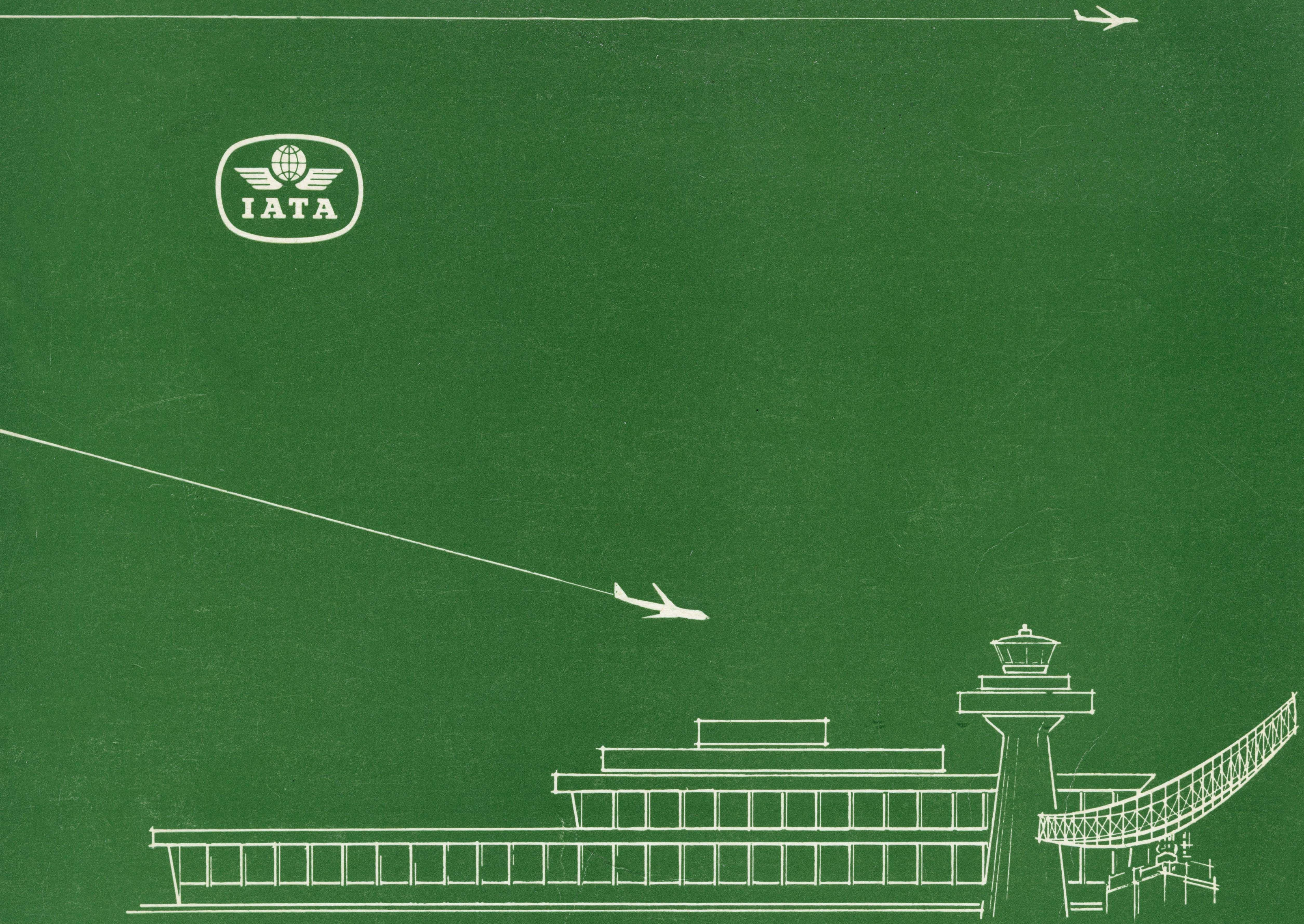

AIR TRAFFIC SERVICES
REFERENCE DOCUMENT

REQUIREMENTS FOR
INTERNATIONAL AIR TRANSPORT OPERATIONS

REVISED JANUARY 1973

FOREWORD

The IATA ATS Reference Document was first issued in January 1967. This revised edition represents an updating and rearrangement of the original content, to reflect changes in the operational requirements for air traffic services which have taken place during the intervening years.

This Document sets out to provide guidance on air traffic services requirements, procedures, and practices as seen from the viewpoint of international civil air transport operations. Although much of the content reflects recognized ICAO provisions for ATS, the importance of these services to the operator and the consequences of non-implementation of, or non-adherence to, internationally agreed procedures are also dealt with in more detail than is warranted in the relevant ICAO documents. For this reason the material has proved useful not only to those responsible for the overall planning of air traffic services, but also as a source of information and guidance to those involved in the day-to-day control of air traffic.

In a separate supplement at the back of the Document, IATA guidance is provided for the first time on SST operational requirements for air traffic services. While much of the material contained in the main part of the Document is equally applicable to SST operations, the supplement deals with those aspects which are unique to the SST and is intended to augment the recently published ICAO Guidance on the Planning of Air Traffic Services for SST Aircraft. At this stage, SST operational requirements for air traffic services should be regarded as being of a preliminary nature. They will be confirmed or revised as experience in SST operations is gained.

Since this Document is intended for reference purposes it contains, in addition to a comprehensive index, discreet repetition of some of the material throughout the various sections, in order to maintain cohesion and avoid the need for excessive cross-referencing on the part of the reader.

January 1973

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SECTION 1

AERODROMES

Aerodrome Location and Design

The design of aerodromes should facilitate the expeditious flow of traffic. Therefore, the overall capacity of the system - ground and air - should be the over-riding consideration in the initial design of the aerodrome, and when additions or improvements are subsequently made. A successful design involves continued close coordination among the aerodrome authorities, the Air Traffic Services and the operators from the initial stages of planning until the plan has been finalized.

Some major ATC operational factors which should be considered in aerodrome design are as follows:

- overall demand versus capacity

- interaction with the community; e.g. noise problems etc.

- climatological considerations; prevailing visibility conditions; the potential effects of snow and ice on the performance of essential navigational aids

- topographical and special terminal airspace problems

- number, orientation, interaction and dimensions of runways; surface characteristics; associated entries and exits for peak demand and safety; parallel and special purpose runways; braking performance in wet and icy conditions

- taxiway layout, guidance and control system (day/night VMC/IMC)

- holding bays associated with departure runways

- routes for ground vehicle traffic

- aprons, holding areas and by-pass areas for aircraft

- terminal control area airspace problems; e.g. proximity of other airports

Aerodrome Location and Design (cont'd)

Aerodrome capacity and siting can be influenced by hazardous concentrations of certain species of birds. Existing or possible areas of bird concentrations should therefore be taken into consideration when evaluating potential locations for new aerodromes. Similarly, in some areas of the world, adequate precautions are required to ensure that runways and movement areas can be kept free of hazards arising from the presence of stray animals.

Overall Capacity

The predicted demand for which the aerodrome is being planned should be determined on the basis of all forecast data available to the operators, the aerodrome authorities, and any other governing agencies involved. The capacity to meet this demand should be planned in stages, taking into consideration all of the details covered below. Actual runway usage statistics should be available to the operators for assessment of operational problems and the need for expansion after the aerodrome is operational. In day-to-day operations, the Air Traffic Services should be responsible for assessing the capacity considering all current factors and should notify the operators of the values. This enables operators to assess whether delays should be consumed on the ground or in the air.

Saturation of Aerodromes and Scheduling

The problems connected with delays are primarily local. As such, they should be dealt with locally by discussions between the administration and the operators, with the objective of recommending corrective measures. No attempt should be made to solve this problem by restricting the number of regular scheduled movements that could be operated into each international aerodrome.

Information concerning delays will normally be necessary in order to analyse the causes and magnitude of delays or diversions. Experience indicates that this is best tackled by joint efforts of the administration and the operators so as to provide a composite picture of the situation as seen by the operators and those responsible for ATC. It will normally be more useful to gather such data during the peak periods, and the requirements for the study and the method of data analysis should again be a matter of joint

Saturation of Aerodromes and Scheduling (cont'd)

discussion between the administration and the operators. As a result of previous experience IATA is in a position to provide guidance material on the conduct of such a study, the subsequent processing of the data, and the way in which detailed analysis of the problems can be carried out. Surveys of this nature are needed on a regular basis.

Noise Problems

Noise abatement take-off and landing procedures, and special routings implemented to combat this problem can have a serious impact on the efficiency of an aerodrome and its users in a number of ways e.g.:

- reduction in capacity because of otherwise unnecessary runway changes resulting from the use of preferential runways

- reduction in capacity due to inefficient use of the terminal airspace for maximum runway utilization

- artificial gross weight limitations with resultant wasted runway length

- otherwise unnecessary diversions due to the lack of instrument approach facilities on noise preferential landing runways, tailwind factors etc.

- conflict between noise measurement methods, noise abatement routings, ATC routes, and operators optimum routes.

All of these items should therefore be considered in the planning stages in order to arrive at the most efficient solution.

At some aerodromes, where there is a problem, operators see the need for noise abatement procedures, and are prepared to cooperate with administrations in the development of suitable procedures in order to facilitate operations on a 24-hour basis. Efforts should be made to minimize the impact of such procedures on flight operations, and close cooperation between ATC, the operators, and others responsible for the development of noise abatement

Noise Problems (cont'd)

procedures is necessary to foster this objective. The resulting ATC procedures must be acceptable to all concerned, and it must be possible to comply with them without violating airline safety standards or noise abatement procedures established by the responsible authority.

The solution to noise problems lies in the proper zoning of land in the vicinity of aerodromes, and when new aerodromes are planned adequate precautions in this regard should be taken.

Climatology and Topography

All weather factors such as number of occurrences, timing, and duration of snow, other forms of precipitation, fog, low clouds, thunderstorms, wind directions and velocities, etc. should be carefully evaluated in the planning stages. Proposed runway layouts, the siting of navigational aids, and air traffic services procedures should be assessed in relation to the surrounding terrain. The direction of runway headings and the types of approach aid should be determined after such evaluation. The problems of runway drainage, snow removal and de-icing are also greatly eased if properly considered in the planning stages. After the airport is operational, runway closures for snow or ice removal should always be coordinated with the users.

Terminal Airspace

The proximity of airports in high density areas creates a traffic flow problem and should be throughly evaluated where the solution to increased capacity lies in the construction of an additional aerodrome. Runway orientation and location must be chosen so as to permit a minimum of restriction on approach and departure procedures, not only at the aerodrome itself but at adjacent aerodromes in the same terminal area. Furthermore, where an uncontrolled aerodrome encroaches on the airspace needed for the IFR arrival and departure routes, there will be an increase in traffic conflicts, especially in VMC.

Close coordination between all concerned is essential for safe and efficient use of the particular airspace available.

Runways

The number and type of runways and the associated taxiway system should be designed so as not to restrict significantly the peak demands of arrival and departure traffic.

It is very difficult to establish criteria for evaluation of the required runway capacity necessary at a given aerodrome. It is generally expressed as a practical capacity, based on an average delay due to the quasi-random distribution of traffic. When considering such a method, due regard must be given to the fact that a significant portion of traffic may have been subjected to delays much greater than that represented by the average figure. (Some States have adopted an average delay related to selected peak hours, but an arbitrary figure cannot be accepted as a standard and efforts should be made to eliminate or minimize delays.)

In many circumstances, the use of adequately spaced runways increases aerodrome capacity and is a convenient means of obtaining optimum use of surrounding airspace and reducing departure and arrival delays. Runway utilization can also be increased by permitting take-offs from intersections (in which case the available take-off distance should be promulgated), or by the use of short runways by general aviation or other traffic where this is acceptable. These procedures should not, however, be used for purposes other than the improvement of runway utilization.

