	3.06.50	P 5
	FIXED SPEED STRATEGIES	SEQ 010	REV 06

R

CRUISE - MCT/330KT - 1 ENGINE OUT

MAX. CONTINUOUS THRUST PACK FLOW HI ANTI-ICING OFF	ISA CG=30.0%	N1 (%) KG/H NM/1000KG	MACH IAS (KT) TAS (KT)

WEIGHT (1000KG)	FL100		FL130		FL140		FL150		FL160		FL170		FL180		FL190	
130	98.0	.594	100.4	.627	101.2	.638	102.3	.650	103.3	.662	103.6	.667	103.6	.668	103.5	.668
	6969	330	7062	330	7093	330	7146	330	7201	330	7051	326	6801	320	6557	314
	54.4	379	56.0	396	56.6	401	57.0	407	57.4	413	58.8	415	60.8	413	62.8	412
140	98.2	.594	100.6	.627	101.5	.638	102.6	.650	103.6	.662	103.7	.664	103.6	.664	103.5	.664
	7024	330	7120	330	7151	330	7216	330	7264	330	7046	325	6795	318	6550	312
	54.0	379	55.6	396	56.1	401	56.4	407	56.9	413	58.6	413	60.5	411	62.5	409
150	98.4	.594	100.9	.627	101.8	.638	102.9	.650	103.8	.660	103.7	.660	103.7	.659	103.6	.658
	7088	330	7187	330	7220	330	7299	330	7291	329	7038	323	6788	316	6541	309
	53.5	379	55.1	396	55.6	401	55.8	407	56.5	412	58.3	410	60.1	408	62.1	406
160	98.7	.594	101.2	.627	102.2	.638	103.4	.650	103.8	.656	103.8	.655	103.8	.654	103.7	.652
	7168	330	7270	330	7315	330	7400	330	7281	327	7030	320	6779	313	6531	306
	52.9	379	54.4	396	54.9	401	55.0	407	56.2	409	57.9	407	59.7	405	61.6	402
170	99.1	.594	101.6	.627	102.7	.638	103.7	.648	103.9	.650	103.9	.649	103.8	.648	103.8	.645
	7257	330	7364	330	7425	330	7461	329	7270	324	7021	317	6770	310	6522	303
	52.2	379	53.7	396	54.1	401	54.4	406	55.8	406	57.5	404	59.2	401	61.0	398
180	99.4	.594	102.0	.627	103.2	.638	103.8	.643	104.0	.645	104.0	.644	103.9	.641	103.9	.638
	7355	330	7465	330	7545	330	7451	326	7260	321	7013	314	6762	307	6513	300
	51.5	379	53.0	396	53.2	401	54.1	403	55.4	402	57.0	400	58.7	397	60.4	394
190	99.8	.594	102.5	.627	103.6	.636	103.8	.638	104.0	.639	104.1	.637	104.0	.634	104.0	.629
	7460	330	7588	330	7622	329	7439	323	7248	318	7005	311	6753	303	6503	295
	50.8	379	52.1	396	52.5	400	53.7	399	55.0	399	56.5	396	58.1	392	59.7	388
200	100.3	.594	103.1	.627	103.6	.630	103.9	.631	104.1	.632	104.2	.629	104.2	.625	104.2	.618
	7577	330	7728	330	7609	326	7426	320	7237	314	6996	307	6743	299	6487	289
	50.0	379	51.2	396	52.1	396	53.2	395	54.5	394	55.9	391	57.4	387	58.7	381
210	100.7	.594	103.4	.623	103.7	.624	103.9	.624	104.2	.624	104.3	.620	104.3	.613	104.4	.604
	7702	330	7768	328	7594	322	7412	316	7223	310	6985	302	6727	293	6469	283
	49.2	379	50.6	393	51.6	392	52.8	391	53.9	389	55.2	385	56.4	380	57.5	372
220	101.2	.594	103.4	.616	103.7	.616	104.0	.615	104.3	.614	104.5	.609	104.6	.598	104.6	.579
	7829	330	7750	324	7576	318	7395	312	7206	305	6972	297	6707	286	6412	271
	48.4	379	50.2	389	51.1	387	52.1	385	53.2	383	54.3	378	55.2	370	55.7	357

ENGINE ANTI-ICE ON	TOTAL ANTI-ICE ON
ΔFUEL = + 1.5 %	ΔFUEL = + 3.5 %

10B -08F0A330-301 CF6-80E1A2 12300010C6KG300 0 018590 0 0 3 1.0 .0 .00 0 01100.000 .000 .000 0 FCOM-G0-03-06-50-006-010

A330 FLIGHT CREW OPERATING MANUAL	SINGLE ENGINE OPERATIONS	3.06.50	P 9
	FIXED SPEED STRATEGIES	SEQ 010	REV 06

R

CRUISE - MCT/310KT - 1 ENGINE OUT

MAX. CONTINUOUS THRUST PACK FLOW HI ANTI-ICING OFF	ISA CG=30.0%	N1 (%) KG/H NM/1000KG	MACH IAS (KT) TAS (KT)

WEIGHT (1000KG)	FL100		FL150		FL160		FL170		FL180		FL190		FL200		FL210	
130	94.8	.559	98.7	.612	99.6	.623	100.5	.635	101.6	.647	102.7	.659	103.4	.668	103.5	.670
	6125	310	6219	310	6247	310	6273	310	6335	310	6378	310	6314	308	6134	303
	58.2	357	61.7	383	62.3	389	62.9	395	63.2	401	63.8	407	65.0	410	66.8	410
140	95.1	.559	99.1	.612	100.0	.623	100.9	.635	102.1	.647	103.2	.659	103.5	.663	103.6	.664
	6194	310	6298	310	6327	310	6359	310	6433	310	6465	310	6306	305	6122	300
	57.6	357	60.9	383	61.5	389	62.1	395	62.3	401	62.9	407	64.5	407	66.4	406
150	95.4	.559	99.5	.612	100.4	.623	101.4	.635	102.7	.647	103.6	.658	103.5	.657	103.7	.657
	6274	310	6388	310	6418	310	6467	310	6538	310	6541	309	6297	303	6108	297
	56.8	357	60.0	383	60.6	389	61.1	395	61.3	401	62.1	406	64.1	403	65.8	402
160	95.8	.559	99.9	.612	100.8	.623	102.0	.635	103.2	.647	103.7	.652	103.6	.650	103.8	.649
	6363	310	6487	310	6517	310	6587	310	6643	310	6531	306	6287	299	6093	293
	56.0	357	59.1	383	59.7	389	59.9	395	60.3	401	61.6	402	63.5	399	65.2	397
170	96.2	.559	100.4	.612	101.4	.623	102.7	.635	103.8	.647	103.8	.645	103.8	.642	103.9	.641
	6460	310	6596	310	6641	310	6717	310	6757	310	6522	303	6277	296	6080	289
	55.2	357	58.1	383	58.6	389	58.8	395	59.3	401	61.0	398	62.9	395	64.5	392
180	96.6	.559	100.9	.612	102.1	.623	103.3	.635	103.9	.641	103.9	.638	103.9	.633	104.1	.630
	6566	310	6714	310	6780	310	6843	310	6762	307	6513	300	6266	291	6064	284
	54.3	357	57.1	383	57.4	389	57.7	395	58.7	397	60.4	394	62.1	389	63.6	385
190	97.1	.559	101.6	.612	102.8	.623	103.9	.635	104.0	.634	104.0	.629	104.1	.622	104.3	.616
	6680	310	6849	310	6924	310	6970	310	6753	303	6503	295	6252	286	6044	278
	53.4	357	56.0	383	56.2	389	56.6	395	58.1	392	59.7	388	61.2	382	62.4	377
200	97.6	.559	102.2	.612	103.5	.623	104.2	.629	104.2	.625	104.2	.618	104.3	.609	104.5	.598
	6802	310	6997	310	7064	310	6996	307	6743	299	6487	289	6234	279	6012	269
	52.4	357	54.8	383	55.1	389	55.9	391	57.4	387	58.7	381	60.0	374	60.8	366
210	98.2	.559	103.0	.612	104.2	.623	104.3	.620	104.3	.613	104.4	.604	104.5	.586	104.7	.556
	6940	310	7168	310	7218	310	6985	302	6727	293	6469	283	6185	269	5891	249
	51.4	357	53.5	383	53.9	389	55.2	385	56.4	380	57.5	372	58.2	360	57.8	340
220	98.8	.559	103.8	.612	104.3	.614	104.5	.609	104.6	.598	104.6	.579	104.8	.539		
	7087	310	7333	310	7206	305	6972	297	6707	286	6412	271	6062	247		
	50.3	357	52.3	383	53.2	383	54.3	378	55.2	370	55.7	357	54.7	331		

ENGINE ANTI-ICE ON	TOTAL ANTI-ICE ON
ΔFUEL = + 1.5 %	ΔFUEL = + 3.5 %

10B -08F0A330-301 CF6-80E1A2 12300010C6KG300 0 018590 0 0 3 1.0 .0 .00 0 01100.000 .000 .000 0 FCOM-G0-03-06-50-010-010

e) Adequate airports list

For the listed adequate airports are given the name of the city, the three (IATA) and four (ICAO) letters code and reference to a note mentioned at the bottom of the list.

- ***North Atlantic and Caribbean Area***

Airport	Code		Note
• *Europe*			
Asturias	OVD	(LEAS)	
Bergen	BGO	(ENBR)	
Bodo	BOO	(ENBO)	
Brest	BES	(LFRB)	
Cork	ORK	(EICK)	
Glasgow	GLA	(EGPF)	
Lisbon	LIS	(LPPT)	
Porto	OPO	(LPPR)	
Santiago	SCQ	(LEST)	
Shannon	SNN	(EINN)	
Stornoway	SYY	(EGPO)	
• *Iceland/Greenland*			
Akureyri	AEY	(BIAR)	(1)
Egilsstadir	EGS	(BIEG)	(2)
Keflavik	KEF	(BIKF)	
Narssassuaq	UAK	(BGBW)	(3)
Reykjavik	REK	(BIRK)	(4)
Sondre Stromfjord	SFJ	(BGSF)	
Thule	THU	(BGTL)	(5)
• *Mid Atlantic*			
Ascension Island	ASC	(FHAW)	(6)
Llha do Sal	SID	(GVAC)	
Lajes/Terceira	TER	(LPLA)	
Las Palmas	LPA	(GCLP)	
Ponta Deegada	PDL	(LPPD)	
Santa Maria	SMA	(LPAZ)	

Airport	Code	Note
• *Canada/US*		
Bangor	BGR	(KBGR)
Gander	YQX	(CYQX)
Goose Bay	YYR	(CYYR)
Halifax	YHZ	(CYHZ)
Iqaluit	YFB	(CYFB)
Resolute	YRB	(CYRB)
St Johns	YYT	(CYYT)
Stephenville	YJT	(CYJT)
Sydney (Nova Scotia)	YQY	(CYQY)
• *Carribean*		
Antigua	ANU	(TAPA)
Barbados	BGI	(TBPB)
Barranquilla	BAQ	(SKBQ)
Bermuda	BDA	(TXKF)
Havana	HAV	(MUHA)
Kingston	KIN	(MKJP)
Nassau	NAS	(MYNN)
Panama City	PTY	(MPTO)
San Jose	SJO	(MROC)
San Juan	SJU	(TJSJ)
Villahermosa	VSA	(MMVA)

- ***South America and South Atlantic***

Airport	Code	Note	
• *Mainland*			
Antofagasta	ANF	(SCFA)	
Buenos Aires	EZE	(SAEZ)	
Caracas	=MP	(SVMP)	
Cayenne	CAY	(SOCA)	
Georgetown	GEO	(SYCJ)	
Fortaleza	FOR	(SBFZ)	
Lima	LIM	(SPIM)	
Natal	NAT	(SBNT)	
Quito	UIO	(SEQU)	
Rio de Janeiro	GIG	(SBGL)	
Rio Gallegos	RGL	(SAWG)	
Santiago	SCL	(SCEL)	
Temuco	ZCO	(SCTC)	
Ushuaia	USH	(SAWH)	
• *Islands*			
Mount Pleasant	MPN	(EGYP)	(7)