When planning parallel runways and special purpose runways, current knowledge concerning wake turbulence and the probable mix of aircraft types should be carefully evaluated and considered, since this may be a definite limitation on the practicality of such runways. This problem is becoming more acute with the advent of the newer, larger and faster jet transports. In addition, in the terminal control area or the climb and descent phase, the effect of multiple runway operation is likely to be far-reaching and deserves serious technical effort. The need to reduce runway occupancy and establish closer parallel runway spacing for simultaneous operations must be examined in a realistic manner. The present practices for parallel landings, although limited, should provide excellent practical experience which may be used to find the ultimate answer to this question.

Runways (cont'd)

The use of parallel runways under instrument conditions will ease traffic congestion. It is important when assessing the value of parallel runway installations that it is realized that full benefit of this system cannot be obtained unless the whole ATC system is able to accommodate the increased traffic amount.

When contemplating operations on multiple or parallel runways, authorities should ensure that proper precautions are stipulated and adequate procedures developed. These should encompass:

- all separation criteria, (including evaluation of various forms of composite separation, when true simultaneous operations are not possible)
- ILS siting and glide path angle
- aircraft path stretching and approach sequencing
- establishment of a "no transgression" zone between approach paths
- approach monitoring systems and procedures
- communications requirements and procedures
- missed approach procedures
- equipment failure (ground and airborne)

Use of Runways

Regarding choice of runways, ATC should take into account criteria relating to:

- physical characteristics and conditions of runway in relation to type of aircraft
- wind effect
- departure routings
- noise abatement procedures
- requirements of the operators

Use of Runways (cont'd)

In order to facilitate the departure and arrival of the maximum number of aircraft with minimum delay, ATC should use the total runway and taxiway configuration subject to:

- safeguards which are necessary to prevent collision, and,
- the need for the pilot to use a runway which matches his aircraft performance and other operational requirements.

It will be necessary to develop safety standards applicable to the conduct of simultaneous take-offs and landings, and such standards should be developed within ICAO.

Turbulent Wake Precautions

As procedures are improved, it is possible that turbulent wake could prove to be the limiting factor in runway utilization. More studies are required to ascertain the exact duration of turbulence resulting from the movement of different types of aircraft.

Precautions should however be taken to prevent exposure to vortex turbulence when and where it might be a hazard, and continuing advice should be given by aerodrome tower controllers when appropriate. ATC personnel should be fully familiar with the effect of turbulent wake and should take this into consideration, especially during periods of no wind. (See also under "SEPARATION OF AIRCRAFT")

Instrument Landing Systems (ILS)

At aerodromes serving scheduled airline operations, the ultimate objective is for all approaches to be carried out by automatic means as a routine procedure. For this purpose, installation of suitable ILS facilities, appropriate to the category of operation but having at least Cat. 2 automatic approach capability, is encouraged.

ILS should no longer be considered solely as a bad weather landing aid since, apart from the above-mentioned ultimate requirement, it should be utilized whenever appropriate to assist ATC in the efficient handling and sequencing of arriving aircraft. ATC should also recognize that aircraft will wish to conduct coupled approaches routinely in clear weather, whenever this will not reduce runway capacity.

Instrument Landing Systems (cont'd)	When significant numbers of aircraft have Cat. 2 or 3 automatic approach capability and utilize it routinely, there are a number of reasons, both technical and operational, which indicate that ATC traffic handling capability may be affected. For example, aircraft ground manoeuvring may be restricted in designated areas of the movement area; or ATC may be faced with traffic sequencing problems if, under a limiting weather situation, aircraft possessing different categories of approach capability are mixed in a single holding facility. Suitable ATC procedures should therefor be developed in advance to prepare for such situations.
Runway and Taxiway Maintenance	The non-availability of a runway or taxiway may result in significant operational penalties to the operators, particularly if short notice is given. Accordingly, runway and taxiway closure for maintenance should be carefully planned and coordinated in advance with the operators.
Departure Runway Queue	No aircraft should be cleared onto the departure runway, or to enter the runway behind a landing aircraft, until ready for departure. Departure queue areas ("holding bays" in ICAO terminology) should be designed to permit aircraft to by-pass others which may be delayed for any reason, or to return to the terminal or hangar areas without undue disruption to the remaining departure flow.
Landing Runway	A sufficient number of properly designed "high speed" exits should be provided to assure minimum runway occupancy and minimum taxi time for all types of aircraft served by the runway. Preferred spacing of such exits from the runway threshold is as follows:

1200-1400 m	-	international general aviation
1800-2100 m	-	two engine jet transports
2200-2400 m	-	four engine jet transports

Landing Runway (cont'd)

In locating exits care should also be taken to ensure that aircraft which may over-run the preferred exit are not obliged to taxi an excessive distance before being able to vacate the runway.

Information regarding the status of all visual and electronic approach, runway aids and the runway surface conditions (see page 1-12) should be available to the pilot and to the operational control agency. In addition, accurate RVR observations appropriate to the category should be furnished when visibility is below, or expected to fall below, 1500 m.

Aerodrome Ground Control

Ideally, all surface traffic should be controlled from a common location but this is not always possible. Where surface traffic is controlled by more than one unit, it would be preferable to divide the work by sectorizing the area, but in any event there must be very close coordination as in any other form of traffic control.

Where required, an aircraft surface movement control channel should be provided exclusively for communication between aircraft and the ground control unit. No surface vehicles or other type of mobile communication should be permitted on this channel, for which purpose separate facilities should be provided.

Communications procedures for obtaining pre-flight information, taxi clearance, etc. may vary with locality, but in principle the arrangements should be such as to minimize cockpit workload. ATIS channels should be established wherever practical. (See also under 5 "ATC CLEARANCES" - Initial Clearances.)

RTF communications for control of aircraft on the manoeuvring area should be reduced to a minimum number of short radio contacts for the issue of clearances and information to aircraft, and their acknowledgement. Maximum use should therefore be made of visual aids to the pilot for taxiing aircraft to and from the runway. Guidance of this kind must be unambiguous, simple, effective and standardized, and should be monitored by the control unit for failures. The RTF communications channel should be regarded as supplementing the visual system, and the ultimate aim should be the provision of a fully automatic ground guidance system.

Aerodrome Ground Control (cont'd)	The unit(s) controlling surface traffic should have knowledge of all activity on the manoeuvring area without any need for communications; for example, by direct view, automatic signals at selected positions on the airport, by television, or aerodrome surface detection radar (ASDE). The requirement for unhindered movement of aircraft entails careful integration and timing on the part of ATC in relation to other ground movements and to arriving and departing air traffic in the terminal control area. To achieve optimum utilization of airspace, particularly in all-weather operations, it will be necessary to concentrate more effort on the coordination of control of aircraft on the manoeuvring area and of those in flight. In this regard it must be appreciated that the permitted holding points for aircraft on the ground in Cat. 2 conditions may impose additional restrictions or limitations on the flow of traffic on manoeuvring areas, e.g. ILS "CRITICAL AREAS" must be avoided while the ILS is being used by aircraft approaching to land.
Surface Vehicles	Separate routes which do not conflict with taxiways should be provided for supporting surface equipment, and these should be marked and lighted in such a manner as not to confuse or hinder the free movement of aircraft. Only essential vehicles should be permitted on the taxiways or runways, and then only under ATC control.
Aprons and Holding Areas	Adequate aprons and holding areas for safe and efficient manoeuvring of all types of aircraft should be provided. Information to enable operators to establish the geographical coordinates of INS significant points on the aerodrome is required and should be provided.
Visual Aids	In Cat. 2 and 3 operations pilots are obliged to place increased reliance on the approach and runway lighting systems. It is essential, therefore, that the monitoring capability by the aerodrome controller is such that the pilot can

Visual Aids (cont'd)

be provided with immediate information in the event of partial or complete malfunction of these aids. Visual aids should always be available at night and by day when necessitated by the prevailing weather conditions, and in accordance with ICAO Annex 14 requirements. Controllers should have the capability of varying the intensity of the visual aids immediately upon pilot request and the procedure in use at each aerodrome should be standardized and promulgated.

Serviceability of Aids and Facilities

It is essential that:

- navaids and facilities perform accurately while they are in operation and, therefore, are monitored or checked frequently;

- the ATS unit controlling the aircraft in the intermediate and final approach areas should be provided with remote status indicator equipment displaying information on the operational status of the navigation facilities essential to approach procedures;

- the periods of shutdown for maintenance purposes should be as short as possible;

- planned interruptions in service are promulgated well in advance and are always made known to pilots at the latest when they are entering the relevant area (airway, terminal control area, control zone etc.);

- provision be made to back-up the essential components of the ATC system in order to maintain adequate air traffic services in the event of failure of any of the primary services. (See also under "NAVIGATION AND NAVIGATIONAL AIDS".)

Meteorological Information

In accordance with ICAO procedures the pilot is provided with various categories of meteorological information during flight. To meet these needs, Flight Information Centres (FICs) and Area Control Centres (ACCs) (and/or communications stations) should have the necessary meteorological information readily available for designated aerodromes and

Meteorological Information (cont'd)	significant weather stations over, and adjacent to, the route flown. This information shall also be supplied routinely to Aeromobile Service operating positions, so that immediate replies can be made to requests from aircraft in accordance with the provisions of ICAO Annex 11.
Runway Conditions	Knowledge of the state of runways, including presence of precipitants, braking action, etc., is essential to the safe planning and conduct of flight. It is essential that runway conditions be assessed and reported in accordance with accepted methods, and it is essential that information thereon be readily available and kept up to date. The provision and issue of essential aerodrome information is the responsibility of the air traffic control services (ICAO PANS RAC "Information on Aerodrome Conditions"). The machinery for ensuring that this information is transmitted in sufficient time should be kept under constant review by the air traffic control services. Pending the development of ICAO Standards for the measurement and reporting of runway precipitants and braking action, States are encouraged to develop interim procedures on a regional basis, based on measures which experience has indicated will provide acceptable results. The methods adopted should be promulgated so that the operators can correlate the results with the performance characteristics of their aircraft. (Detailed guidance material on this subject is available in the ICAO Aerodrome Manual, Part 5, Volume 2)
Closure	The concept of regulations which may permit States to close aerodromes to airline traffic solely for meteorological reasons is strongly opposed.

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SECTION 2

AIRSPACE ORGANIZATION

General

Airspace organization must provide full protection for civil aircraft throughout the flight without the need to deviate substantially from optimum or planned flight path. The ultimate objective is therefore the provision of separation between all aircraft, without exception, and during all weather conditions, within the airspace required by airlines' operations. Traffic should be provided with adequate separation and its movement organized efficiently, with a minimum of restriction. The system must therefore have the ability to cope with the peak traffic demand in order to permit aircraft to operate as closely as possible to their flight plans, including the filed time of departure, from the point of departure to the point of intended landing.

Uncontrolled operations should be catered for by the allocation of specific portions of the airspace, separate from those required for controlled operations.

The objective can therefore be described as an air traffic control system governed throughout by agreed international standards and within which there is:

- efficient air traffic control

- protection from collision throughout the flight (by application of the prescribed separation minima)

- flexibility in the choice of flight path for flight planning

- operation with the minimum of restriction along the planned flight path, with the ability to revise the flight path if conditions encountered in flight so require.

In pursuing this objective there are a number of aspects which are of predominant importance from the airline operator's point of view. These are given in the following paragraphs:

General (cont'd)

- The ATC system should be designed to cater for all types of operations. It should be based on direct routings and should generate a minimum of pilot workload.

- Complete freedom in the choice of routes, i.e. an area concept of ATC is required, however it is recognized that in some high density areas, traffic channeling may be necessary. The need for the most direct routings is, however, the ultimate aim.

- Due to the structure of the air traffic control system, a flight is normally subject to control by a series of consecutive air traffic control units. Prior to assuming responsibility for control of a flight, each unit must be able to integrate the aircraft's planned path with other traffic in good time so as to ensure maximum continuity of the flight path. This requires rapid transfer of flight data between all units and agencies having a potential interest in the flight's progress. It also requires that adequate means are available for presenting to the controller the existing and predicted traffic situations in a meaningful manner. At present the method of transferring data is not compatible with heavy traffic, nor is a suitable method of display available. These problems will be intensified in the coming years when aircraft having wide differences in performance capability constitute the traffic mix in an environment of increased traffic density.The potential of automation should therefore be studied carefully, particularly with a view in future to superceding current data transfer and display methods with more advanced ATC techniques, in step with the growth in air traffic.

Individual State activity conducted in isolation, even when it is within the framework of international agreement, can create significant operational problems. It is therefore necessary for ICAO to devise appropriate means of achieving an orderly development of implementation of the airspace structure to avoid problems such as discontinuities in the flight path and incompatibility of procedures. Regional activity does not entirely overcome the problem. In addition, when States plan to make changes within their airspace organization, operators should be consulted and should be permitted to participate in the planning.

General (cont'd)

As already stated, the ideal method of meeting airline requirements, is an area ATC system providing an unlimited choice of routes, and this has been advocated by IATA for many years. Recognizing that the development of such a system will be evolutionary, IATA has proposed that "pre-determined routes" be implemented. (See also Page 2-7)

Airspace in which other users have priority and which could be used to advantage by airline traffic, should not be allowed to remain sterile during inactive periods. For example, when restricted areas are established for special types of activity, such areas should be released to all traffic when not actually in use for their special purpose. Traffic in terminal control areas should not, as a permanent procedure, be required to follow circuitous routings established to meet traffic problems which may only exist on some occasions, e.g. arrangements should be made to permit aircraft to penetrate holding areas, departure sectors, jet penetration areas, etc., when these are not used for their designated purpose, provided this is on a planned basis.

While IATA considers that all traffic within controlled airspace should be controlled, it is accepted that this will take some time to accomplish. As a progressive step towards full control, States have agreed to the categorization of airspace to define the types of operation permitted and appropriate terminology is now being introduced in ICAO Annexes 2 and 11, and the PANS RAC.

IATA strongly supports such categorization as an intermediate step towards full control. However, it is vital that States implement these categories and publish their introduction and use in their AIPs in the interests of safety. (See also "Terminology", Page 2-9)

Air Traffic Advisory Service

A more effective type of service than Flight Information Service is required where Air Traffic Control Service cannot be provided.

IATA encourages the introduction of advisory airspace as an evolutionary step towards the establishment of controlled airspace. However, the efficiency of service which can be provided

Air Traffic Advisory Service (cont'd)

will depend upon the extent of aircraft cooperation and unless all aircraft operating within advisory areas participate in the service offered, such airspace gives only very limited protection. Consequently, IATA believes that all aircraft operating in such airspace should be required to provide the necessary information to the appropriate air traffic services unit. Although it is recognized that this procedure does not ensure adequate separation for all aircraft flying in these areas, it is nevertheless considered that Air Traffic Advisory Service may be a convenient interim stage in the provision of Air Traffic Control Service. As part of the Air Traffic Advisory service, the dimensions and locations of advisory areas and routes should be clearly defined, designated in the appropriate ICAO Regional Plan, and promulgated in AIPs. When advisory service or advisory routes are being established, the air traffic services should, as far as possible, endeavour to accommodate operators optimum routing requirements. Also, if complex routes are developed, they will add unnecessarily to ATC difficulties.

Area Control Concept

In the interests of efficient operations, the airlines' objective is to maintain a regular flow of traffic without restriction in choice of routes. To obtain the most effective use of the airspace, development of the Area Control concept is to be encouraged. However, at the present time it is recognized that there are insufficient facilities in many areas to allow for the implementation of this concept. In those areas, the primary requirement is for control of all air traffic at all times and under all conditions with the minimum of restriction, bearing in mind that this should be expanded into an Area Control System when facilities are available.

Towards realization of Area Control, consideration should be given on a regional basis to modification of existing systems, and the use of pre-determined routes should be examined as a means of attaining the objective whenever and wherever possible.

Airspace Boundaries

IATA interest in airspace boundaries is obligatory simply because they are inevitable in the administration of the airspace organization, and because they have relationship to transfer of control procedures. The lateral limit should not necessarily be associated with political boundaries, but should encompass sufficient airspace so as to limit the number of control transfers, and should relate to the route structure and coverage of radio and radar facilities.

Terminal Control Area

The Terminal Control Area should be organized in conjunction with the control organization in adjacent airspace, so that traffic flow into and out of the Terminal Control Area is capable of being matched by the flow capacity of the adjacent airspace.

Procedures should ensure that the climb and descent requirements of all aircraft types are met and optimum flight paths flown as expeditiously as possible.

Standard Instrument Departures (SIDs) and Standard Terminal Arrival Routes (STARs) should be established and promulgated in clear pictorial form for each Terminal Control Area where traffic density so warrants. These routes should be as direct as possible between the Terminal Control Area entry/exit points and the runway. These routes should not:

- impair ATC flexibility
- unnecessarily involve circuitous routings and additional mileage.

They should be:

- identified in a simple, unambiguous and internationally standardized manner. The designation should be compatible with flight plan processing requirements and provide for the identification of amendments
- used strictly as published and not be a combination of several different procedures
- related only to published facilities. (The number of facilities used for this purpose should be as few as possible, as should be the number of waypoints used to designate SIDs or STARs for area navigation purposes.)

Terminal Control Area (cont'd)

- compatible with aircraft performance capabilities

- compatible with noise abatement procedures.

Standard Instrument Departure routes should terminate at an airway or other ATS route, or at a radio navigation fix. They should be established for all runways and when developed should take into consideration the possibility of engine failure and, in that event, the subsequent procedure to be followed thereafter by the aircraft.

Standard arrival routes should commence at a positive fix no further from the aerodrome than necessary for the efficient control of traffic.

Standard arrival and departure routes should be established in consultation with the operators. (See also under "ATC Clearances" - SIDs and STARs)

If tactical radar vectoring takes an aircraft off the promulgated route, controllers should clear the aircraft back to the direct route as soon as possible. To avoid pilot disorientation, they should also ensure that the pilot is always given his position at the conclusion of radar vectoring.

The design of the terminal control area must permit climb and descent to and from the airways structure in controlled airspace at all times, with efficient coordination between the ATS units concerned.

In high density terminal control areas an important feature of maintaining maximum capacity is an orderly and expeditious flow of traffic onto final approach and runway. Computer assisted approach sequencing appears a promising development in this respect.

To minimize flight deck workload, the terminal control area procedures and route system must be planned to ensure the minimum number of reporting points, changes of communications frequencies, SSR modes and codes and navigational aids.

All navigation aids used to define these routes should be static-free aids.

Terminal Control Area (cont'd)

All flights in a terminal control area should be conducted under IFR. Until such time that this can be achieved, and to ensure the safe separation of IFR and VFR traffic, the latter should either be segregated from IFR traffic or be conducted in accordance with CVFR. All aircraft operating in accordance with VFR should be obliged to contact the appropriate ATS unit for clearance before entering the terminal control area and thereafter maintain radio contact with the appropriate ATS unit.

Transit routes should, as far as possible, without incurring excess mileage, avoid terminal control areas. Where a route must transit a terminal control area, direct routings must be established and promulgated to ensure minimum confliction with the other routes in the terminal control area and position reports should be at a minimum consistent with ensuring adequate separation standards.

Aerodrome Complexes in the Terminal Control Area

In terminal control areas containing more than one aerodrome, measures should be taken to ensure the efficient integration of traffic by the units providing approach control service. Where there is potential conflict between the arrival and departure routes of each aerodrome, the control of traffic should be the responsibility of a single unit to ensure the coordination required.

Predetermined Routes

As previously mentioned, the airlines' objective is to maintain a regular flow of traffic without restriction in choice of routes. Development of the area control concept is, therefore, to be encouraged and the use of predetermined routes should be examined as a means towards realization of this objective whenever and wherever possible.

Predetermined routes are defined by IATA as being promulgated routes established, after consultation with operators, in controlled airspace. Within the capabilities of ATC they provide a choice of tracks, thereby promoting expedition of air traffic and maintaining the maximum of operational flexibility in the area. They also assist the air traffic services by facilitating the setting-up of ATC displays and automation techniques. In order to promote any developments tending to make more efficient use of the airspace, the establishment of predetermined routes is supported. Their application should be governed by the following principles:

Predetermined Routes (cont'd)

- Such routes should be established within controlled airspace where they will:
    - enable a regular flow of air traffic to be maintained,
    - ensure maximum flexibility and economy of operations, and
    - dispense with the need for permanent reservation of airspace for a particular type of operation.

- All flights operating on such routes should comply with IFR. Those military flights operating in controlled airspace but not subject to air traffic control should be separated from controlled flights in accordance with ICAO standard separation criteria.

- All civil and military aircraft movements must be coordinated in advance with a view to providing a safe, orderly and expeditious flow of air traffic.

- Accurate information on those military operations in progress, liable to affect controlled traffic, must be transmitted to the appropriate ATC unit. Likewise, precise data on the flow of controlled traffic must be transmitted to the relevant military control units.

- For implementation of the above principles, effective air-ground and inter-centre communications will be required.

- In order to ensure that coordination is effective, qualified military personnel should be assigned to civil ATC units and vice versa, if necessary.

Compared with airways, predetermined routes offer many advantages, particularly where there is intensive military activity, since:

- they provide for greater freedom in choice of route to be flown, thus enhancing the possibility of flying the optimum route,

- they improve flexibility in the ATC system, thus cutting down delays,

- they do not block airspace permanently when not in use for civil operations, Predetermined Routes (cont'd)

- they promote the application of lateral separation,
- they facilitate the exploitation of area navigation and INS techniques.

Terminology

It is desirable to standardize terminology describing controlled airspace and to maintain simplicity both in terms and in rules. ICAO approved qualifiers for categories of controlled airspace have been developed and are contained in relevant ICAO documents. The introduction of any form of controlled airspace without a suitable designator can be misleading and, in fact, hazardous. This is particularly the case where uncontrolled VFR flights are permitted in the controlled airspace.

Limits of Controlled Airspace

In order to provide all civil aircraft operations with Air Traffic Control Service and achieve optimum use of airspace:

- the upper limit of controlled airspace should be established to coincide with and include a level which is at least five hundred feet above the highest level required by aircraft operating under IFR within the control area. Normally this is determined by Regional Air Navigation Meetings and updated at subsequent meetings. With subsonic jet transport aircraft, the requirement should be for extension up to FL 450.
- the lower limit of controlled airspace should be established to coincide with and include a level which is at least five hundred feet below the lowest level usable by aircraft operating under IFR within the control area. It should also embrace the airspace required to complete the arrival and departure phases.

  Note: The reason for establishing the upper and lower limits at levels above and below the flight levels required, is to ensure that a buffer exists between aircraft operating at flight levels within controlled airspace, and those aircraft operating outside controlled airspace.

Limits of Controlled Airspace (cont'd)

In considering stratification of the airspace, States should be guided by the principle that stratification is not required for its own sake, but might constitute a useful expedient in some circumstances towards providing improved air traffic service. (See also under "AIRSPACE ORGANIZATION - Stratification")

Airspace that is not being used by controlled aircraft below the levels prescribed above should be released so as to provide greater freedom of movement for aircraft not suitably equipped for operation in controlled airspace.

IFR, VFR, CVFR

It is essential that all traffic operating within the airspace required for civil air transport operations be controlled. The prohibition of all VFR activities, or the separation of VFR from IFR traffic without the imposition of penalties or delays to IFR traffic is an urgent necessity.

States should eliminate progressively the see-and-be-seen concept of collision avoidance by the elimination of clearances subject to maintaining own separation in VMC.

It is realized, however, that the nature of traffic, the limitations of facilities and services in certain areas, the type of equipment operated, and pilot qualification may to some extent require the retention of VFR operations; accordingly, it is not practicable to expect aircraft to operate under instrument flight rules in all areas. Where uncontrolled traffic does operate, it must be segregated from controlled traffic, preferably by being confined to airspace not normally required for airline operations.