- ***Africa***

Airport	Code	Note
• *Mainland*		
Addis Ababa	ADD	(HAAB)
Aswan	ASW	(HESN)
Bangui	BGF	(FEFF)
Benghazi	BEN	(HLLB)
Cairo	CAI	(HECA)
Casablanca	CAS	(GMMC)
Conakry	CKY	(GUCY)
Cape Town	CPT	(FACT)
Dakar	DKR	(GOOY)
Djibouti	JIB	(HDAM)
Entebbe	EBB	(HUEN)
Ghardaia	GHA	(DAUG) (8)
Harare	HRE	(FVHA)
Johannesburg	JNB	(FAJS)
Khartoum	KRT	(HSSS)
Kinshasa	FIH	(FZAA)
Lilongwe	LLW	(FWLI)
Luanda	LAD	(FNLU)
Lusaka	LUN	(FLLS)
Mogadishu	MGQ	(HCMM)
Mombasa	MBA	(HKMO)
Nairobi	NBO	(HKJK)
N'Djamena	NDJ	(FTTJ)
Ouagadougou	OUA	(DFFD)
Port Harcourt	PHC	(DNPO)
Tamarasset	TMR	(DAAT)
Windhoek	WDH	(FYWH)
• *Islands*		
Antananarivo	TNR	(FMMI)
Mauritius	MRU	(FIMP)
Moroni	HAH	(FMCH)
Seychelles	SEZ	(FSIA)

- ***Indian Ocean and Asia***

Airport	Code		Note
• *Arabian Sea/Bay of Bengal*			
Bombay	BOM	(VABB)	
Dhaka	DAC	(VGZR)	
Diego Garcia	DIG		(9)
Calcutta	CCU	(VECC)	
Cocos Islands	CCK	(YPCC)	
Colombo	CMB	(VCBI)	
Karachi	KHI	(OPKC)	
Male	MLE	(VRMM)	
Muscat	MCT	(OOMS)	
Salalah	SLL	(OOSA)	
• *Asia*			
Banda Aceh	BTJ	(WITT)	
Bangkok	BKK	(VTBD)	
Biak	BIK	(WABB)	
Car Nicobar	CBD	(VOCX)	(10)
Davao	DVO	(RPMD)	
Hanoi	HAN	(VVNB)	
Hochiminh City	SGN	(VVTS)	
Kagoshima	KOJ	(RJFK)	
Manado	MDC	(WAMM)	
Manila	MNL	(RPLL)	
Medan	MES	(WIMM)	
Port Moresby	POM	(AYPY)	
Sandakan	SDK	(WBKS)	
Sapporo	CTS	(RJCC)	
Tainan	TNN	(RCNN)	

- ***Australia and New Zeeland***

Airport	Code		Note
• *Australia*			
Adelaide	ADL	(YPAD)	
Alice Springs	ASP	(YBAS)	
Brisbane	BNE	(YBBN)	
Cairns	CNS	(YBCS)	
Darwin	DRW	(YPDN)	
Forrest	FOS		(11)
Hobart	HBA	(YMHB)	
Kalgoorlie	KGI	(YPKG)	(12)
Learmonth	LEA	(YPLM)	
Melbourne	MEL	(YMML)	
Mount Isa	ISA	(YBMA)	
Perth	PER	(YPPH)	
Sydney	SYD	(YSSY)	
Townsville	TSV	(YBTL)	
• *New Zealand*			
Auckland	AKL	(NZAA)	
Christchurch	CHC	(NZCH)	
Wellington	WLG	(NZWN)	

- ***Pacific Ocean***

Airport	Code	Note	
• *North American coast*			
Anchorage	ANC	(PANC)	
Cold Bay	CDB	(PACD)	
Guadalajara	GDL	(MMGL)	
Juneau	JNU	(PAJN)	
Los Angeles	LAX	(KLAX)	
La Paz (Mexico)	LAP	(MMLP)	
Portland	PDX	(KPDX)	
Sacramento	SMF	(KSMF)	
Vancouver	YVR	(CYVR)	
• *Islands*			
Apia	APW	(NSFA)	
Canton Island	CIS		
Christmas Island	CXI	(PLCH)	(13)
Guam	NGM		
Hao	HOI	(NTTO)	
Hilo	ITO	(PHTO)	
Honiara	HIR	(AGGH)	
Honolulu	HNL	(PHNL)	
Johnston Atoll	JON	(PJON)	(14)
Majuro Atoll	MAJ	(PKMJ)	
Midway	MDY	(PMDY)	(15)
Nauru	INU		
Noumea	NOU	(NWWW)	
Papeete	PPT	(NTAA)	
Shemya	SYA	(PASY)	
Suva	SUV		
Wake Island	AWK	(PWAK)	(16)

- ***Ex. URSS***

Airport	Code	Note
• *Armenia*		
Yerevan	EVN	(UGEE)
• *Azerbaijan*		
Baku	BAK	(UBBB)
• *Byelorussia*		
Minsk	MSQ	(UMMS)
• *Estonia*		
Tallinn	TLL	(EETN)
• *Georgia*		
Sukhumi	SUI	(UGSS)
Tbilisi	TBS	(UGGG)
• *Kazakhstan*		
Aktyubinsk	AKX	(UATT)
Alma-Alta	ALA	(UAAA)
• *Kirgyzstan*		
Bishkek	FRU	(UAFM)
• *Latvia*		
Riga	RIX	(EVRA)
• *Lithuania*		
Vilnius	VNO	(EYVI)
• *Moldova*		
Kishinev	KIV	(LUKK)

Airport	Code	Note
• *Russia*		
Bratsk	BTK	(UIBB)
Chita	HTA	
Irkutsk	IKT	(UIII)
Kazan	KZN	(UWKD)
Khabarovsk	KHV	(UHHH)
Magadan	GDX	(UHMM)
Mineralnye Vody	MRV	(URMM)
Moscow	SVO	(UUEE)
Moscow	VKO	(UUWW)
Murmansk	MMK	(ULMM)
Novosibirsk	OVB	(UNNT)
Petropavlovsk-Kam	PKC	(UHPP)
Petrozavodsk	PES	(ULPB)
Providenia Bay	PVS	(UHMD)
Rostov-na-Donu	ROV	(URRR)
Samara	KUF	(UWWW)
St Petersburg	LED	(ULLI)
Syktyvkar	SCW	(UUYY)
Ulan-Ude	UUD	
Yakutsk	YKS	(UEEE)
Yuzhno-Sakhalinsk	UUS	(UHSS)
• *Tajikistan*		
Dushanbe	DYU	(UTDD)
• *Turkmenistan*		
Ashkhabad	ASB	(UTAA)
• *Ukraine*		
Kiev	KBP	(UKBB)
Lvov	LWO	(UKLL)
Odessa	ODS	(UKOO)
• *Uzbekistan*		
Samarkand	SKD	(UTSS)
Tashkent	TAS	(UTTT)

Notes

1 - *Akureyri*

On the northern coast of Iceland. Used as a domestic alternate for Keflavik by Icelandair, although the normal international alternate is Glasgow.

2 - *Egilsstadir*

This airfield is to be upgraded in the future.

3 - *Narssassuaq*

The UK CAA have declared this airport to be inadequate as an ETOPS alternate. However, it has been checked adequate in terms of performance by an A310 operator.

4 - *Reykjavik*

The domestic airport. The international airport for the city, and the one commonly used as an ETOPS alternate, is Keflavik.

5 - *Thule*

A US military base subject to inclement weather.

6 - *Ascension Island*

A British military base used as a staging post to the Falklands, but it has been used for ETOPS.

7 - *Mount Pleasant*

Normally a military field, better than Port Stanley.

8 - *Ghardaia*

Concerns have been raised about the practical inconvenience of using this remote airfield.

9 *Diego Garcia*

A military base but it has been used as an ETOPS alternate.

10 - *Car Nicobar*

An Indian military base. This airfield closes a 60-minute gap in the Indian ocean. However, permission to use it must be obtained from the Authorities of India.

11 - Forrest

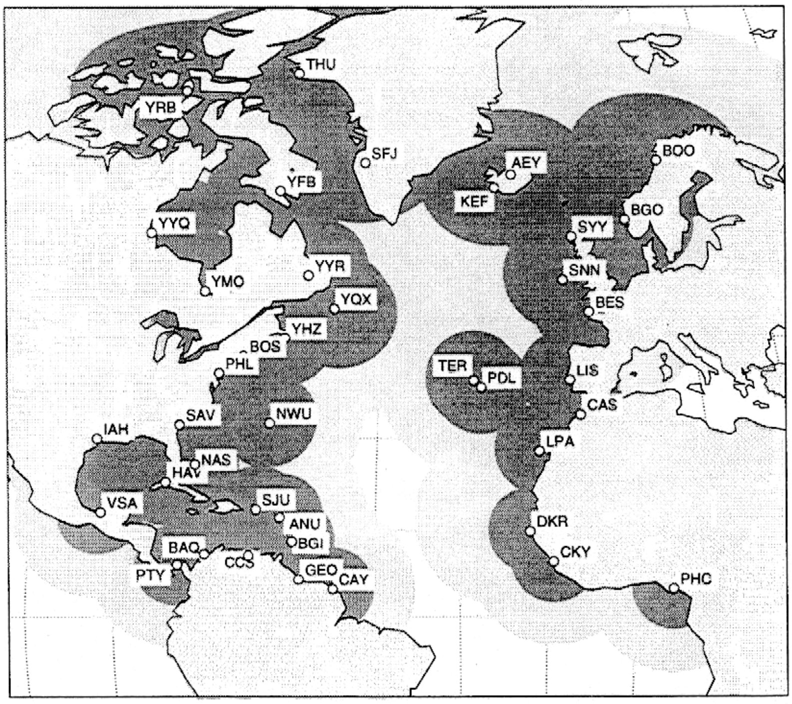
The facilities and runway strength are below the standards most authorities would accept, but twin-engined operators in Australia have been given special dispensation in the absence of ETOPS capable aircraft. The AIP gives this cryptic warning: "Beware of kangaroos on movement area"!

12 - Kalgoorlie

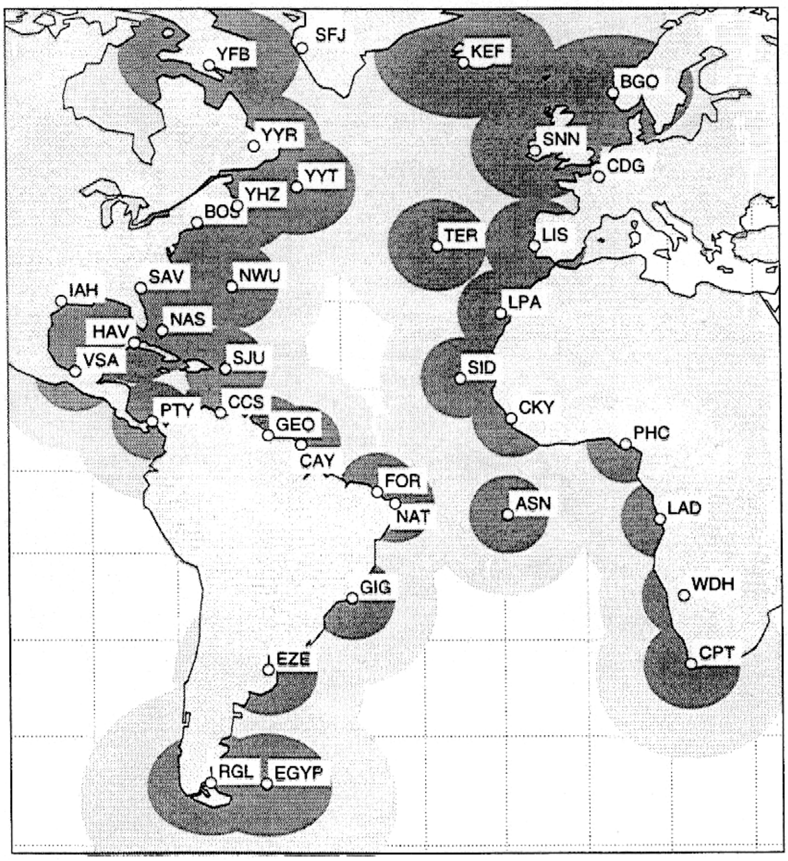
Would not normally be considered, except in dire need. Without this airfield and Forrest, there is a gap between Perth and Adelaide.

13
to
16 - Pacific islands

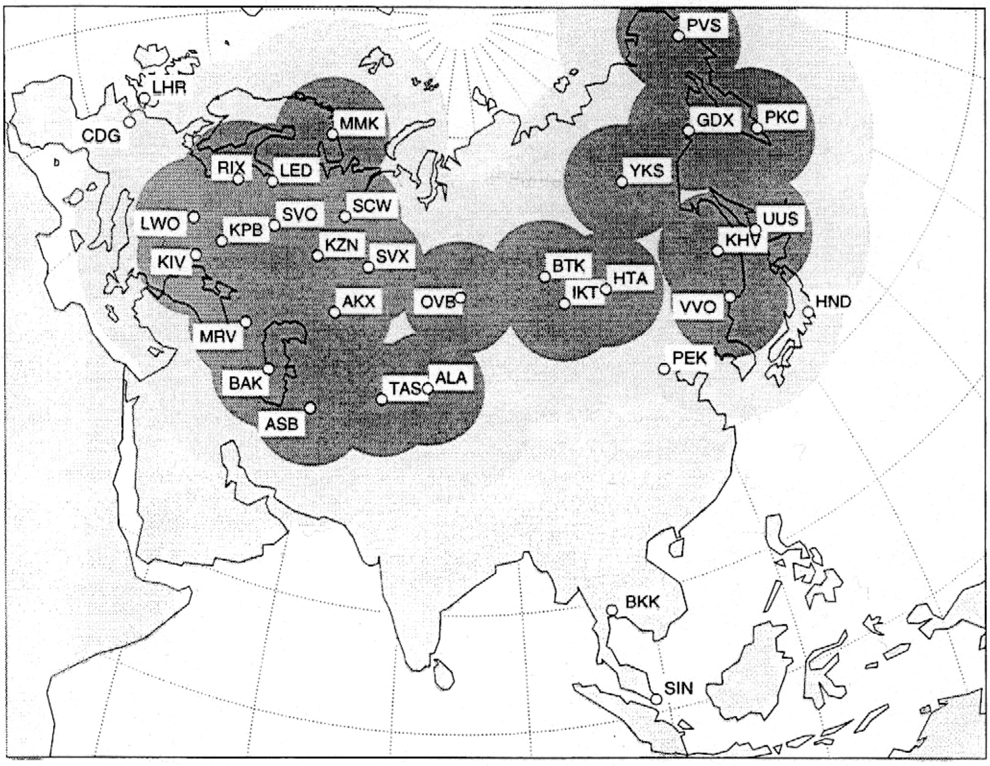
These airfields are darkly labeled "Prior permission required" and must therefore be considered as last resort.



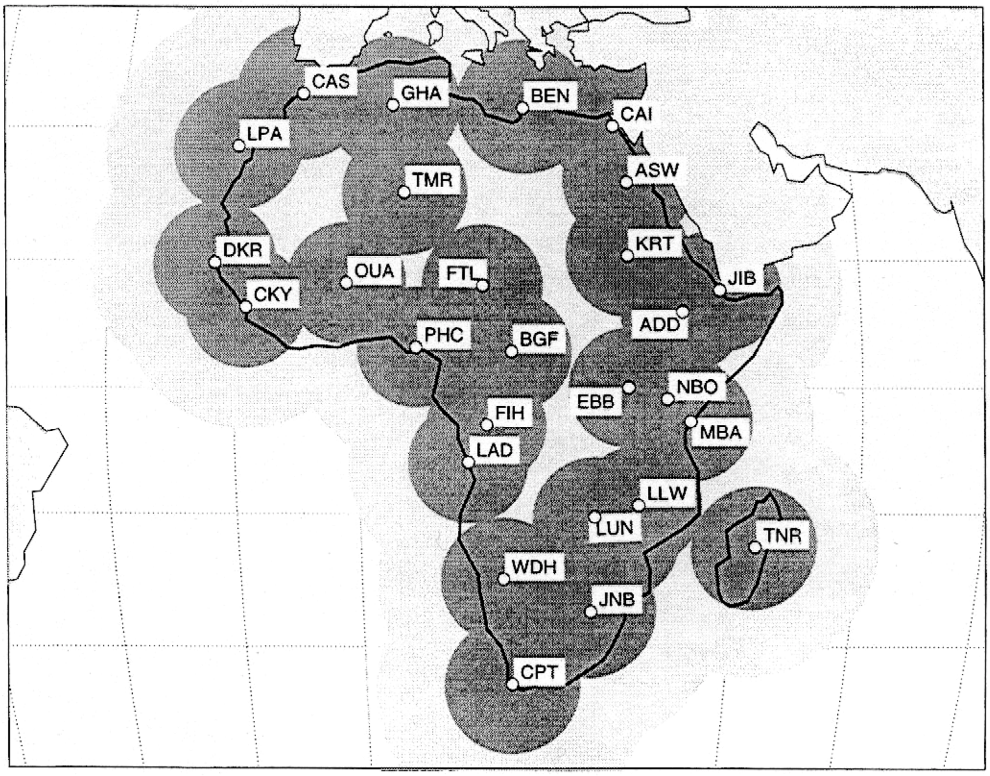
North Atlantic diversion airfields



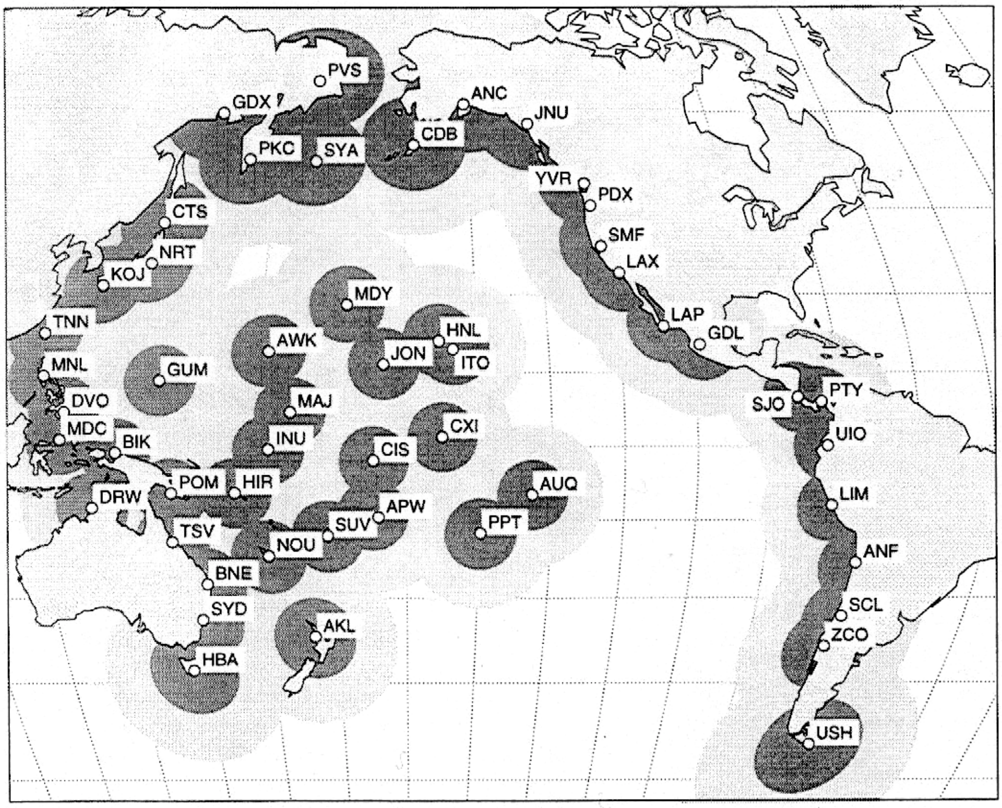
Atlantic Ocean diversion airfields



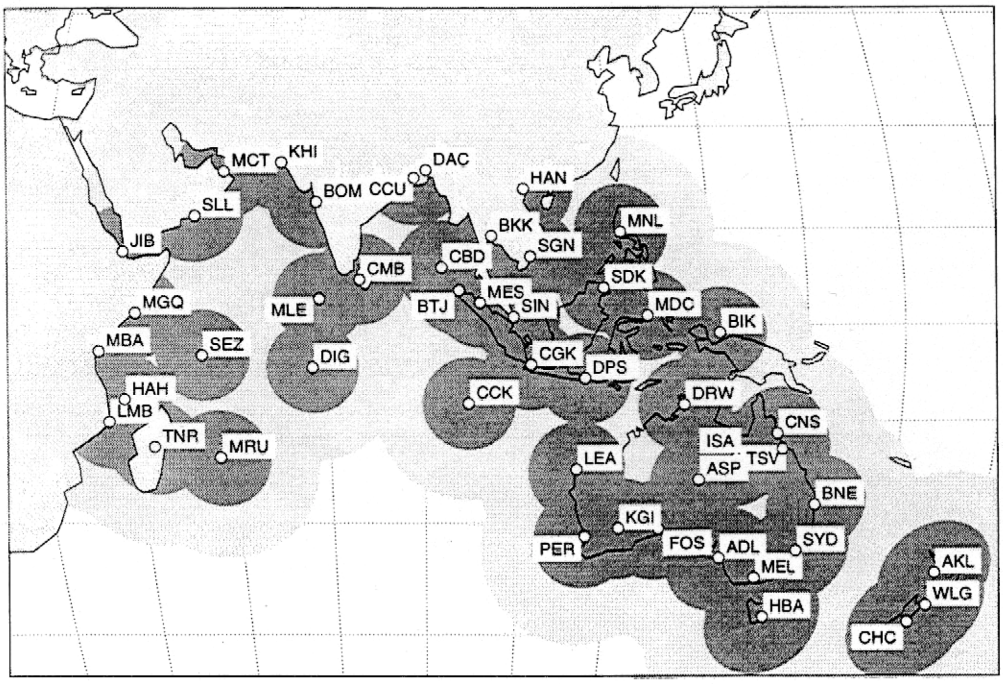
Ex-URSS diversion airfields



Africa diversion airfields



Pacific Ocean diversion airfields



Indian Ocean & Australasia diversion airfields

Chapter 5

1 - INTRODUCTION

The operator must ensure that each aircraft approved for ETOPS is correctly operated and supported in accordance with the terms of the ETOPS Operational Approval.

Dispatching an ETOPS flight is basically processed as a normal flight but with some additional specific aspects related to ETOPS operations.

The success of the ETOPS operations is essentially dependent on the quality of the flight preparation. Therefore, a successful ETOPS flight preparation is achieved by collecting, processing and transmitting to the flight crew all relevant information to safely and economically conduct the flight. Dispatchers and flight crew should then work in close coordination.

The following paragraph describes the tasks assigned to the dispatcher.

2 - DISPATCH REQUIREMENTS

a) Dispatch limitations

As early as possible, the dispatcher should be aware of all information which could result in operational limitations. This information will then be transmitted to the flight crew.

Therefore, it is necessary that the maintenance department issues an ETOPS release statement for each aircraft to be operated, to inform the dispatcher and the crew on the aircraft status with regard to the CMP document at the latest revision. Depending on the maintenance report, the airline's maximum diversion time may be reduced for any technical reason. In such an occurrence a flight plan re-routing may have to be considered.

Also, MEL and CDL (Configuration Deviation List) items can introduce dispatch requirements and / or limitations (e.g. additional fuel factors).

Thus, the availability of all relevant information to the dispatch office must be assured without delay in order to avoid re-routing the flight at the last minute whenever limitations are effective.

Therefore, to ensure the success of the ETOPS operations an appropriate coordination between the dispatch and maintenance groups is of paramount importance.