The application of "extended control" is supported by IATA as a step towards the control of all traffic. The special type of flight rules (CVFR) which provide air traffic control services to VFR flights away from the vicinity of aerodromes, permit the control of such flights even though they are not able to operate in accordance with IFR. (See also under "FLIGHT RULES")

Optimum Climb

Ideally the flight path for the climb of each aircraft should be directed towards destination, and the ATC organization and procedures should be designed to facilitate the clearance of aircraft to climb on the most direct track and without interruption from take-off to cruising level. Lengthy and/or circuitous routings must be avoided. Routings should permit normal rates of climb and should not normally require climbing turns at more than 15° bank unless a terrain clearance problem would otherwise occur. The use of race track or shuttle patterns to attain altitude is also unacceptable except when necessary for terrain clearance purposes.

At the present time, climb-outs can be expedited by the following means:

- by full use of suitable radar,

- by permitting aircraft with superior climb performance and appropriate navigational capability to climb without restriction on predetermined tracks, established as and when necessary and promulgated as far as possible in advance. Such alternative routes should, in consultation with the operators, be kept reasonable in number and assigned for special use e.g. for faster aircraft, or for slower aircraft,

- vertical separation may be effected if a preceding aircraft has a climb performance superior to that of a succeeding aircraft, and can maintain that performance throughout the climb phase. It cannot be stressed too strongly however, that the climb performance varies considerably with weight and temperature and that the vertical profile is non-linear. Consequently, extreme caution must be used when permitting this procedure to be used,

- climb paths can be shortened for high performance aircraft, where high terrain or other restrictions would necessitate more circuitous routings for aircraft of inferior performance,

- facilities can be properly deployed in conjunction with appropriate procedures designed to permit optimum utilization of the available airspace, such as the application of track separation.

Optimum Utilization of Terminal Control Area to Facilitate Arrivals

An uninterrupted descent from cruising level to the runway is desirable. Prior to descent the pilot requires to know, while still at cruising level:

- runway in use at destination and condition e.g. snow, slush, water, braking action,

- the runway category and, if this is lower than the promulgated category, a statement of the responsible unserviceable facilities, (see also "Serviceability of Approach Aids")

- present weather at, and short period trend forecast for, the aerodrome of destination and, if requested, the alternate aerodrome(s),

- anticipated delay based on the current landing rates (See also under "HOLDING PROCEDURES - Expected Approach Times").

Where an uninterrupted descent is not possible, aircraft should be permitted to descend on the relevant inbound routing to arrive over the approach fix at a suitable level. The approach fix(es) should be located so as to permit an aircraft to make a normal descent and be established on the final approach path for the runway concerned at least 6-8 nautical miles from the runway threshold. Promulgated descent paths should not be too steep, i.e. they should not generally exceed the 1:20 descent plane, in order to avoid pilots' difficulties with management of speed and rate of descent. Below 10,000 feet this is considered to be the maximum acceptable descent gradient. When descent clearances are given, ATC must recognize the need to give the pilot time to arrange the most efficient descent, taking into account any head wind or tail wind effect in steepening or shallowing the descent plane. For example, a promulgated 1:20 descent plane could necessitate a reduction in TAS under tail wind conditions.

Approach clearance, or where this is not possible, appropriate holding instructions and expected approach time should be given at least three minutes prior to the arrival of an aircraft over the approach fix. The holding pattern established at the fix should be orientated along the related inbound track, or, when the fix is offset from the final approach

Optimum Utilization of Terminal Control Area to Facilitate Arrivals (cont'd)

path, should be orientated to facilitate orderly transition from the holding configuration to final approach (See also "Traffic Sequencing")

Whenever significant delays are expected, which may necessitate extensive holding, the pilot-in-command should be informed sufficiently in advance in order that he may decide either to hold high or to proceed, with the possibility of holding at a lower level. It may be desirable to conduct holding for delay absorbing purposes, particularly at high levels, over a fix other than the approach fix, in order to permit uninterrupted descent from the holding point to the runway via the approach fix.

If radar is available, aircraft should normally be sequenced between the approach fix and the final approach path using established radar procedures and separation standards, in order to expedite traffic. (See also "Radar Service")

If radar is not available aircraft must be sequenced within an established pattern of routings and must be separated between the approach fix and the final approach path using normal procedural techniques and appropriate separation minima. The pattern of routings should be used by ATC as flexibly as necessary under prevailing traffic conditions, in the interest of promoting a safe and expeditious flow of traffic. A fixing capability approximately 10 nm from the runway threshold along the final approach path is required to serve as a gate to assist in the spacing of aircraft during the approach sequence. An additional consideration warranting the establishment of an approach gate fixing capability is the increasing use by aircraft of automatic approach equipment. In this case it provides valuable assistance to the pilot in ILS localizer interception and stabilization of the aircraft, as catered for in ICAO PANS OPS ILS procedures.

Stratification

Stratification of the airspace is not required as such, but taking into consideration the traffic environment and other relevant factors, it may in some circumstances constitute a useful expedient towards providing improved air traffic services.

Stratification (cont'd)

Where stratification of the airspace is considered necessary the level of division should be agreed upon on a regional basis. In any event it should be ensured that the lower limit of the upper airspace coincides with the upper limit of the lower airspace.

Transition Areas

The problems arising from the transition of traffic between two areas in which different separation standards are applicable increase as the volume of traffic increases. They lengthen and intensify peak traffic periods and result in significant operational and economic penalties. Therefore, when States are contemplating new measures to handle traffic transitioning between areas in which different separation standards are applied, the operators should be consulted in advance and recommendations of a constructive nature solicited, in order to avoid or minimize undesirable flight plan changes which would impose operational inflexibility.

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SECTION 3

AIRSPACE RESTRICTIONS

States should ensure that the intended establishment of airspace restrictions, and the conduct of military exercises, which may affect civil transport operations should always be the subject of prior consultation with civil operators. (See also under "ATS COORDINATION - Military/Civil Coordination".)

Information concerning the establishment and deactivation of prohibited areas, danger areas, or activity which may affect civil air operations should be published well in advance in accordance with the relevant ICAO procedures (Annex 15, Appendix 3). (See also under "AIRSPACE UTILIZATION - Planning".)

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SECTION 4

ATS INFORMATION

Aeronautical Information

To facilitate the preparation of flight documentation when briefing is carried out by the operator, it is necessary to rely basically on information supplied by AIPs and Class I or Class II NOTAMS. The latter should preferably be published on AIRAC dates, in accordance with ICAO procedures designated in Annex 15. Extreme difficulties are encountered by operators when States do not adhere to AIRAC dates in the publication of procedures by Class II NOTAMS, or when procedures are promulgated by Class I NOTAM. Apart from the consequent problem of ensuring that the necessary amendments are made to flight documentation, it must also be recognized that language problems and ambiguities can occur which may be difficult to resolve in the limited time available before the new procedures are implemented. Somewhat similar problems can occur if procedures are cancelled at short notice. It is an operational requirement, therefore, that advance aeronautical information be promulgated by means of Class II NOTAM procedures, that ATS authorities adhere to the content of such NOTAMS, and that any changes be processed in a similar manner.

The procedure for updating airlines' route manuals or other documentation is normally such that aeronautical information promulgated immediately prior to the commencement of a flight cannot be incorporated therein.

Therefore, it is essential for the safety and regularity of the flight that such information as has been promulgated up to the time of departure of a flight be available at the departure aerodrome.

Accordingly, at international aerodromes, information should be readily available in respect of:

- all relevant aerodromes' conditions and associated facilities

- all relevant air navigation facilities

- all other information pertinent to the safety and regularity of a flight,

within defined areas along air routes originating from such aerodromes. Pertinent information relevant to

Aeronautical Information (cont'd)

Category 1, 2 or 3 operations should also be included, as appropriate. ICAO Regional Navigation Meetings appear to provide the most suitable means by which the areas to be covered from any international aerodrome may be defined and agreed.

Pre-flight AIS

There is a requirement for the provision of aeronautical information in accordance with SARPS and Guidance Materials contained in ICAO Annexes and relevant documents to enable operators to prepare route documentation and brief flight crews.

Requirements for pre-flight briefing may vary from operator to operator. Whilst some operators prefer to conduct their own pre-flight briefing of flight crews, others will require the use of AIS briefing facilities provided by the authorities.

The extent to which pre-flight briefing is required may likewise differ between various operators. The needs of some operators may be satisfied by confining briefing to items of a temporary nature and last-minute changes not included in the flight documentation, whereas other operators may have more extensive requirements, including the need for complete presentation of routine information.

Pre-flight briefing service should include all pertinent aeronautical information relating to the route to be flown and to the aerodromes to be used, including that relating to Categories 1, 2 and 3 operations. The latest pre-flight information should be available to flight personnel in concise and legible form, all irrelevant items being removed as far as possible. Bulletins are considered to be the only satisfactory method of issuing such information to flight crews since individual briefing tends to increase the time on ground, especially at busy aerodromes. At peak traffic periods it would also place a great burden on briefing personnel and would require considerable additions to staff to ensure the necessary services. Nevertheless, all information should also be available on a request/reply basis, as required in ICAO PANS RAC (Part 4, para 5, for departing aircraft, and Part 4, para 13, for arriving aircraft).

Pre-flight AIS (cont'd)

Delays on the ground which adversely affect flight schedules are not compatible with the airlines' responsibility to maintain regularity and to reduce ground time to a minimum. Bulletins should therefore be made available to operators in such a form as to obviate as far as possible the necessity for:

- any additional briefing to that provided by the operator
- the operator having to extract additional information from NOTAMS or other aeronautical publications.

The bulletins should be in plain language and should:

- contain information indicating availability, operating data, actual status, etc., of aerodromes and navigational facilities
- state effective dates of any changes in the given information
- contain information covering all such changes which have occurred during the past fourteen days, if still valid
- be designed for easy reference on a route basis to minimize the search for data.

Aeronautical information publications, NOTAMS and ICAO documents are not normally carried by flight crews in their original form and any reference to such publications in information bulletins issued to flight crews may render the information completely meaningless. The bulletins should therefore be formulated so as to obviate the necessity for reference to other publications.

Aerodrome Conditions

The requirement to make available essential aerodrome information is clearly specified in the appropriate ICAO documents. Knowledge of the state of runways, etc. is essential to the safe planning and conduct of the flight, and it is essential that this information be available to operators as soon as practicable. It is necessary that the machinery for updating and transmitting such information in a timely manner be kept under constant review by the air traffic control authorities concerned, and this should be done in coordination with the other responsible aerodrome authorities. Specifically, the

Aerodrome Conditions (cont'd)	provision and issuance of essential aerodrome information to aircraft is the responsibility of Air Traffic Control (ICAO PANS RAC - Information on Aerodrome Conditions). The following information related to aerodrome conditions is the type considered to be essential: - construction or maintenance work on, or immediately adjacent to, the manoeuvring area - rough portions of any part of the manoeuvring area, whether marked or not, e.g., broken parts of the surface of runways and taxiways - the presence of snow, slush, ice or water on runways and taxiways, including their effect on braking action - snow drifted or piled on or adjacent to runways and taxiways - parked aircraft or other objects on or immediately adjacent to taxiways - the presence of other temporary hazards, such as birds on the ground or in the air - failure or irregular operation of part or all of the aerodrome lighting system, including the approach, threshold, runway, taxiway obstruction and manoeuvring area unserviceability lights - any other pertinent information.
Information on Traffic Delays	Timely information of a non-routine nature, such as departure and arrival delay information, implementation of flow control procedures, etc. should be provided to operators concerned.
Information on Wake Turbulence	Turbulence resulting from vortices generated by large turbojet aircraft may affect runway utilization. When the prevailing conditions are likely to favour this situation, appropriate advisory information should be transmitted by the tower (see also "AERODROMES - Turbulent Wake Precautions").
In Flight Information	Verbal updating of aeronautical information during flight is required in accordance with relevant ICAO documents (ICAO PANS RAC, Part 6 and Annex 11, Chapter 4). The service described therein as flight information service is theoretically satisfactory. However, in practice, the air

In Flight Information (cont'd)

traffic control function is becoming increasingly important and there is a tendency to consider the complementary task of providing flight information service as a low grade function, despite its importance to the safety and regularity of air traffic. This is an undesirable situation, and if the workload in ATS units does not permit the provision of a satisfactory service to individual aircraft, alternative means, such as scheduled or continuous broadcasts, should be encouraged. However, up-to-date information on serviceability is not the solution to frequent non-scheduled outages of facilities or services, and every effort must be made to provide fully serviceable systems.