A330 FLIGHT MANUAL	APPENDICES AND SUPPLEMENTS	6.01.57 P 02	
	CONFIGURATION DEVIATION LIST	24 JUN 97	REF 01

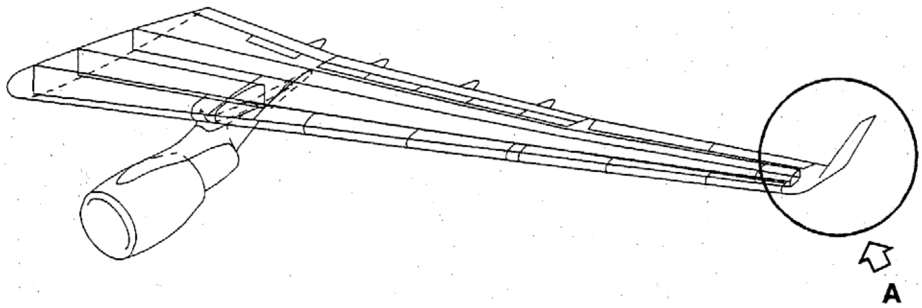
DGAC APPROVED

57. WINGS

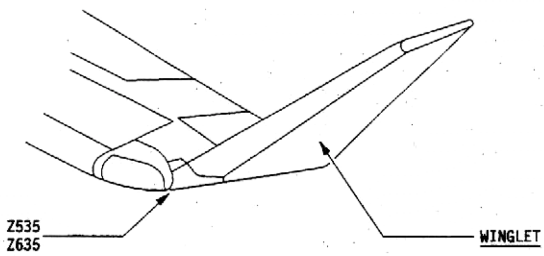
2. WINGLET	2	(m) One may be missing provided hole is covered. Increase fuel consumption by 1 %. Reduce the take-off and approach climb limiting weight by 4 %. R The maximum zero fuel weight must not be higher than 152 tonnes (335 100 lb). R The maximum takeoff weight must not be higher than 200 tonnes (44 920 lb).

FOR INFORMATION ONLY

Refer to AMM 57-31-00



A



60FM-06-0157-002-A001AA

A330 CDL example

b) Suitable airports determination

One of the distinguishing features of ETOPS operations is the concept of a "suitable" airport which should apply to the required "adequate" en-route alternate airports for ensuring the feasibility of the intended route for a given flight. An en-route adequate airport is declared as suitable when:

- weather forecasts for this airport are better than the ETOPS required dispatch weather minima for a defined period of time as explained in Chapter 4,
- applicable NOTAMs ensure that the required en-route alternate airport is and will remain available (no reduction in ground services, runway availability, let-down aids, etc.) for the same time period,
- surface crosswind forecast and runway conditions are within acceptable limits to allow a safe approach and landing with one engines inoperative.

For certain routes, the departure and/or destination airports are considered as ETOPS en-route alternate airports. This requires that they must meet the above conditions to be declared as suitable.

Therefore, when the suitability of a required en-route alternate airport is not ensured, the ETOPS flight may not be possible unless either redundant suitable airports are available or a modification of the routing is done accordingly. Then, an ETOPS flight can be dispatched, provided that sufficient suitable airports are declared to cover the intended area of operation.

3 - FLIGHT CREW DOCUMENTATION

During the flight preparation, the dispatcher (or dispatch office) will collect and process relevant information which will be presented to the flight crew under the following documents.

a) Computerized Flight Plan

As ETOPS flights are in general long flights, flight crews should be provided with a Computerized Flight Plan (CFP), referred to as Reference Flight Log (RFL), established with forecast en-route winds and temperatures. Detailed information and recommendations regarding the CFP format are provided in the previous chapter.

b) Navigation charts

In addition to the usual navigation documents, the dispatch office should provide the flight crews with navigation charts clearly defining the ETOPS area of operations by drawing the relevant circles centred on the suitable airports declared for the particular flight and by hatching the non-authorized areas. The aircraft routing will be traced as well as the ETOPS Entry Point (EEP), the Equitime Points (ETP) and the Critical Point (CP) considering the prevailing wind conditions. The position of ETPs based on current winds forecast is given either by the CFP or using a manual wind correction method.

c) Weather dossier

The dispatch office must provide the crew with relevant weather information:

- TAF (Terminal Airport Forecast) and METAR (observed weather report) for destination, destination alternate and en-route alternate airports, the TAF should be valid for the required window of suitability in accordance with the CFP,
- significant weather charts which provide synoptic weather information and forecast (e.g. turbulence and icing conditions),
- wind and temperature forecast charts for FL 100, for the typical single-engine cruise altitude and for normal cruise flight levels.

4 - FLIGHT CREW PREPARATION

The flight crew will review the flight documentation which should include:

- NOTAMs for departure, destination, destination alternate and ETOPS en-route alternate airports,
- meteorological forecast and reports for the same airports and en-route wind and temperature forecast,
- ATC flight plan,
- any particular diversion strategy specific to the route (minimum time, obstacle clearance, etc.),
- CFP, which usually include all the above items,
- navigation and plotting charts with ETOPS relevant information,
- any other documents (i.e. airport, route, area briefings, etc.) as per company practices.

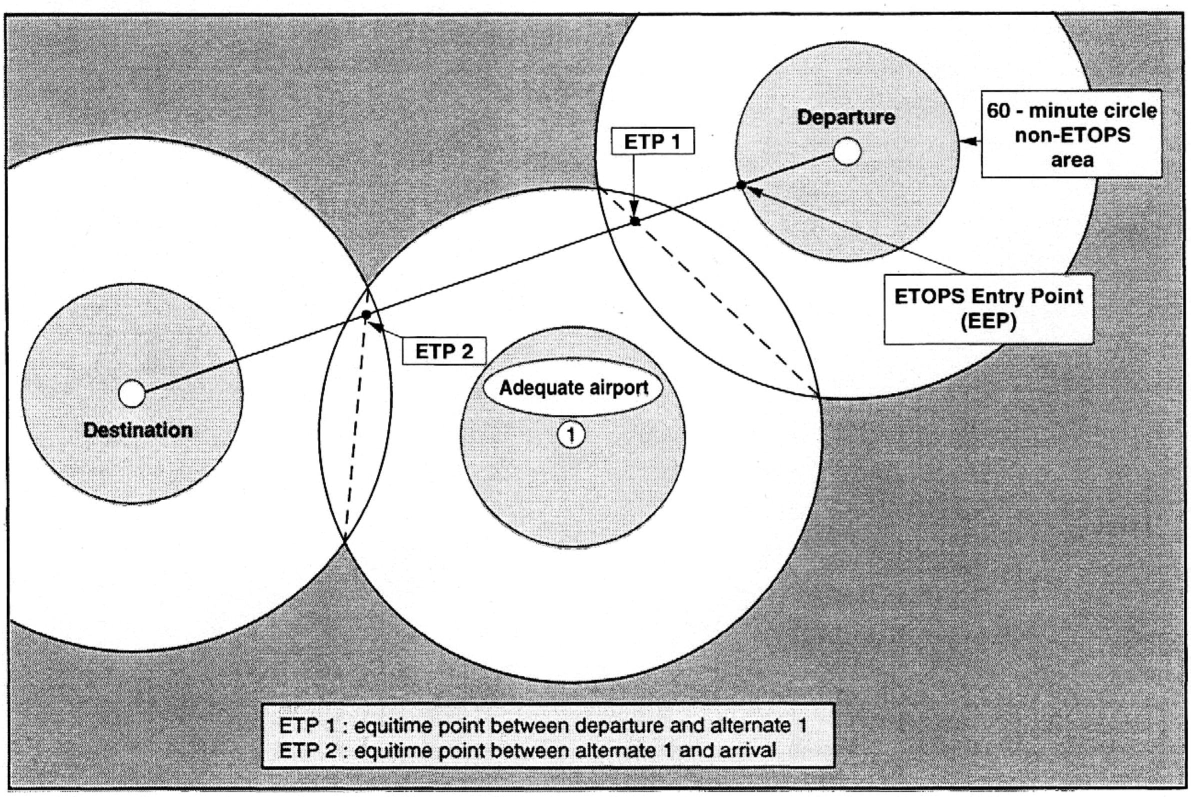
CFP fuel and time predictions are in general very accurate; however, it is the duty of the crew to perform the following checks to detect any possible gross error:

- conformity of the CFP routing with ATC flight plan,
- type of aircraft, date, estimated time of departure (ETD), estimated ZFW/ TOW/FOB,
- wind data compared to en-route MET forecast,
- trip fuel, fuel to alternate, ETOPS fuel from ETPs to en-route alternates compared to FCOM (including performance factor).

5 - LOCATION OF ETOPS ETPs

a) No-wind conditions

In no-wind conditions, the ETOPS ETPs between two alternate airports can be geometrically determined. It is the intersection point between the route and the chord of the arcs generated by the overlap of the two circles centred on the two considered alternate airports. The following figure illustrates the above statement.



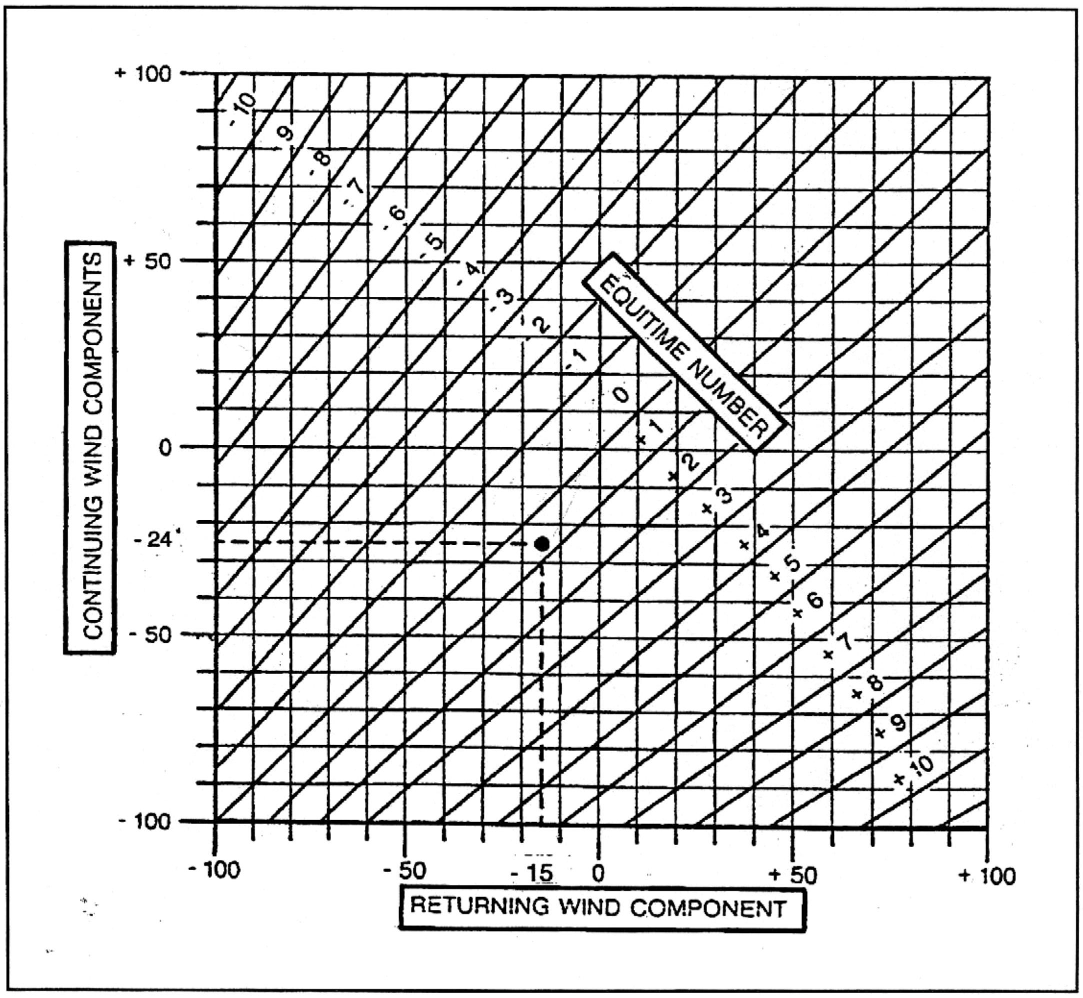
Equitime Point location,no wind

b) Wind condition

In wind conditions, the ETPs position must be corrected by the wind effect.

The "equitime graph" (graph valid for a given TAS) provided below can be used to determine the on-track ETP between two alternate airports located either on- or off-track. The following data are necessary to use the method:

- distance between these two diversion airports (in NM),
- wind component from the on-track midpoint (no wind) to the continuing alternate airport (continuing wind component),
- wind component from the on-track midpoint (no wind) to the returning airport (returning wind component).



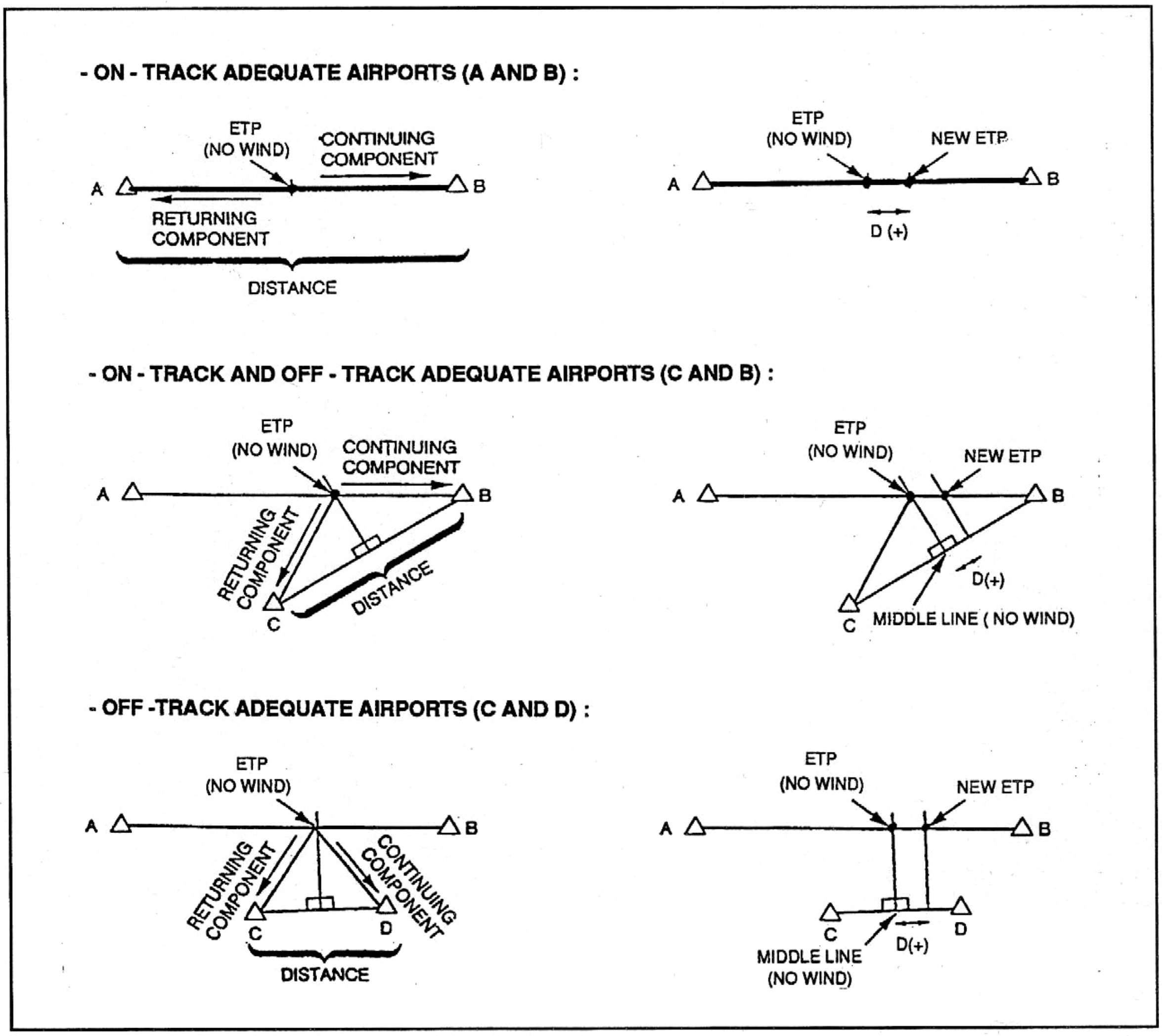
Equitime graph (given TAS)

Procedure:

1) Using the equitime graph, determine the corresponding "equitime number", considering the continuing and returning wind components.

2) Take 1% of the distance between the two suitable diversion airports and multiply this value by the equitime number. The result (in NM) will give the distance D to be used to correct the no-wind ETP for the wind effect (D can be either positive or negative).

3) Apply the D correction on the map, as shown on the following figure. The new ETP position is then determined.



Wind effect for ETP location

ETP positions are defined to serve two purposes:

- in-flight use, for diversion decision-making,
- dispatch use, for computation of the diversion fuel.

The computation of the diversion fuel being the most critical aspect, it is proposed to use the TAS at the diversion speed schedule and altitude to locate the ETPs.

Usually, this TAS will be the TAS corresponding to the selected one-engine-out diversion speed at FL 100, this scenario being usually the critical fuel scenario.

c) Example: Critical Point (CP) location in wind conditions

For the route Paris / Fort-de-France (French West Indies), the CP is the ETP between Bermuda and Fort-de-France (which is, in that case, the destination airport and the last en-route alternate airport).

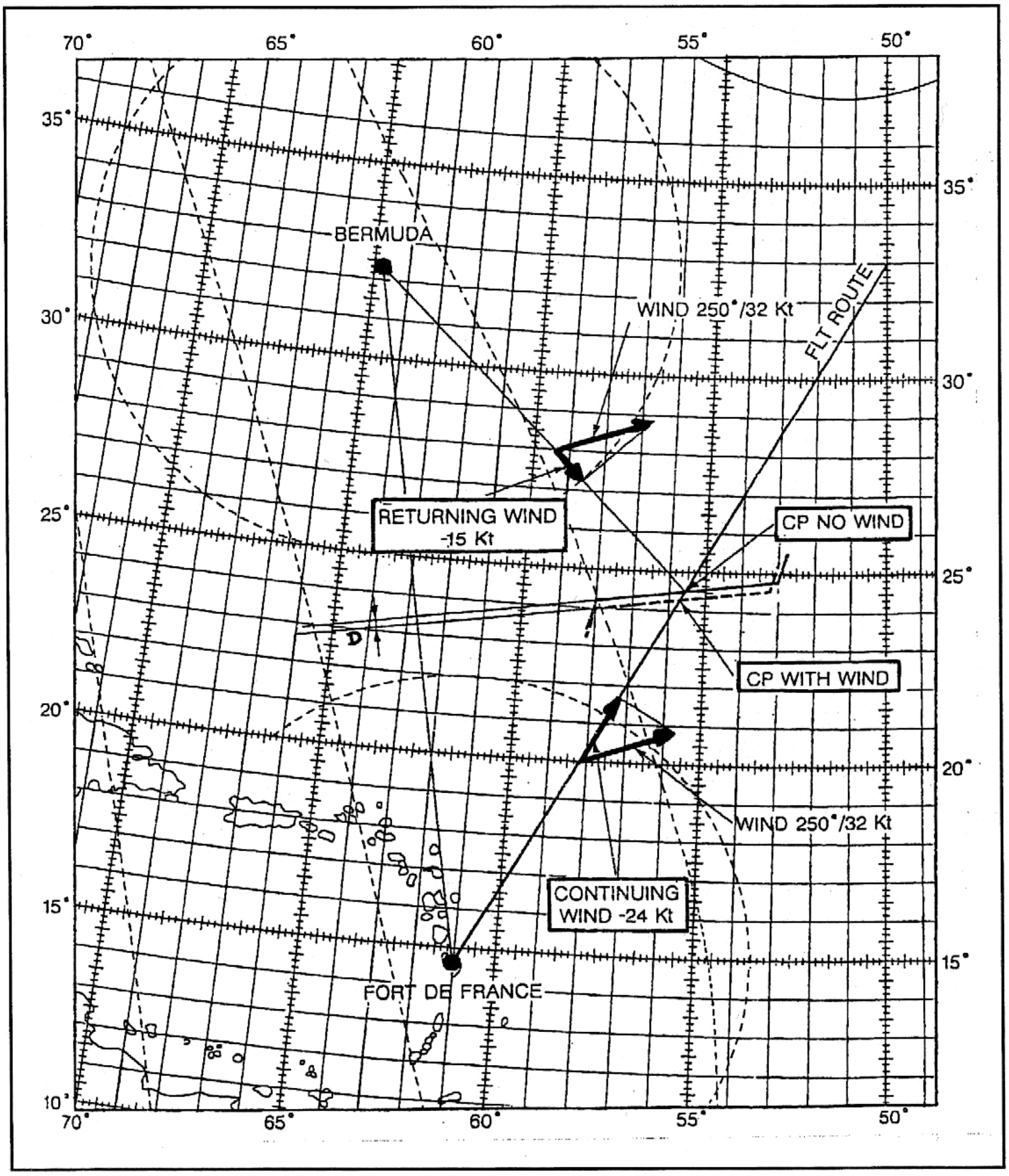
The prevailing wind at the CP is assumed to be 250°/32kt. The following figure shows the positioning of the off-track diversion airport Bermuda and the on-track airport Fort-de-France in relation to the CP.

Considering the tracks from CP (no wind) to Bermuda and from CP (no wind) to Fort-de-France in relation with the 250°/32 kt wind, the following wind components are determined for plotting on the equitime graph.

- returning wind component: - 15kt,
- continuing wind component: - 24kt.

The distance between Bermuda and Fort-de-France also needs to be determined on the navigation chart. This distance is 1080NM, and 1% is 10.8NM.

Using the procedure described in the paragraph b), the equitime number is found to be + 0.8 and therefore the distance D is 8.6NM (0.8 x 10.8). The new CP location is thereafter defined and found farther on the route.



Critical Point re-location

6 - UNEXPECTED CLOSURE OF AN EN-ROUTE ALTERNATE AIRPORT

When dispatching a flight for a non-ETOPS sector, as soon as the dispatch office is informed of an unexpected closure of an en-route alternate airport the consequence of which is to revert to an ETOPS sector, the flight may have to be re-routed (to remain non-ETOPS) or cancelled.

However, for particular non-ETOPS sectors where some essential en-route alternate airports are regularly closed or permanently closed for a well-determined period of time (for example, in winter for weather reasons such as the lack of snow removal equipment), operators have to anticipate to apply the requirements for a 75 or 90-minute ETOPS operation.

It should be noted that, for 75 or 90-minute operations, an approval has to be obtained from the national operational authorities, but the approval requirements are usually less stringent than for a 120-minute approval.

For an ETOPS operator, when dispatching an ETOPS flight and facing an unexpected closure of an en-route alternate airport or its non-suitability for dispatch weather minima reason, thereby modifying the area of operation, the flight may have to be re-routed or cancelled.

However, in order to help operators to avoid flight re-routing or cancellation, the operational authorities may agree to slightly increase the diversion time for specific routes if it can be shown that the resulting routing does not jeopardize flight safety. This applies to operations cleared up to 120-minute diversion time, provided such an increase:

- does not exceed the limitations given in the aircraft ETOPS type design approval,
- is not more than 15% of the operator's original maximum diversion time,
- does not exceed 180 min.

To fully take benefit (or credit) of this regulations item, the operator should anticipate the possible closure of an adequate airport and be ready to dispatch the flight with the increased diversion time, whenever it is required. Consequently the 15% increment should be provisioned in the operator's operational specifications.

Chapter 6

Some procedures specific to ETOPS need to be added to the normal and abnormal procedures published in the FCOM.

1 - COCKPIT PREPARATION

a) Additional system checks

Additional system checks may be required prior to each ETOPS flight, these checks are listed in the relevant sections of the applicable FCOM.

- **A310/A300-600:**
  - Check of standby generator:

    Except for aircraft under US registration, this test is not required by certification. However, it has been made mandatory by most authorities at the operational approval level.
  - Check of APU/APU GEN (if needed for dispatch)
  - Check of fuel cross-feed valve.

- **A319/A320/A321 and A330:**
  - Check of APU and APU generator (if needed for dispatch),
  - Check of fuel cross-feed valve.

b) FMS preparation

F-PLN inserted in FMS must be checked for any flight. However, for ETOPS flights which are usually long-range flights, and in particular if the flight includes a long period in IRS-ONLY navigation, the F-PLN check needs to be more systematic.

It is recommended that this check is made by both crew members, one reading F-PLN on (M)CDU, the other checking tracks and distances with the navigation charts or the CFP (provided the CFP has been previously checked with ATC F-PLN and navigation charts during flight preparation).

Particular attention must be given to way points which are not defined in the FMS data base. It is recommended that the defined way point function be used to name the lat/long way points (i.e 45 W20)

NOTE: This is not necessary on the A330, as it is automatically done when a lat/long is entered.