Automatic Terminal Information Service (ATIS)

The provision of Automatic Terminal Information Service (ATIS) broadcasts in high traffic density terminal areas (on discrete frequencies if possible) reduces the communications load on pilot/controller voice channels significantly. The use of such broadcasts should be extended as necessary to remove routine information from en route as well as terminal area control channels. Confirmation of receipt of an ATIS broadcast must be **a required procedure.**

Essential Traffic Information

There is a requirement for essential traffic information to be provided to aircraft which are on IFR flight plans but temporarily separated from each other or from CVFR flights by less than the minima prescribed for IFR operations, including the case when one aircraft is conducting part of the flight subject to maintaining VMC. In addition, information must be provided to IFR flights on those known VFR flights which, in the judgment of ATC, constitute a potential hazard.

It is particularly necessary that IFR traffic be advised by ATC in the event that other traffic has been cleared to pass through its level under VMC. The experience of operators indicates that the PANS RAC provisions in this regard are frequently misinterpreted by ATC authorities in those cases involving controlled flights which have been cleared to operate subject to maintaining own separation and remaining in VMC. In such cases, essential traffic information is given only to the aircraft restricted to maintain VMC and not to the other IFR flights concerned, despite the PANS RAC requirement reflected in Part III para 18.2.

Essential Traffic Information (cont'd)	The provision of essential traffic information should become a condition of the request, issuance and acceptance of clearances to IFR flights to fly subject to maintaining VMC within controlled airspace.
	Since there is a practical limit to the amount of information ATC can pass and which a pilot can relate to the flight path of his aircraft, the use of clearance subject to maintaining VMC will need to be confined to limited portions of climb and descent (see also "FLIGHT RULES").

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SECTION 5

ATS FLIGHT PLANS

Elements of Information in the ATS Flight Plan

The main airline requirement with regard to the ATS Flight Plan is for simplification. The current ICAO flight plan format demands a number of items of operational information considered unnecessary by the operators. These impose additional workload each time a flight plan is completed and efforts are required by all concerned to secure early elimination of redundant elements. The flight plan information required should be limited to those items <u>necessary</u> to ATC, i.e.

- identification
- aircraft type
- proposed time of departure
- destination aerodrome
- estimated time of arrival
- true air speed
- flight level
- route

Nevertheless, it is recognized that supplementary information may be required by ATC or SAR units, on occasion, and the operator should therefore make provision to have this readily available on request. Examples of this type of information are: number of persons on board, aircraft endurance, emergency equipment carried, pilot's name, alternate intended aerodrome, etc. (Item 19 of the ICAO ATC Flight Plan).

Through Flight Plans

There should be no requirement to complete a separate flight plan for each stage of a multi-sector flight, as this is costly, time-consuming and imposes additional workload on both the operator and the air traffic services. Efforts are therefore required to restore the use of TRU and RETURN flight plans, to assist aircraft in achieving short transit stops and turn-rounds.

Filing of Flight Plans

It should only be necessary to file flight plans with one office, and it must be possible to do this by telecommunications (e.g. telephone or teleprinter). In submitting flight plans, the operators recognize that the air traffic services need time to process them and transmit details to other ATS units. Thirty minutes is normally stipulated as being required for this purpose. However, taking into consideration the availability of improved telecommunications facilities, efforts should be made by ATS units to reduce this time.

Stored Flight Plans

Whenever possible the repetitive filing and transmission of flight plan data should be eliminated by the introduction of a system of stored flight plans. Such a system reduces not only the loading on the AFTN but also ATS and operators' workload.

Some States have developed procedures for scheduled flights operating between them, whereby lists containing the flight plans in condensed form for each aerodrome of departure are centrally compiled. These lists are distributed to all ATS units concerned, so that transmission of flight plan messages is unnecessary. Each plan is acted upon in sufficient time to provide the required flight progress strips for use by the ATC unit concerned. Since scheduled air services operate on the basis of fixed traffic schedules which remain valid over a long period of time, it is only necessary for the operator to notify any significant differences from the standard on a day-to-day basis.

Other States have systems where the flight plan information is stored in a central data processor. When the flight is activated the processor originates and transmits the necessary flight plan data to the ATS units concerned.

There are several variations on the methods of storing flight plans but any are acceptable which do not present interface problems and which provide for a standardized method of flight plan filing by the operator, to avoid confusion. Standardized methods are also required with respect to notification and amendment procedures. Where a system of stored flight plans is in use, appropriate procedures should be developed to permit expeditious reversion to manual handling in the event of failure of the automated system.

Relationship Between ATC Flight Plan and Subsequent Operation

Once airborne with a fuel load related specifically to a particular flight path, it is essential that system design and procedures permit the aircraft to proceed throughout the flight as planned and with a minimum of restriction.

It is therefore a desirable objective that, before departure, aircraft receive an ATC clearance bearing a very close relationship to the planned flight. This form of flight plan "protection" calls for a substantial improvement in the correlation of flight plan data in ATC centres.

Both the initial level at which cruise is commenced and the subsequent flight path - whether climbing cruise or a series of step climbs - should correspond closely to the filed ATC flight plan. Where step climbs are planned they should be authorized at the times and to the levels which have been planned, since delay in authorizing climb or step climb to planned level will involve a fuel penalty. It should also be noted that the execution of step climbs earlier than planned may normally be impractical by reason of aircraft weight.

Modification of ATC Flight Plans

With respect to flight planning

- ATC procedures should be designed to permit maximum flexibility in choice of route and level consistent with safe separation. In cases where traffic conditions impose some form of restriction, optimum choice between route restriction and level restriction should lie with the operator. It has been found impracticable to lay down hard and fast limits of acceptable deviation from the filed ATC flight plan in view of the many variables involved such as aircraft characteristics, stage length, prevailing meteorological conditions, etc.

- The characteristics of modern aircraft require that they be operated on, or close to, optimum level. Consequently there is often a common demand for a single narrow level band by aircraft operating along any one route. To solve the problem ATC generally separates aircraft vertically. However, fuel consumption penalties are caused by departure from the optimum level and the point is soon reached where lateral separation, applied at the level originally desired, would be preferable.

Modification of ATC Flight Plans (cont'd)

Nevertheless, lateral displacement from the optimum time track means increased time, again with a corresponding increase in fuel consumption. The amount of lateral displacement, and therefore the amount of increased flight time, depends inter alia on the lateral separation standards which apply on the route concerned, and as these are reduced, the use of lateral separation as a control element tends to become more attractive.

- The use of a stored flight plan system should not preclude the possibility of a pilot requiring a change of the flight plan level to request same on RTF at point of departure.

With respect to the issuance of clearances

- In areas of high traffic density, temporary tactical changes to the ATC clearance in order to facilitate the aircraft's progress with suitable conflict resolution is a more acceptable practice than any alternatives of a procedural nature. The extent of the changes will depend upon the particular environment and the airspace in which they occur.

- It can be concluded that in regions of high traffic density with a high proportion of climbs and descents, temporary changes to the clearance are unavoidable. However, procedural measures would probably result in permanent and more significant penalties.

- In areas where the density of traffic is low, with the flow in one general direction, and the majority of aircraft operating in level flight, there may be valid reasons to support a procedural system in which conflicts are solved in advance and where, as a consequence, changes in clearances are minimal.

- Where stored flight plans are in use, the ATS unit must, if requested by the pilot, be able to provide full details (including specific routings and flight levels) whenever clearances abbreviated to "cleared as filed" are given.

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SECTION 6

ATS COORDINATION

Delegation of Authority

Only one ATS unit should be responsible for the provision of air traffic services within a given portion of airspace. The delegation of authority of one unit to another, including a military ATS unit, may be acceptable if this results in improved service, and provided the following are ensured:

- the availability of adequate communication links between the respective units to enable effective coordination

- the delegation of authority by letters of agreement

- the application of ICAO Standards in respect of civil traffic

- the competency of controllers in the application of ICAO Standards.

Military/Civil Coordination

In many areas, military requirements for tactical freedom, training and other operations tend to conflict with civil requirements. Civil and military traffic have developed different systems of organization, equipment, and control, and these factors make attainment of the civil objective more difficult. In such circumstances, the need for cooperative action in the sharing of airspace by civil and military users should be considered in relation to the following basic principles:

- Whenever there is substantial conflict between civil and military airspace requirements, effective control can only be provided if all aircraft, civil and military, participate in a common system and operate to acceptable standards of navigation and communication. A joint civil/military machinery should be established within a State with the object of achieving full integration of the control of military and civil air traffic.

Military/Civil Coordination (cont'd)

- In States where there are substantial civil/military problems, but where arrangements, equipment, operational function and techniques prevent the early adoption of an integrated system, adequate coordination between civil and military control units should be effected. Such coordination should be improved progressively until a stage is reached where transition to an integrated system can be achieved.

- In those States where the scale of military activity is insufficient to justify adoption of an integrated system of control there still remains a need for effective coordination.

- In order to ensure the effectiveness of measures involving integration or coordination it is essential to ensure that both civil and military ATS units are acquainted with traffic information on all civil and military operations.

- Regardless of whether the day-to-day control of traffic within a State is conducted by coordination between units, or within an integrated system, joint effort by civil and military authorities is necessary in aeronautical planning to ensure cooperation in the planning of the usage of airspace and in the availability of planned facilities for joint use. Planning should take into account the need for consultation with civil operators.

- The establishment of international regional joint committees is supported where these are justified by the scale of civil/military problems requiring solution, and provided that there is adequate opportunity for participation by civil operators.

The subject of civil/military coordination is of great importance to the civil operators, and further elaboration and guidance on the above basic principles is therefore warranted.

Integration (in the context of the basic principle of a common system, mentioned above) implies air traffic services in which civil and military air traffic services are combined with the object of increasing safety and using all airspace to the best advantage.

Military/Civil Coordination (cont'd)

Coordination falls under two broad headings:

- international coordination on civil/military matters

- civil/military coordination to improve the use of airspace and control of air traffic within the airspace for which the State is responsible.

The objective is an air traffic control system which is governed throughout by agreed International Standards and within which there is:

- protection from collision throughout the flight by application of agreed separation minima

- flexibility in the choice of flight path for flight planning

- operation with a minimum of restriction along the planned flight path and with the ability to revise the flight path if conditions encountered in flight so require.

To meet these requirements in full, an area control system is needed, as advocated in greater detail in this document under "AIRSPACE ORGANIZATION".

Wide variations exist between different States in the pattern and density of civil and military air traffic, equipment used, and organizations responsible for the control or direction of air traffic. As a result, States have reached different stages in the development of systems for coordination or integration. In many areas there still remains basic reliance on segregation of the airspace; that is to say, the separation of civil from military traffic by rigid and continuous division and sub-division of airspace into discrete areas for each type of traffic. This is often combined with continued dependence on the "see and be seen" method of collision avoidance. In many States a large proportion of military traffic is at present unable to comply with ICAO procedures (see also under "FLIGHT RULES")

Military/Civil Coordination (cont'd)

The development of the lower airways system for civil traffic in recent years has been substantially influenced by the need to rely on segregation methods to separate civil from military flights. The crossing of airways by military traffic operated in VMC without clearance has been permitted as an interim expedient to help meet military requirements. In some areas crossings are also frequently conducted under military radar, independent from civil ATS units.

The introduction of civil jet aircraft has led to widespread civil operations above the lower airspace system. Despite the acute need for air traffic control service to civil aircraft in the upper airspace, States are having difficulties in providing it, particularly where military activity is substantial, thus prohibiting the application of the segregation method. In such circumstances reliance on the coordination method and, ultimately, the application of the integration method is necessary to permit safe and efficient control of air traffic in the upper airspace.