Entering the EEP and ETPs as defined way points (not necessary on A330) is useful for conducting the flight. It is usually not recommended to string EEP and ETPs to the F-PLN. Therefore they will only be displayed if the WPT key is selected on the EFIS control panel. For A330, use of EQUITIME POINT function and TIME markers is recommended.

Wind entries should be performed on all the relevant FM(G)S pages to ensure dependable fuel and time predictions along the flight and (in the case of the A330) during a diversion.

c) ETOPS service check

ETOPS maintenance procedures request specific systems check before dispatching for an ETOPS flight, these checks should be described in the operator's ETOPS Maintenance Procedures Manual.

For those ETOPS flights which are not dispatched from the operator's main base, but from an outstation following a first flight leg, all operational authorities agree on the fact that the complete ETOPS service check could be performed at the operator's main base and a reduced ETOPS service check be done at the transit airport by the flight crew provided they are instructed to perform it. The reduced ETOPS service check would only include systems checks from the cockpit.

2 - AFTER ENGINE START PROCEDURES

After engine start, ECAM STATUS page is checked. Failures which were known at the time of the flight preparation are normally already covered by MEL entries. Additional failures may occur which require the crew to proceed as per company policy to dispatch the aircraft.

At this point MEL ETOPS restrictions must be observed.

As soon as the aircraft is moving under its own thrust, it is usually considered that the flight has commenced, this means that the MEL does not apply any longer.

3 - IN-FLIGHT ETOPS PROCEDURES

a) Operations flight watch

Depending of the profile of the intended flight route, a flight watch from the dispatch office to support the crew during the flight may be recommended.

The flight watch office should be equipped with appropriate means of communication to contact the aircraft in the air at any or predetermined times.

HF communication system ACARS, or SATCOM systems could be used.

The flight watch team should collect any relevant information for the current flight operation including:

- update of weather forecasts and reports for ETOPS en-route alternates,
- update of en-route weather forecasts at cruise altitude but also at lower altitude including FL100,
- sigmet,
- NOTAMs, SNOWTAMs etc.

The flight watch should also be ready to assist the crew if a diversion is required following a failure (re-routing, fuel status reassessment).

b) Weather update

- **before ETOPS Entry Point:**

  With the support of flight watch or by their own means, the crew must make every effort to obtain weather forecasts and reports for ETOPS en-route alternates.

Weather forecasts at the estimated time of arrival at the en-route alternate airports must be higher than the **normal** minima.

NOTE: The ETOPS **dispatch** minima do not apply when airborne.

If weather forecasts are lower than the normal crew minima, then re-routing is required, or turn back if no route at the authorized distance from an en-route alternate airport can be used.

– **after ETOPS Entry Point:**

The crew should continue to update the weather forecasts and reports for en-route alternates. There is no requirement to modify the normal course of the flight if the weather degrades below normal minima.

As for a normal flight, the crew must make every effort to keep themselves informed on the weather at the destination and the destination alternate.

c) Fuel monitoring

The procedures normally used as per airline policy is also applicable for ETOPS.

This is true even for flights where ETOPS fuel planning is the limiting factor.

There are no requirements in the ETOPS rules to reach the CP with the Fuel On Board (FOB) being at least equal to the fuel required by the critical fuel scenario.

This means that CP should not be considered as a reclearance point. Therefore, if during the flight it appears that the estimated FOB at the CP will be lower than the fuel required by the critical fuel scenario, there is no requirement to make a diversion, provided the estimated fuel at destination is above the minimum required to divert to the destination alternate. Normal rules apply.

However, it is recommended that if the CP is regularly over flown with a FOB lower than the fuel required by the critical fuel scenario, the appropriate corrective actions should be taken in the way the required fuel is determined at dispatch (i.e increase performance factor, route reserves, etc.).

d) Navigation monitoring

In most cases, ETOPS flights are conducted in areas outside radio-navaid coverage. If the aircraft remains for a long period of time in IRS-ONLY NAVIGATION, then some specific procedures, which are not directly linked to ETOPS, need to be considered. This is also true for flights within the MNPS (Minimum Navigation Performance Specification) area or in the polar regions or using GPS primary.

Airbus navigation monitoring recommendations are as follows:

- **before leaving radio navaid coverage:**
  - validate the FMS position with DME or VOR/DME raw data,(in specific areas, take account of the magnetic variations for bearing check),
  - tune, as appropriate, the last navaid to display raw data as long as possible.
  - check IRS position relative to FMS position, to note any abnormal IRS drift;

  when the IRS ONLY NAVIGATION message comes up

  - validate FMS position (raw data versus computed BGR/DIST on PROG page),
  - if a significant deviation is noticed between the IRSs deviations, determine the two best IRSs
    - on DATA POS MONITOR page (A320/A330),
    - on FIX page for Smiths FMS (A310/A300-600),
    - by comparison ISDU - PROGRESS PAGE for Honeywell FMS (A310/A300-600),

    - example:

IRS1	IRS2	IRS3	results in: IRS2/3 are the best
6.4	2.8	2.5	

  However, the FMS position, even in IRS-ONLY NAVIGATION, may be more accurate than a distant VOR or ADF. Therefore, this cross-check is useful only to detect gross errors.

– **outside radio navaid coverage:**
  - use NAV mode, check XTK error = 0 on ND,
  - keep FD bars displayed on both PFDs to quickly visualize any discrepancy between the two FMS,
  - in the absence of any discrepancy, use normal FMS navigation procedures as for a standard flight.

  However, if a navigation system failure occurs, e.g. one FMS failed on A300-600/A310/A319/A320/A321 or two FMS failed on A330 (resulting in back-up navigation situation) , apply the following procedure in using the last sequencing way point as a reference point to anticipate a subsequent navigation system failure:
  - before passing each way point:
    – read on CFP the outbound MT/TT to the next way point,
    – set HDG bug on the outbound track,
    – compare distance to next way point of CFP with distance given on FMS F-PLN,
  - passing the way point:
    – verify that correct outbound MT/TT is steered using track indication on ND (Green diamond on Blue index),
  - after passing the way point:
    – check XTK error = 0,
    – plot position on a navigation chart (according to company policy or operational requirements).

– **Within ETOPS area:**
  - select WPT on EFIS control panel to display ETPs on ND (not necessary for A330),
  - on A330, review / modify EQUITIME POINT page,
  - insert BRG/DIST to current diversion airport on FMS PROG page, or prepare diversion on SEC F-PLN,
  - . consider CLOSEST AIRPORT page information.

– **Coming back inside radio navaid coverage:**
  - whenever in line of sight of any navaid NDB, VOR, VOR/DME, cross-check FMS position by comparing navaid raw data with BRG/DIST on PROG PAGE,
  - use remote (manual tuning on (M)CDU) tuning of navaid to receive, as early as possible, navaid raw data.

- **after the flight:**
  - check IRS performance for abnormal drift rate and residual GS,
  - as appropriate, make logbook entry.

  The above-mentioned navigation procedures are general guidelines which need to be adapted to each operator's internal policy. In addition, more detailed navigation procedures are provided in the relevant aircraft FCOM.

e) Diversion decision-making

The Airbus recommendations and guidelines for in-flight re-routing or diversion decision-making are published in the A310/A300-600 FCOM 2.18.70 § 5, pages 4 and 5, and in the A319/A320/A321/A330 FCOM 2.04.40.

The technical criteria governing a re-routing or diversion decision can be classified in four categories, as follows:

- loss of MNPS capability, before entering the MNPS area (as applicable),
- weather minima at diversion airport(s) going below the company / crew en-route minima, before reaching the EEP, or diversion airport(s) becoming unsuitable for any reason,
- failure cases requiring a diversion to the nearest airport (cases leading to a LAND ASAP message on the ECAM and / or in the QRH),
- failure cases resulting in excessive fuel consumption, exceeding the available fuel reserves.

Some failures related to electrical generation require special consideration for ETOPS:

	1st ENG-GEN failure	HYD.LO LVL (blue for A319/A320/ A321) (green for A310/ A300-600/A330)
A310, A300-600	Start APU*	Start APU*
A319/A320/ A321/A330	Start APU diversion required if APU GEN is not available.	Start APU diversion required if APU GEN is not available.

(*) Diversion is not required if APU GEN is not available; however, crew should evaluate the operational situation and take a decision accordingly.

In case of a cargo fire, diversion to the nearest suitable airport is mandatory, whatever is the performance, in term of protection time, of the fire-extinguishing system.

f) Conducting a diversion

Whatever one-engine-inoperative speed schedule is assumed in the determination of the area of operation, the crew is free to adopt the strategy it considers the most appropriate after assessment of the overall situation. This means that in conducting the diversion the application of the pre-planned speed strategy is not mandatory.

However, each time a time-dependent situation occurs, the crew should conduct the diversion at maximum speed.

Crews should first refer to the route instruction given in the Airlines Operations Manual or in separate route documentation in which they will find the diversion strategy relative to the route.

Chapter 7

1 - GENERAL

This chapter provides an overview of a typical ETOPS flight over the North Atlantic, which is the busiest ETOPS area of the world in terms of traffic.

The example is based on a New York (JFK) - Shannon (SNN) flight (with Dublin (DUB) as destination alternate airport) operated with an A330-301 (GE engines), considering the successive 90-minute, 120-minute and 138-minute diversion time approval.

The following operational data are presented

- area of operation,
- fuel/time analysis for a given payload, using, the Airbus Flight Planning (FLIP) computer program.

This example is particularly interesting in the framework of this brochure because Shannon, the normal destination, is also the last en-route diversion airport, and Dublin, the destination alternate, is close to Shannon.

These considerations mean that a standard fuel plan close to the ETOPS fuel plan is to be expected. The maximum diversion time as well as the diversion speed strategy will be the key factors in the determination of the limiting fuel plan.

2 - OPERATIONAL ASSUMPTIONS

- departure: New York (JFK)
- destination: Shannon (SNN)
- destination alternate: Dublin (DUB)
- declared suitable en-route alternates:
  - for 90-minute diversion time:
    - Goose Bay (YYR)
    - Sondre Stromfjord (SFJ)
    - Keflavik (KEF)
  - for 120-minute diversion time:
    - Gander (YQX)
    - Keflavik (KEF)
  - for 138-minute diversion time:
    - Gander (YQX)

	90-minute	120-minute	138-minute
- route	north track	great circle track	great circle track
- ground distances:			
• JFK-SNN	2 782nm	2 670nm	2 670nm
• Critical Point - SNN	467nm	643nm	955nm
• SNN-DUB	130nm	130nm	130nm
- statistical winds (85%, winter):			
• FL 370	+ 9kt	+ 18kt	+ 23kt
• FL 100 (for diversion)	- 20kt	- 15kt	- 14kt
- circle radii:			
• 310kt	620nm	820nm	940nm
• 330kt	630nm	835nm	955nm

- average temperature: ISA
- cruise altitude: FL 370 with a step climb to FL 410 when possible
- cruise speed: M0.81
- MTOW = 212 000kg
- MZFW = 167 000kg
- MLW = 177 000kg
- OEW = 122 000kg
- selected payload = 45 000kg (maximum payload)
- aircraft reference gross weight: 180 000kg
- one-engine-inoperative diversion speed: 310 and 330kt IAS
- two-engine-operative diversion speed: LRC
- standard fuel policy:
  - performance factor: 1.0 (nominal)
  - contingency fuel: 5% of trip fuel

– ETOPS fuel policy:
  - performance factor: 1.0 (nominal)
  - contingency fuel: 2% of trip fuel for JFK to CP
  - diversion fuel reserves:
    i) contingency fuel: 5% of diversion fuel
    ii) total anti-ice and ice accretion reserves considering 30-minutes moderate icing conditions forecast at FL 100: 2% of diversion fuel.

NOTES:

– The A330-301 total anti-ice selection increases the fuel consumption by 3.5%. The total anti-ice fuel reserve for a 30-minute exposure will be approximately equivalent to 1% of the diversion fuel.

– For the A330, the effect of ice accretion on unheated surfaces on the fuel burn increase is equivalent to three times the exposure time in hours (in percentage). Thus, for a 30-minute exposure, the fuel reserve will be 1.5% of the diversion fuel and will be divided by 2 assuming moderate icing conditions forecast (according to regulation). For this example, the reserve will be 1%.

3 - RESULTS AND COMMENTS

The various fuel plan results are presented in the following table (in kg):

	Standard fuel	ETOPS fuel		
		Pressure loss + engine failure		Pressure loss
		310kt	330kt	LRC
90-min	40 971	39 963	40 432	39 289
120-min	38 894	39 800	40 471	38 792
138-min	38 894	41 338	42 766	-

The comments are:

- With 90-minute diversion time, the standard fuel plan is limiting, this means that the standard fuel is sufficient to cover all the ETOPS possible failure scenarios, whatever is the diversion speed strategy.
- With 120-minute diversion time, the ETOPS fuel plan is limiting on the basis of the double pressurization and engine failure scenarios. The difference between the ETOPS and standard fuel plans is usually called "additional (or extra) ETOPS fuel reserve" in the computerized flight plans.
- This example points out the impact of the diversion speed schedule on the fuel plan result. The fuel requirement is increased by approximately 2% when considering 330kt compared to 310kt.
- Should operators envisage the diversion time increase from 120 minutes to 138 minutes, it is worth noting the relevant advantages and disadvantages.

  The main advantage is, therefore, to remove Keflavik from the list of adequate en-route diversion airports. Thus, the suitability of Keflavik is not required to dispatch the flight.

  The main disadvantage is to move the CP away from Shannon. By this, the CP becomes the ETP between Gander and Shannon. The immediate consequence is to increase the ETOPS fuel requirement by 2t.

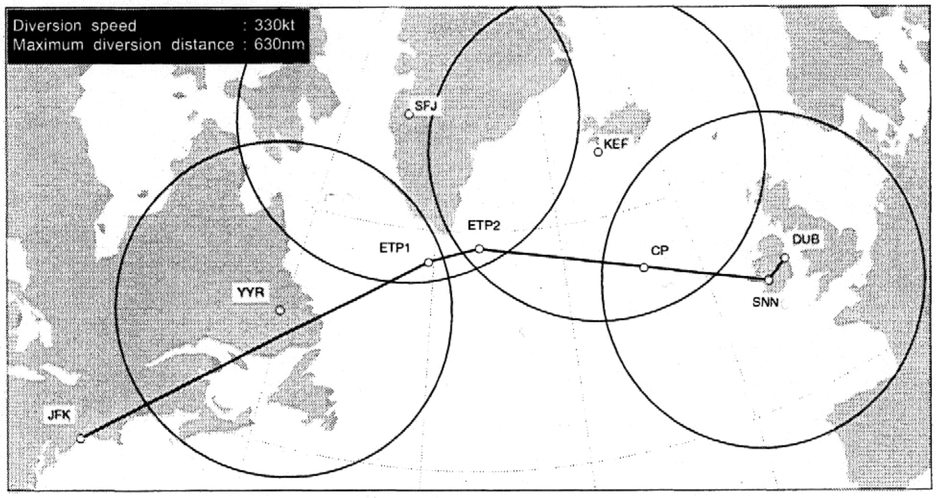
  However, from an operational point of view, Keflavik should be maintained as en-route diversion airport whenever its suitability is guaranteed, to avoid carrying the additional ETOPS fuel reserves required by the 138-minute diversion time.
- The comments relative to this typical example would differ as soon as another normal destination is considered, as for example, Frankfurt, Rome or Zurich. By this, the standard fuel requirements will thereafter increase accordingly, whereas the ETOPS fuel requirements will remain identical because the ETOPS scenario is the same in all cases, a diversion to Shannon from the CP.

  In the same way, for the westbound flight Shannon/New York, the standard fuel is always limiting because the ETOPS scenario stops in Goose Bay (90-minute diversion time) or Gander (120-minute diversion time), significantly away from the final destination.

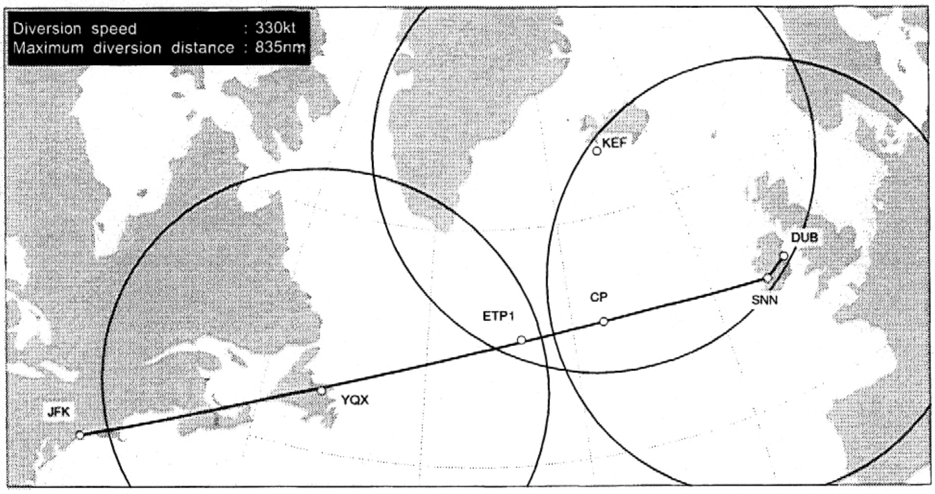
4 - Appended documents

The following documents are appended hereafter:

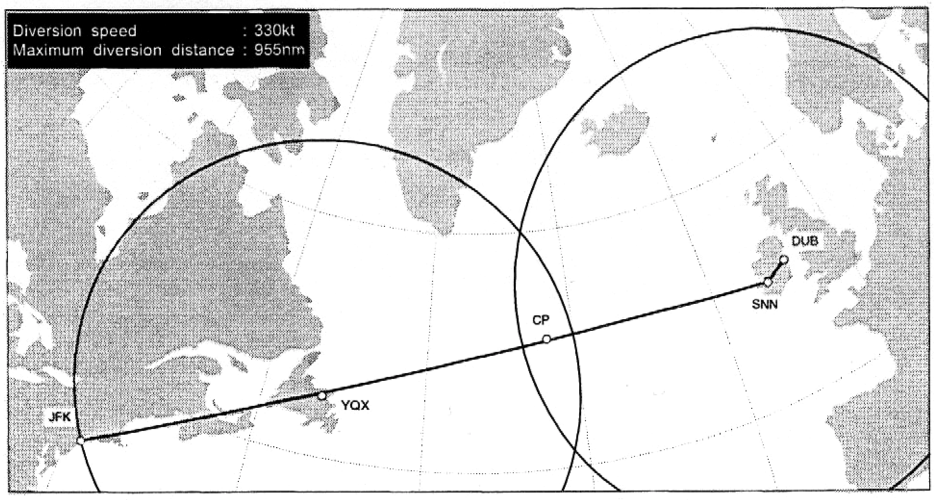
- maps featuring the area of operation for 90-, 120- and 138-minute diversion times,
- plotting chart featuring the area of operation for 120-minute diversion time and a possible route,
- FLIP program outputs for 120-minute diversion time:
  - standard fuel plan,
  - ETOPS fuel plan, pressurization loss and engine failure scenario,
  - ETOPS fuel plan, pressurization loss.



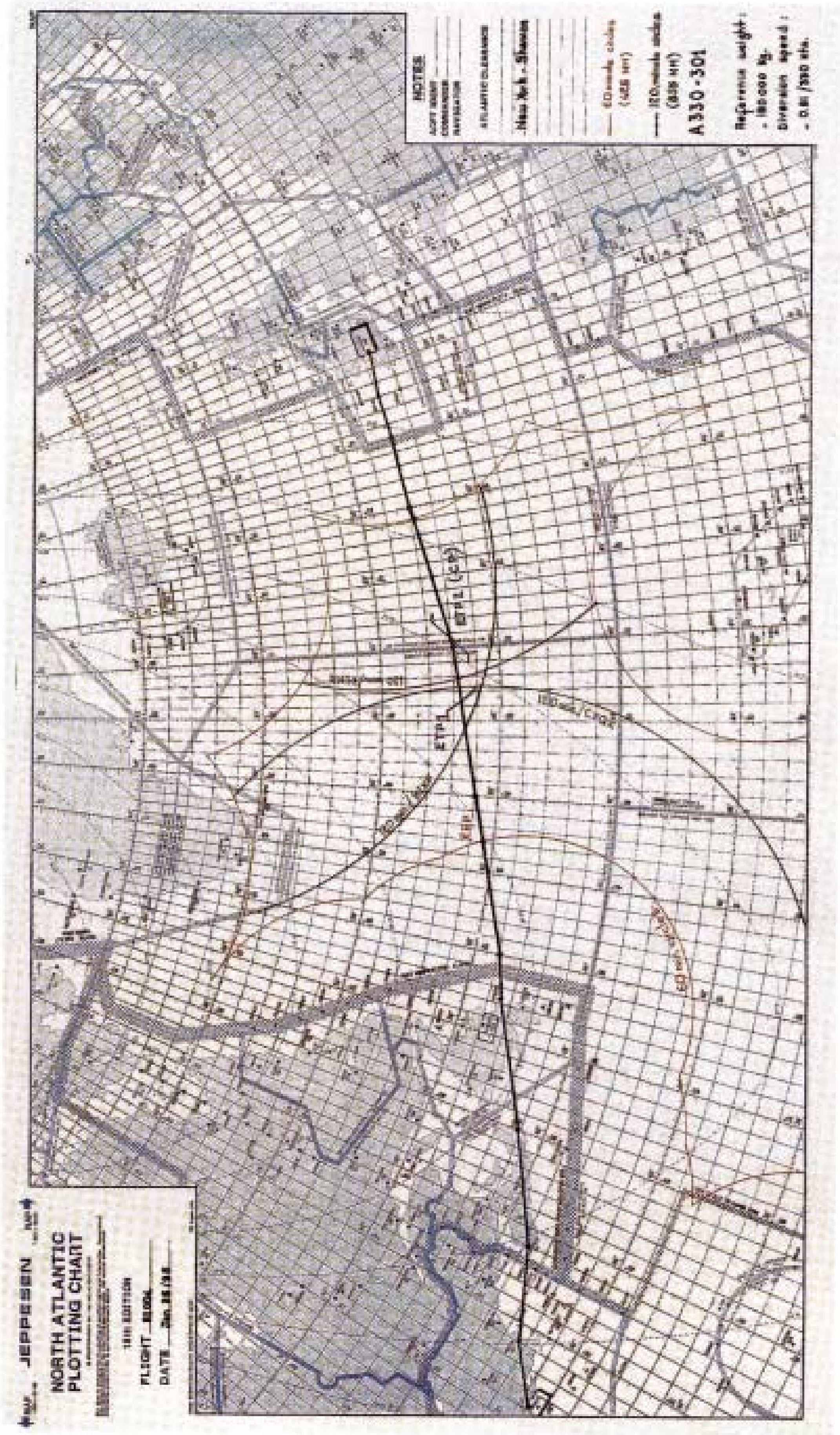
90-minute diversion time



120-minute diversion time



138-minute diversion time


JEPPESEN
NORTH ATLANTIC PLOTTING CHART
NOTES
A330-301

ETOPS-CASE : PRESSURE LOSS + ONE ENGINE FAILURE

FROM	: JFK	TO	: SNN	ETOPS	: ENGINE FAILURE + PRESSURE LOS
AIRCRAFT	: A330-301	ENGINE	: CF6-80E1A2	DATE	: jan 95
AIR CONDITIONING AFTER CRIT.POINT	: 100. % : 125.8 %	ANTI ICING AFTER CRIT.POINT	: OFF : OFF	FLHV	: 18590 BTU/LB
TEMPERATURE	: ISA	CG POSITION	: 37.0 %	MAX CABIN RATE OF DESCENT	: 300 FT/MIN
CRUISE ALTITUDE	: 37000 FT	PAYLOAD WEIGHT	: 45000 KG		