Wherever there is substantial conflict between civil and military airspace requirements, full integration of the control of military and civil air traffic will provide the most effective means of meeting requirements.

The need for integration is based on the following:

- Both civil and military high performance aircraft are operating in large numbers in the upper airspace. The characteristics of these aircraft involve high closure speeds and high rates of climb and descent. Reliance on visual collision avoidance is therefore no longer practicable. The mere extension into the upper airspace of facilities and airspace arrangements already existing in the lower airspace will neither meet requirements for the safety and expedition of civil traffic nor will it give adequate freedom of movement to military traffic for its various functions.

Military/Civil Coordination (cont'd)

- Effective control cannot be provided unless all aircraft, civil and military, participate in a common system and operate to acceptable standards of navigation and communication.

- The control of all traffic, civil and military, within a given area should be provided from a single ATC unit. As traffic situations change rapidly with time, particularly in the upper airspace, timely coordination between different units controlling traffic in the same airspace may in many circumstances become impossible. Consequently, there might be the tendency to return to the application of the segregation method.

- In order to provide an efficient service to all categories of traffic, the common use of certain facilities and services is advantageous, provided that ICAO Standards are met; for example, the use of air defence radar for ATC purposes may be advantageous.

- It may be necessary to exclude security flights from participation in the ATC system. Special safeguards, however, should be provided to minimize the possibility of conflicts between such flights and flights which are subject to air traffic control.

In advocating an area control system combined with integration of air traffic control, it is recognized that certain portions of airspace may need to be reserved to cater for such flying activity which is not adaptable to control, e.g. training flights, research and development flights, military flights involving gunnery and bombing activity. However, flight to and from such areas should be subject to air traffic control, and this should be encouraged.

The horizontal and vertical dimensions of such areas should be adjusted to suit the current activity. When not required for their special purpose, they should be released for use by all traffic. The planning and coordination of operations in such areas should be carried out by a single authority. Appropriate communications are required to enable such areas to be activated for their special purposes for minimum periods of time.

The integration of all traffic into a common ATC system and implementation of an area control system need not occur simultaneously. However,

Military/Civil Coordination (cont'd)

in areas of substantial military activities, it is difficult to visualize the realization of an area control system without an advanced degree of integration of control.

In such areas different organizational arrangements, equipment, operational functions and techniques may make the early adoption of integrated systems difficult. There may be several stages in organization and in the use of equipment between the first step of coordination and the achievement of complete integration where the responsibility for all control functions rests with one unit. Increased coordination between civil and military control units should only be regarded as an intermediate step towards attaining the ultimate objective of a fully integrated air traffic control system.

In other areas, the scale of civil/military problems may not immediately warrant integration, and a system of coordination may suffice.

Coordination for the purposes of controlling air traffic exists in a wide variety of forms. Generally, it implies that separate civil and military units linked with means of communications effect the coordination. The exchange of information between units may be sporadic or continuous depending on:

- the complexity of the traffic situation

- the ratio of one type of traffic to another

- whether there is substantial mixing of civil and military movements, or, on the contrary, whether each category of traffic is generally confined to separate portions of the airspace.

Coordination in some areas may have reached the point where civil and military personnel work side by side in the same units, and even share, in a limited way, the use of equipment. Whatever the detailed arrangements there remains the coexistence of two separate systems each to provide service to its own traffic. Against this background, uncontrolled traffic might operate in accordance with visual flight rules in many areas with no obligation to avail itself of the control service provided by either system.

Military/Civil Coordination (cont'd)

Where coordination is adopted, the objective should be to fulfill the requirements of civil and military users as far as possible within the limitations of the system, to minimize hazards inherent in the mixing of controlled and uncontrolled traffic, and to work deliberately towards a common system.

Where a system of coordination exists it is essential that, within a given airspace, responsibility for air traffic control service to civil aircraft be assigned to only one ATS unit. If military personnel are employed at a unit responsible for the control of civil traffic, the national civil authority should ensure that they are qualified in the application of standard ICAO procedures.

Where the ATS organization is based on the coordination method there should be compatibility in the basic training of civil and military ATS personnel, to ensure that a common understanding of civil and military functions and requirements is imparted at an early stage.

Regardless of whether the control of traffic is conducted by coordination between different units, or within an integrated system, joint effort by civil and military authorities is necessary to ensure cooperation in the planning of the use of airspace and in the availability of planned facilities for joint use. In certain circumstances the use of some of the military radar facilities available might contribute towards facilitating the control of air traffic. Such joint civil and military planning should take into account the need for consultation with operators whenever appropriate.

Coordination in the national and international field is required to facilitate attainment of the objective. In Europe, the value of civil/military cooperation has been proved, to the advantage of both civil and military interest. Coordination in the planning of large-scale military exercises to minimize interference in the normal flow of traffic is an excellent example in this respect. In other areas of the world the establishment of suitable bodies of international standing and with adequate representation from civil operators, is encouraged.

Coordination Between ATC Centres in ATC Planning

Prior to promulgating and implementing changes to its ATS structure, States should secure coordination on a multi-lateral basis, in order to ensure stability of the regional system where that will be affected. This will ensure that problems of interface at ATS boundaries are avoided, and that the necessary compatibility between ATC Centres is provided.

Transfer of Control

Transfer of control procedures must be unambiguous and must ensure that changeover from one controller to another is effected without a disruption in the air traffic control service. The number of transfers should be kept to a minimum compatible with efficiency of control and communications.

Transfer of control of aircraft from one controller to another may not involve communications with the flight crew of an aircraft, particularly following the development of automation techniques. If communication is required, the transfer of control must be accomplished at times and with a frequency compatible with cockpit procedures and without adversely affecting cockpit workload. When transferring control in a non-radar environment, the pilot should be advised of the call-sign and frequency of the next control unit.

Whenever possible, changes of control should take place at a fix. This does not imply that a navigational aid must be located at every FIR boundary since the control change can take place prior to, or subsequent to, the actual boundary. This may mean the delegation of authority for part of a route to an adjacent centre. Adequate ATC procedures are required to effect the necessary coordination. Within a primary radar environment supplemented by SSR, where aircraft are suitably equipped, a radar handover may be arranged with the assistance of positive aircraft identification procedures.

Tranfer of control should not involve level changes required by procedures due to differences in the systems of cruising levels adopted by States.

Adequate arrangements for the efficient ground-to-ground exchange of flight plan data should obviate the need for pilots to provide ATS units with flight plan information since this involves unnecessary increase in cockpit workload and contributes to communications congestion.

Transfer of Control (cont'd)

Furthermore, by the time an ATS unit has requested such information, received it, assimilated it, and has taken appropriate action, the aircraft entering its area of jurisdiction might already be conflicting with other traffic.

Alerting Service

Whilst it is recognized, that in general, the alerting procedures are adequate, they appear to be deficient under certain circumstances. ICAO Annex 11 contains provisions for the declaration of the alert phase in the event that an aircraft fails to land within five minutes of the estimated landing time, and communications have not been re-established. However, there are no similar provisions for departing aircraft. Under the present provisions, when no communication can be established or should have been established, it can take up to thirty minutes before the uncertainty phase is declared.

Adequate procedures are required to cover this phase of flight, so that the appropriate air traffic control unit is actually aware that the aircraft has taken off and receives confirmation from the subsequent control unit that the handover has been established. Where the controlling agency is not able to ensure that an aircraft has safely completed the take-off or landing phase, either visually or by use of radar or ATC coordination techniques, it should institute a radio contact procedure to confirm that the phase has been completed.

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SECTION 7

ATC AUTOMATION

The objective in the automation of ATC functions should be to increase the traffic handling capability of the system in an efficient manner. These measures should be contemplated only where they will resolve outstanding difficulties of this nature, care being taken to ensure that funds are not allocated to automation where they could be better utilized to provide essential facilities and equipment which may be lacking. It is emphasized that automation must never be applied in isolation, but should be developed as part of a systematic programme. When automation methodologies are being considered for adoption there is a firm requirement for coordination with the operators inasmuch as they will involve airborne equipment. There is also a need to ensure compatibility of the automation plans of different States (e.g. to ensure an efficient interface).

The automation of the ATC functions must not restrict the flexibility of operations and should facilitate, rather than restrict, progress towards an area control concept. Simplification of procedures has not been the airlines' experience following the early introduction of automated techniques and in some instances the opposite appears to have been the case.

The methods employed, and the extent to which the automation of ATC should be applied, are primarily matters for determination by the Authorities concerned. However, the method of handling aircraft and the scale of equipment used may affect the overall efficiency of the system. Operators have, therefore, an active interest in the characteristics and use of automation systems. Computer programming should therefore be developed with the assistance of ATC/operational consultation, to avoid as far as possible the limitations and rigidity of procedures which can result through lack of operational representation in the planning stages of such programmes.

Experience has shown that it will be necessary to incorporate a means of rapidly and easily inserting variations in the following factors if operational restrictions are not to be incurred:

- meteorological data
- geographical data
- aircraft performance data
- flight progress data

The equipment should permit an evolutionary development of ATC procedures but, in accomplishing this, should not limit the capabilities of future ATC systems.

It should be adaptable to particular conditions and to the requirements of particular ATS units.

The equipment should allow for the phased implementation of the complete system.

Automation in ATC may create operational problems to operators unless provisions are made to translate data into a form from which operators can obtain essential operational information concerning their aircraft, i.e. arrival/departure times, position reports, etc. At present, operators monitor ATS channels and use operational control channels to obtain this information. They will have to continue these practices unless other means are available to provide the basic information required for operational control purposes. It is therefore necessary to consider this requirement when any form of data handling is to replace pilot/controller voice communications.

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SECTION 8

PRE-DEPARTURE

Pre-departure Procedures

Special arrangements, commonly known as pre-departure procedures, are now in use at most busy international aerodromes. The objective is that turbine-powered aircraft absorb ATC delays as far as possible prior to starting engines, in order to avoid high fuel consumption on the ground. The main advantages and disadvantages of such procedures, possibly indicating a need for flexibility in their application, are as follows:

Advantages

- reduced fuel consumption on the ground

- reduced congestion at the take-off point and consequently more efficient traffic sequencing.

Disadvantages

- they may affect scheduled departure times

- they may result in apron congestion

- under certain circumstances runway and/or airspace utilization may be reduced.

Pre-departure procedures allowing for full absorption of take-off delays will undoubtedly result in unused runway capacity. Where full runway utilization is essential, some part of the delay must therefore be absorbed at the runway entry. Furthermore, due to the present inability to predict aircraft movements with sufficient accuracy, the only current method of achieving full airspace utilization is to have a small number of aircraft at the take-off point and dispatch them as and when runway and/or airspace become available.

The amount of delay which can reasonably be absorbed with engines running depends mainly on local circumstances. For example, where the runway and airspace capacity is not critical, the following might be optimum:

- for an estimated delay of 5 minutes no account should be made

Pre-Departure Procedures (cont'd)

- if the estimated delay is in excess of five minutes ATC should advise the pilot of the traffic situation, so that he may elect whether or not to remain on the apron.

Where full utilization of airspace, aerodrome movement areas, and aprons is essential, operators may be prepared to absorb higher delays with engines running before pre-departure procedures are activated. It is impossible to associate a standard time factor with the procedures due to the wide variations in aerodrome layout, airspace problems and other considerations. Authorities should therefore prepare a strategic plan for departure procedures in consultation with the operators.

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SECTION 9

ATC CLEARANCES

Scope of Clearances

As recognized in ICAO Annex 11, air traffic control clearances must be based solely on the requirements for providing an ATC service with the objective of ensuring a safe, orderly and expeditious flow of traffic. In addition to the points specifically mentioned in Annex 11, such as clearance limits and expiry times, and any necessary information or instructions on approach or departure manoeuvres, controllers must, when issuing clearances, take into account such factors as known traffic situations (both in the air and on the ground), aircraft performance characteristics, noise abatement procedures, known adverse meteorological conditions, and provisions for communications failure.