INSTALLED FACTORS : RESERVE : 1.02 on FUEL
AFTER CRIT.POINT RESERVE : 1.07 on FUEL

POINT OF FLIGHT	WEIGHT KG	FUEL KG	TIME MIN	DISTANCE GRND NM	DISTANCE AIR NM	FL --	SPEEDS KT / M	WIND KT	OAT CELSIUS
RAMP WEIGHT	206800								
TAXI OUT		300				0			15.0
WEIGHT AT BRAKE RELEASE	206500								
TAKE-OFF and INITIAL CLIMB		623	2	4	4	15		0	
CLIMB		4524	24	172	168		250/300/.810	1	
CRUISE (1st flight level)		20799	230	1850	1781	370	.810	18	-56.5
TRIP FUEL TO CRITICAL POINT		25947	256	2027	1953				
ROUTE RESERVES (2% trip fuel)		519							
WEIGHT AT CRITICAL POINT	180553								
DESCENT to DIVERSION CRUISE LEVEL		135	10	76	76	100	.86/330		
CRUISE		10065	93	530	553	100	310	-15	-4.8
DESCENT to DIVERSION AIRPORT		94	6	27	28	15	.810/300/250	0	
HOLDING		1031	15			15	200 GREEN DOT		12.0
1. APPROACH + GO AROUND		740	5						
VFR APPROACH and LANDING		184	4	10	10	0		0	15.0
DIVERSION FUEL BURN		12249	133	643	667				
ROUTE RESERVES after C.P. (7%)		785							
WEIGHT AT DIVERSION AIRPORT	168304								
MINIMUM BLOCK		39800	390						

DISTANCE from DEPARTURE to DIVERSION AIRPORT 2670 / 2620 NM (GROUND / AIR)
DISTANCE from CRITICAL POINT to DIVERSION AIRPORT 643 / 667 NM (GROUND / AIR)

RAMP WEIGHT	: 206800 KG	TOTAL FUEL on BOARD	: 39800 KG	TOTAL FLIGHT TIME	: 6/30 H/MIN
TAKEOFF WEIGHT	: 206500 KG	TOTAL TRIP FUEL	: 38196 KG	TIME until C.P.	: 4/17 H/MIN
LANDING WEIGHT	: 168304 KG	ROUTE RESERVES until C.P.	: 519 KG	TIME C.P. to DIVERSION	: 2/13 H/MIN
ZERO FUEL WEIGHT	: 167000 KG	ROUTE RESERVES after C.P.	: 785 KG		
PAYLOAD	: 45000 KG	EXTRA RESERVES until C.P.	: 0 KG		

A330-301, STANDARD FUEL PLAN, JFK/SNN, WINTER, 120-MIN

FROM	: JFK	TO	: SNN	ALTERNATE	: DUB
AIRCRAFT	: A330-301	ENGINE	: CF6-80E1A2	DATE	: jan 95
AIR CONDITIONING	: 100. %	ANTI ICING	: OFF	FLHV	: 18590 BTU/LB
TEMPERATURE	: ISA	CG POSITION	: 37.0 %	MAX CABIN RATE OF DESCENT	: 300 FT/MIN
CRUISE ALTITUDE	: 41000 FT	PAYLOAD WEIGHT	: 45000 KG		

INSTALLED FACTORS : RESERVE : 1.05 on FUEL

POINT OF FLIGHT	WEIGHT KG	FUEL KG	TIME MIN	DISTANCE GRND NM	DISTANCE AIR NM	FL --	SPEEDS KT / M	WIND KT	OAT CELSIUS
RAMP WEIGHT	205894								
TAXI OUT		300				0			15.0
WEIGHT AT BRAKE RELEASE	205594								
TAKE-OFF and INITIAL CLIMB		620	2	4	4	15		0	
CLIMB		4485	24	171	166		250/300/.810	1	
CRUISE (1st flight level)		23970	268	2155	2074	370	.810	18	-56.5
CLIMB		797	8	61	59		300/.810	18	
CRUISE (2nd flight level)		1418	17	137	132	410	.810	20	-56.5
DESCENT to DESTINATION ALTITUDE		392	22	142	139	15	.810/300/250	1	
IFR APPROACH and LANDING		240	6	0	0	0		0	15.0
TRIP FUEL		31922	347	2670	2573				
ROUTE RESERVES (5% trip fuel)		1596							
WEIGHT AT DESTINATION AIRPORT	173672								
GO-AROUND to ALTERNATE AIRPORT		500	0						12.0
CLIMB		1159	5	22	23		250/280/.550	0	
CRUISE		898	10	58	60	160	.563 LONG RANGE	-14	-16.7
DESCENT		206	10	50	51	15	.550/280/250	0	
HOLDING		2152	30			15	209 GREEN DOT		12.0
VFR APPROACH and LANDING		160	4	0	0	0		0	15.0
ALTERNATE FUEL		5075	59	130	134				
LANDING WEIGHT AT ALTERNATE	168596								
MINIMUM BLOCK		38894	406						

DISTANCE from DEPARTURE to DESTINATION AIRPORT 2670 / 2573 NM (GROUND / AIR)
DISTANCE from DESTINATION to ALTERNATE AIRPORT 130 / 134 NM (GROUND / AIR)

RAMP WEIGHT	: 205894 KG	TOTAL FUEL on BOARD	: 38894 KG	TOTAL FLIGHT TIME	: 6/46 H/MIN
TAKEOFF WEIGHT	: 205594 KG	TRIP FUEL	: 31922 KG	TRIP TIME	: 5/47 H/MIN
LANDING WEIGHT at DEST.	: 173672 KG	ALTERNATE FUEL	: 5075 KG	ALTERNATE TIME	: 0/59 H/MIN
LANDING WEIGHT at ALTERN.	: 168596 KG	ROUTE RESERVES	: 1596 KG		
ZERO FUEL WEIGHT	: 167000 KG	EXTRA RESERVES	: 0 KG		
PAYLOAD	: 45000 KG				

ETOPS-CASE : PRESSURE LOSS + ONE ENGINE FAILURE

FROM	: JFK	TO	: SNN	ETOPS	: ENGINE FAILURE + PRESSURE LOS
AIRCRAFT	: A330-301	ENGINE	: CF6-80E1A2	DATE	: jan 95
AIR CONDITIONING AFTER CRIT.POINT	: 100. % : 125.8 %	ANTI ICING AFTER CRIT.POINT	: OFF : OFF	FLHV	: 18590 BTU/LB
TEMPERATURE	: ISA	CG POSITION	: 37.0 %	MAX CABIN RATE OF DESCENT	: 300 FT/MIN
CRUISE ALTITUDE	: 37000 FT	PAYLOAD WEIGHT	: 45000 KG		

INSTALLED FACTORS : RESERVE : 1.02 on FUEL
AFTER CRIT.POINT RESERVE : 1.07 on FUEL

POINT OF FLIGHT	WEIGHT KG	FUEL KG	TIME MIN	DISTANCE GRND NM	DISTANCE AIR NM	FL --	SPEEDS KT / M	WIND KT	OAT CELSIUS
RAMP WEIGHT	207471								
TAXI OUT		300				0			15.0
WEIGHT AT BRAKE RELEASE	207171								
TAKE-OFF and INITIAL CLIMB		626	2	4	4	15		0	
CLIMB		4554	25	174	169		250/300/.810	1	
CRUISE (1st flight level)		20839	230	1849	1780	370	.810	18	-56.5
TRIP FUEL TO CRITICAL POINT		26018	256	2027	1953				
ROUTE RESERVES (2% trip fuel)		520							
WEIGHT AT CRITICAL POINT	181152								
DESCENT to DIVERSION CRUISE LEVEL		135	10	76	76	100	.86/330		
CRUISE		10620	87	529	551	100	330	-15	-4.8
DESCENT to DIVERSION AIRPORT		94	6	27	28	15	.810/300/250	0	
HOLDING		1034	15			15	201 GREEN DOT		12.0
1. APPROACH + GO AROUND		740	5						
VFR APPROACH and LANDING		184	4	10	10	0		0	15.0
DIVERSION FUEL BURN		12808	127	643	666				
ROUTE RESERVES after C.P. (7%)		824							
WEIGHT AT DIVERSION AIRPORT	168345								
MINIMUM BLOCK		40471	384						

DISTANCE from DEPARTURE to DIVERSION AIRPORT 2670 / 2619 NM (GROUND / AIR)
DISTANCE from CRITICAL POINT to DIVERSION AIRPORT 643 / 666 NM (GROUND / AIR)

RAMP WEIGHT	: 207471 KG	TOTAL FUEL on BOARD	: 40471 KG	TOTAL FLIGHT TIME	: 6/24 H/MIN
TAKEOFF WEIGHT	: 207171 KG	TOTAL TRIP FUEL	: 38826 KG	TIME until C.P.	: 4/17 H/MIN
LANDING WEIGHT	: 168345 KG	ROUTE RESERVES until C.P.	: 520 KG	TIME C.P. to DIVERSION	: 2/ 8 H/MIN
ZERO FUEL WEIGHT	: 167000 KG	ROUTE RESERVES after C.P.	: 824 KG		
PAYLOAD	: 45000 KG	EXTRA RESERVES until C.P.	: 0 KG		

ETOPS-CASE : PRESSURE LOSS

FROM	: JFK	TO	: SNN	ETOPS	: PRESSURE LOSS
AIRCRAFT	: A330-301	ENGINE	: CF6-80E1A2	DATE	: jan 95
AIR CONDITIONING AFTER CRIT.POINT	: 100. % : 100. %	ANTI ICING AFTER CRIT.POINT	: OFF : OFF	FLHV	: 18590 BTU/LB
TEMPERATURE	: ISA	CG POSITION	: 37.0 %	MAX CABIN RATE OF DESCENT	: 300 FT/MIN
CRUISE ALTITUDE	: 37000 FT	PAYLOAD WEIGHT	: 45000 KG		

INSTALLED FACTORS : RESERVE : 1.02 on FUEL
AFTER CRIT.POINT RESERVE : 1.07 on FUEL

POINT OF FLIGHT	WEIGHT KG	FUEL KG	TIME MIN	DISTANCE GRND NM	DISTANCE AIR NM	FL --	SPEEDS KT / M	WIND KT	OAT CELSIUS
RAMP WEIGHT	205792								
TAXI OUT		300				0			15.0
WEIGHT AT BRAKE RELEASE	205492								
TAKE-OFF and INITIAL CLIMB		620	2	4	4	15		0	
CLIMB		4481	24	170	166		250/300/.810	1	
CRUISE (1st flight level)		20740	230	1852	1783	370	.810	18	-56.5
TRIP FUEL TO CRITICAL POINT		25840	256	2027	1953				
ROUTE RESERVES (2% trip fuel)		517							
WEIGHT AT CRITICAL POINT	179652								
DESCENT to DIVERSION CRUISE LEVEL		173	11	80	79	100	.86/330		
CRUISE		9122	102	526	552	100	.506 LONG RANGE	-15	-4.8
DESCENT to DIVERSION AIRPORT		127	6	27	28	15	.810/300/250	0	
HOLDING		1065	15			15	208 GREEN DOT		12.0
1. APPROACH + GO AROUND		740	5						
VFR APPROACH and LANDING		183	4	10	10	0		0	15.0
DIVERSION FUEL BURN		11411	143	643	669				
ROUTE RESERVES after C.P. (7%)		724							
WEIGHT AT DIVERSION AIRPORT	168241								
MINIMUM BLOCK		38792	400						

DISTANCE from DEPARTURE to DIVERSION AIRPORT 2670 / 2623 NM (GROUND / AIR)
DISTANCE from CRITICAL POINT to DIVERSION AIRPORT 643 / 669 NM (GROUND / AIR)

RAMP WEIGHT	: 205792 KG	TOTAL FUEL on BOARD	: 38792 KG	TOTAL FLIGHT TIME	: 6/40 H/MIN
TAKEOFF WEIGHT	: 205492 KG	TOTAL TRIP FUEL	: 37251 KG	TIME until C.P.	: 4/17 H/MIN
LANDING WEIGHT	: 168241 KG	ROUTE RESERVES until C.P.	: 517 KG	TIME C.P. to DIVERSION	: 2/23 H/MIN
ZERO FUEL WEIGHT	: 167000 KG	ROUTE RESERVES after C.P.	: 724 KG		
PAYLOAD	: 45000 KG	EXTRA RESERVES until C.P.	: 0 KG		

AIRBUS S.A.S.
31707 BLAGNAC CEDEX - FRANCE
CONCEPT DESIGN SCM12
REFERENCE SCM-A295
AUGUST 2002
PRINTED IN FRANCE

AN EADS JOINT COMPANY
WITH BAE SYSTEMS