Alternative Clearance

Whenever a clearance indicates substantial changes to the filed flight plan, including delays, the reason for the deviation should be given and alternatives offered to the pilot whenever possible.

Initial Clearance

Ideally it would be desirable for the initial clearance issued at the aerodrome of departure to be pre-coordinated with all ATC units concerned for the entire flight and, under normal circumstances, require no modification once the flight is commenced. Such an objective is applicable to all aircraft types, but assumes particular significance in the case of turbojet aircraft and even more so in the case of the SST. Insistence on such a requirement would necessarily mean the support of a procedural ATC system in which all conflict problems would be solved before entry of the flight into the system. This would entail a standard of predictability which is difficult to envisage, particularly in a region of high density traffic. It would probably lead to unacceptable penalties involving the use of undesirable deviations from the intended route or flight level. Delays to aircraft before departure, resulting from the time-consuming coordination process, might also preclude the use of such a system.

For these reasons a tactical ATC system is inevitable in those regions where the complexity and density of traffic requires the use of successive short clearances. Onward clearances should be transmitted to the aircraft in sufficient time prior to reaching each respective clearance limit. In this case the first of such a sequence of clearances would be the initial clearance.

Initial Clearance (cont'd)

It should be feasible to issue initial clearances covering a much greater portion of the flight in regions where a procedural type of control is more appropriate (e.g. North Atlantic and Pacific, etc.)

The initial clearance should, to the maximum extent possible, be a confirmation of the filed flight plan, be clear and unambiguous, and should meet the following requirements:

- cover the entire flight path both in the horizontal and vertical plane from the aerodrome of departure to the clearance limit

- take into account known adverse weather conditions

- be compatible with noise abatement procedures

- provide for the possibility of communication failure

- be based on established departure procedures. These should be published for each departure direction and route.

If restrictions to the planned flight path or delays are anticipated, the pilot-in-command should be advised sufficiently in advance in order that he may request an alternative clearance or take any other action deemed necessary, such as uplifting additional fuel, without the aircraft suffering delay at the last moment.

The issuance of the initial ATC clearance, including the departure runway, prior to the aircraft receiving taxi clearance is strongly recommended (see also under "AERODROMES - Aerodrome Ground Control").

Procedures must also be developed which, among other aspects, will ensure:

- that there is no misunderstanding on the part of the controllers concerning the aircraft's flight plan

- that adequate precautions preclude the possibility of errors and misunderstandings due to last minute flight plan changes

- that the pilot retains the prerogative to request a detailed clearance when required in the case of abbreviated clearances.

Uncoordinated Clearances

In a highly complex ATC system and dense traffic environment the amount of coordination required prior to the issuance of the conventional ATC clearance constitutes a major problem. Preflight clearance coordination may be extremely time-consuming and frequently results in:

- delays to departing flights, and
- a burden on controllers which distracts them from their primary task, i.e. the separation of flights and the monitoring of the traffic flow.

It is often found that once an aircraft has departed (and to the controller becomes "active traffic"), the traffic situation upon which the ATC clearance was based during the coordination phase has changed substantially, thus necessitating an amendment to the initial clearance at an early stage of the flight.

In many cases when radar control is exercised, the actual flight path assigned to the aircraft has no relationship to the initial clearance given.

Authorities should attempt to minimize the need for pre-flight coordination of clearances as far as possible. This may be accomplished by:

- proper organization of the airspace and the delegation of responsibility to the different ATC units involved
- the establishment of appropriate procedures obviating the need for clearance coordination as a routine matter. These procedures should be laid down in letters of agreement between the ATC units concerned.

The ultimate solution is complete abolition of the need for pre-flight coordination. It would be replaced by the technique of issuing abbreviated clearances consisting solely of approval of filed flight plan route and levels, supplemented only by details of the initial departure and the procedure to be followed in the event of communication failure. Where standard instrument departures

Uncoordinated Clearances (cont'd)

(SIDs) have been established and where appropriate, procedures covering loss of communications have been published, there may no longer be any need to transmit the clearance to the pilot in the conventional manner. He could even receive his clearance in a printed form prior to boarding the aircraft.

The issuance of uncoordinated clearances necessitates a highly developed ATC system, supported by fail-safe radar coverage enabling the controller at any time to initiate the appropriate changes to the aircraft's flight path whenever necessary, including appropriate measures to be taken in the event of communications failure (see also "Initial Clearance").

The area, or areas, so covered must be sufficiently large to ensure that, once an aircraft is established on its planned route, sufficient time is available for the coordination associated with the transfer of control to the ATC unit responsible for the adjacent area.

Revision of Initial Clearance

Revision of the initial clearance immediately prior to take-off should carry with it the authorities' acceptance of responsibility for any noise abatement violations that may result from the revised clearance. Additionally, a revised clearance given to the aircraft at this stage will probably involve the crew in a reorganization of their flight documents and a resetting of radio and navigation equipment. This may incur the aircraft in a minor delay prior to take-off and such belated clearances should be avoided.

Standard Instrument Departures (SIDs) and Standard Instrument Arrivals (STARs)

Standard instrument departures (SIDs) and standard arrival routes (STARs) in high density and complex terminal control areas contribute to an orderly and expeditious flow of traffic. They also reduce the cockpit workload and relieve RTF congestion, by condensing what would otherwise be long and involved clearances. SIDs and STARs should be established and promulgated in clear pictorial form for each Terminal Control Area where traffic density so warrants.

Standard Instrument Departures (SIDs) & Standard Instrument Arrivals (STARs) (cont'd)	In advocating the use of standard instrument departure and arrival procedures, certain safeguards should be assured, i.e. - they should be identified in a simple, unambiguous and preferably uniform manner - they should not impair ATC flexibility - they should be used strictly as published and must not be a combination of several different published procedures - they should be related only to published facilities and the number of facilities used for this purpose should be as few as possible - they should be compatible with aircraft performance capabilities - they should be compatible with noise abatement procedures - they should, as far as practicable, be directed towards destination and should not involve circuitous routings and additional mileage.
Weather Avoidance	Every effort should be made to accommodate pilot requests for clearance to avoid severe weather conditions. ATC should do everything possible to provide clearances which will avoid known adverse weather conditions, in addition to this factor being given proper attention when the initial clearance is issued. It should also be borne in mind by ATC that the pilot has emergency authority to over-ride ATC if aircraft safety is in jeopardy. (See also under "RADAR SERVICE - Weather Avoidance")
Optimum Flight Plans	Clearances over tracks and at levels requested by pilots for reasons of flight time or fuel savings, or for passenger comfort, should be granted promptly whenever possible. It is recognized, however, that in areas and periods of heavy traffic this may be impossible without undue penalty to the other users of the airspace.

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SECTION 10

FLIGHT RULES

IFR/VFR

In the interests of safety, it is essential that all traffic operating in the airspace required for the operation of civil air transport aircraft be controlled. Where all traffic in this airspace cannot be controlled, the uncontrolled traffic must be segregated from controlled traffic. This requires that uncontrolled traffic be confined to the airspace not normally required for civil transport operations.

States should abandon the "see and be seen" concept of collision avoidance, and legislate for the mandatory application of IFR by all aircraft capable of operating in this manner.

It is accepted that this measure will probably have to be progressive, but States should develop a positive time scale for this and pursue its application accordingly. For example, VFR operation above FL 200 should be disallowed, and VFR operations progressively eliminated from controlled airspace.

IATA Member Airlines have taken the initiative in complying with IFR at all times, both in controlled and uncontrolled airspace. However, this in itself will not eliminate the collision hazard inherent in the mixing of controlled and uncontrolled traffic, and complementary action is required by States and other users of the airspace.

Compliance with IFR is not intended to preclude a pilot from requesting and being granted clearance to conduct a visual approach by day or night as provided for in ICAO PANS RAC.

Clearances Subject to Maintaining VMC

For the present, the application of IFR does not preclude the use of clearances subject to maintaining VMC, for specified and limited portions of a flight, provided that adequate safeguards are taken both by ATC and pilots. Such clearances should only be given by ATC when requested by a pilot, and States should work towards eliminating the need for such clearances.

Controlled VFR

Unfortunately, for a number of reasons it is not practicable to expect aircraft to operate under instrument flight rules in certain areas. Therefore, the application of control service to VFR flights in such areas is endorsed by IATA and States are encouraged to use this means where full IFR requirements cannot be met.

At the same time, the introduction of controlled VFR should not delay the development of reduced IFR separation standards; nor should any attempt be made to introduce controlled VFR flights into those portions of the airspace where compliance with IFR is already mandatory.

IATA accepts the fact that there will be a need in many areas to continue to provide for special VFR routings as a means of separating these flights from controlled flights. This applies particularly when the VFR flights are unable to navigate and communicate as required for control purposes.

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SECTION 11

POSITION REPORTING

General

The needs of air traffic services units for up-to-date information regarding the progress of aircraft in flight vary considerably, depending upon the type of service provided, the airspace organization, the volume and characteristics of the air traffic and the ability of aircraft to adhere to their current flight plan. However, under a given set of circumstances, the aim should be to minimize position reporting requirements, in order to alleviate the workload of both pilots and controllers. In this regard it has been established that there is a direct relationship between ATS position reporting requirements and the volume of cockpit documentation needed for the flight.

Accuracy of Position

Reporting points should be designated geographically or in relation to ICAO short range navigational aids, and where VOR or VOR/DME coverage is available these facilities should be used. The navigational guidance provided shall be such that it is possible for aircraft to position themselves over the reporting points with accuracy.

Composition & Frequency of Position Reports

The contents and frequency of position reports should be sufficient to enable ATS units to provide for the safe expedition of all traffic in a procedural system. They must, however, be kept to a minimum consistent with ATS requirements, the need to reduce workload, and the congestion on communications channels. High-speed aircraft have been introduced on routes often with little or no change in the pattern of position reporting points, imposing an increasing burden on both pilots and controllers. In some areas, the required frequency of reporting indicates the improbability that all information being given to the controller can be effectively applied, particularly where only a few minutes elapse between reports and when radar surveillance is available.

Simplification of Position Reporting Requirements

Simplification of position reporting practices is primarily intended to achieve a reduction in workload through reduction and/or elimination of reporting point(s), following a critical review by individual States and/or ICAO Regional Air Navigation Meetings.

Simplification of Position Reporting Requirements (cont'd)

Simplification of current reporting practices can be achieved by:

- reducing the number of compulsory reporting points
- differentiating between compulsory reporting procedures for different categories of aircraft
- application of exemption procedures
- use of abbreviated position reports.

Abbreviated Procedures

In terminal control areas, where ATC may require position reports at relatively short intervals, the inclusion of forward estimates is generally unnecessary since the controller, having handled previous aircraft, can often determine the ETA with better accuracy. However, where multiple routings exist it may be desirable for aircraft to indicate the next reporting point as a means of confirming their routing. In the en route case, forward estimates may continue to be required, particularly in areas having inadequate communication or navigation facilities, or inadequate inter-centre coordination. Strict compliance with standard phraseology will ensure brevity of ground/air messages and the avoidance of misinterpretation.

Following review, it may be possible to modify routine position reporting requirements by eliminating some compulsory reports, or by retaining them on a "request" basis only.

Omission of Position Reports

The majority of reporting points in a terminal control area are established in order to control arriving and departing traffic and are not in all cases necessary for control of aircraft in transit through the area. Position reporting should, therefore, be reduced by:

- more rapid and reliable exchange of flight progress information, as well as improved coordination between adjacent ATS units and between individual controllers at each unit

Omission of Position Reports (cont'd)

- elimination of the need to report position at all the reporting points by aircraft in transit through a terminal control area.

In a radar environment, procedures should be developed which will permit automatic omission of reports as soon as the pilot has been informed that his aircraft has been radar identified and while radar contact is maintained. Such procedures should ensure that position reporting is resumed following termination of radar service or loss of radar contact.

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SECTION 12

ATS COMMUNICATIONS

Abbreviations and Phraseology

It is satisfactory to IATA if the abbreviations and phraseology used in air/ground ATC communications are limited to the ICAO-approved terms. Unfortunately, in practice, unauthorized abbreviations are used in some areas, and in this respect there is a need for improved discipline on the part of all users of RTF. This is particularly unsatisfactory when aircraft callsigns are involved, since the result can be a misunderstanding of ATC clearances and a consequent reduction in safety. Only the air traffic controller is in a position to know whether abbreviated callsigns can be used on a particular occasion without risk of ambiguity. The initiative to use abbreviations in this regard should therefore be solely with him, and when there is risk of ambiguity the controller should take steps to ensure that abbreviated callsigns are NOT used.

Language Problems in Air Ground Communications

Whilst it is recognized that ATC may properly be carried out in the national language, use of the English language for this purpose is encouraged. Where English is not used in air/ground communications problems can arise in some circumstances, particularly where IFR traffic is being controlled in relation to local VFR movements and where the language being used by the ATC unit with national aircraft is not understood by non-national IFR traffic. Pilots have become accustomed to monitoring the RTF to gain a better understanding of the traffic situation and this on many occasions is of help to ATC, and certainly improves the discipline necessary on a radio telephony channel. However, if other aircraft movements are observed which cannot be correlated with the RTF conversation, uneasiness and misunderstandings can occur. As long as RTF communications form part of the Air Traffic Services, and until control of all traffic is achieved, the safety standards could be adversely affected when pilots are unable to monitor instructions to other aircraft in their vicinity.

Communications Congestion

In many high density areas, communications congestion already seriously hampers the efficient handling of traffic by air traffic control. As a result of the inability to communicate instantaneously, increased separation may have to be applied, thereby slowing

Communications Congestion (cont'd)

down the flow of traffic and contributing to delays. Disadvantages of the present-day communications system include:

- lack of continuity in the exchange of information
- human limitations
- frequency congestion

Under the existing communications system the effect upon cockpit workload will increase with the general expansion of air traffic. The trend to have all aircraft within designated airspace participate in the ATC system will also aggravate the communications problem. Additional unnecessary communications traffic is generated when pilots are obliged to pass information to ATC units on air/ground channels which should properly have been relayed on the fixed services (see also under "ATS COORDINATION - Transfer of Control").

Immediate Remedies

The following methods should be utilized in order to reduce communications congestion:

- maximum use of data derived from radar, and inclusion of SSR with 4096 codes and Mode C automatic altitude reporting in the system, in order to eliminate all unnecessary voice communications

- a general reduction in the quantity of information required to be passed from the cockpit to the ground. This refers particularly to position reports, many of which could be eliminated.

- use of abbreviated position reports wherever possible

- the use of ICAO standard RTF phraseology and procedures at all times, and the improvement of RTF discipline by both air and ground personnel

- improvement in the quality of air/ground communications to avoid the need for repeating transmitted information, including the use of VHF in preference to HF and the expansion of existing VHF coverage

Communications Congestion (cont'd)

- improvement of communications between ATS units

- improvement of coordination between ATS units

- the use of correct transfer of control procedures (see also under "ATS COORDINATION - Responsibility for Transfer of Control")

- simplification of clearances, e.g. use of standard instrument departures and arrival routes

- maximum use of VOLMET broadcasts to eliminate ground-initiated messages and request/reply traffic for data which could be obtained from such broadcasts

- expanded use of ATIS broadcasts (see also under "ATS INFORMATION - Automatic Terminal Information Service").

Longer Term Remedies

The solution may lie in an automated ATS air/ground communications system to relieve congestion and simplify and accelerate the exchange of flight data between air traffic controllers and aircraft (see also under "Automated ATS Air/Ground Communications"). Improvements in navigational capability will also permit reductions in radar vectoring requirements and associated communications.

Communications During Take-off and Initial Climb

With respect to establishing communications immediately after take-off, the operators' requirement is that no communications should be conducted until the aircraft has completed its "after take-off" procedures (including wheel and flap retraction) or until the completion of noise abatement procedures, whichever is later. A period of two minutes from brake-release time is normally sufficient to cover this process, and except under special circumstances, communications should be avoided during this time. Where an ATC requirement exists for early radar identification of an aircraft, communications should be kept to a minimum. Operators have nevertheless a continued requirement for radar separation service from the time of take-off, and arrangements should be made by ATC to meet this requirement (see also under "ATS COORDINATION - Alerting Service").

Communications During Take-off and Initial Climb (cont'd)

If a frequency or SSR code change immediately after departure is necessary, one of the following procedures should be used:

- the frequency or code should be communicated to the aircraft before take-off, with the instruction for an automatic frequency change at a given position or after a certain time, or

- circumstances permitting, the frequency change should be made before the aircraft starts the take-off roll after it has received its take-off clearance.

Transfer of Communications

(See also under "ATS COORDINATION - Responsibility for Transfer of Control")

Identification of Routes, Facilities, Reporting Points etc.

In order to avoid confusion and to provide for compatibility between automated ATS and COM equipments; routes, facilities and ATS reporting points should be identified in a uniform manner, preferably based on self-evident nomenclature. The widespread use of systems in aircraft suitable for area navigation purposes will necessitate a high degree of international standardization in the designators employed to identify ATS significant Points.

Pilot/Controller Communications

It is essential for the efficient conduct of Air Traffic Control service that radio telephony communications be on a direct basis between the pilot and the controller.

It is recognized that over large expanses of ocean or uninhabited land masses, where HF/RTF is used, there may be disadvantages in trying to provide for direct pilot/controller communications when using a network of frequencies, all of which may need to be monitored at one time.

Wherever it has been proved to be technically feasible to use VHF communication, either with a single station or using techniques providing forward cover to enlarge the area of operation on one frequency, it is essential that the controller is directly in contact with the aircraft on that frequency, and that the forward relays are part of this direct connection.

Radio Communication Failure

It is virtually impossible to provide regulations and procedures applicable to all possible situations associated with two-way radio communications failure. They should, therefore, be kept simple and in accordance with the basic ICAO Annex 2 principles, since the alternative is a proliferation of procedures which pilots engaged in worldwide operations find unmanageable. In the case of aircraft operated by IATA Member Airlines the possibility of total communications failure is remote and borders upon an emergency situation. When confronted by a situation not covered in the regulations, pilots are expected to exercise good judgment in whatever action they elect to take. Correspondingly, controllers must be prepared to deal with such situations and to place considerable reliance on the performance of the pilot under the circumstances pertaining. The intelligent use of SSR is one example. Should the situation dictate, pilots will not be reluctant to use their emergency authority.

IATA endorses the consolidation of worldwide communications failure procedures in an ICAO document of suitable format, preferably including diagrams which clearly illustrate the procedures to be applied by pilots in the various situations in which communications failure may be encountered, e.g. departure, en-route, or arrival phases of flight.

Jammed Transmitter

Interference on a communications channel resulting from a jammed transmitter is not likely to occur so frequently that special warning devices are warranted. However, when such an incident does occur it can seriously affect the ATC situation. Consideration should therefore be given to assigning and promulgating alternative frequencies for use under such circumstances.

ATC Alerting Service

(See under "ATS Coordination")

Automated ATS Air/Ground Communications

Increasing communications congestion associated with traffic growth have generated communications capacity problems as well as adding to controller and pilot workload. This has led to consideration of automating to the maximum practical extent the volume of routine air/ground data exchanges now carried out on RTF channels. In studying the development of techniques and systems to meet this objective it may be desirable to consider the

Automated ATS Air/Ground Communications (cont'd)

orderly introduction of data link in the following stages:

- ground to air provision of all advisory information now generally transmitted by means of broadcasts on voice channels, e.g. VOLMET, ATIS etc.

- air to ground acquisition of information required for ATS purposes, e.g. aircraft identification, flight level, speed, position etc., without pilot involvement

- ground to air provision of ATC instructions and clearances

- pilot/controller exchanges of request/reply message traffic.

ATS applications are likely to constitute one component of a universal data link system, the most significant benefits probably accruing in the first instance by long range operations where procedural ATC methods are in effect.

When automated ATS air/ground communications are being planned, it will be essential to ensure that the air traffic services possess the necessary capability to support and exploit each of the stages as they are implemented.

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SECTION 13

CONTROLLER/PILOT COOPERATION

Air Traffic Services are provided to promote a safe, orderly and expeditious flow of air traffic. ICAO Annex 11 prescribes how the airspace should be organized and how the required units and services should be established to realize this objective. Annex 2 prescribes how aircraft should be operated to fit into the ATS organization, and PANS RAC and other documents prescribe in detail the procedures to be followed by ATS personnel as well as pilots. The efficiency of the total system requires ATS personnel and pilots to be familiar with, and well trained in, the procedures as applied in different environments.

For obvious reasons the ICAO documents can only deal in strict terms with the procedures and their application. However, in the training and recurrent training of controllers and pilots, it is possible and indeed desirable to include certain human relations aspects, in order to maintain a cooperative spirit between the two groups and to foster a better understanding of the problems.

Every effort should be made by both operators and air traffic control authorities towards mutual appreciation of each other's difficulties, since this will promote better coordination and efficiency. A satisfactory method of promoting cooperation between the air traffic services and operators is through the organization of meetings, preferably informal and on a local basis. At these, views can be exchanged, problems discussed and procedures reviewed or developed, to mutual advantage. By this means the environmental limitations which can adversely affect compliance with, and acceptance of, agreed procedures are more readily recognized by those directly involved in the operation and control of aircraft.

Difficulties encountered by controllers should also be made known to operators so that these can be taken into account in pilot training programmes.

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SECTION 14

ALTIMETER SETTING PROCEDURES

In general, the Altimeter Setting Procedures as contained in ICAO PANS OPS are supported. The following procedures warrant emphasis:

- For terrain clearance, QNH should be used. States should establish adequate networks of QNH stations for safe assessment of terrain clearance.

- Feet should be the unit used for vertical separation.

- For landing, QNH should be used internationally; QFE should be made available on request of the pilot.

The setting (using a pressure altimeter) which provides the pilot with the most accurate indication of his altitude is the actual QNH value reported from a station in the vicinity of the aircraft's position.

QNH (and QFE) values should be given in millibars.

Transition Altitude

When establishing the height of the transition altitude, care must be taken to ensure that all relevant factors are taken into account, including pilot workload during the initial climb phase of the flight and current aircraft performance characteristics. Thus, in the case of jet aircraft, a transition altitude established at the ICAO-permitted minimum of 1500 ft. will be attained within a few seconds after take-off, and during a period when the pilot is likely to be preoccupied with post take-off aircraft checks. Similarly, transition levels established at the ICAO-permitted minimum may be too low when considering the performance characteristics of jet aircraft during descent.

Altimeter Pressure Settings

Altimeter setting values should be made available to aircraft at an early stage in the approach. When ATIS is used for this purpose, means should be established to ensure that the pilot has received the correct and latest altimeter setting, (e.g. readback of the altimeter setting when acknowledging receipt of the ATIS broadcast).

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SECTION 15

CRUISING LEVELS

Assignment of Cruising Levels

Within controlled airspace, Air Traffic Control should assign cruising levels to provide vertical separation between aircraft (See also "SEPARATION OF AIRCRAFT".) The assignment of cruising levels should not be based on a rigid system dependent upon the track being flown, since changes in track may require level change(s) en route merely for the purpose of complying with such a system. Instead, the assignment of cruising levels should rather be based on the flow of traffic.

Where transition from controlled to uncontrolled airspace, and vice versa, necessitates a change in cruising level, Authorities should make provisions to ensure as far as possible that such changes take place within controlled airspace, and at a position fixed by radio-navigational aids.

Where transition from an area where vertical separation is based on feet to an area where vertical separation is based on metres, and vice versa, necessitates a change in flight altitude, Authorities should clearly indicate transition areas including buffer zones and the flight levels usable within these areas/zones for safe transition.

In areas where feet designators for flight levels are not accepted, metric flight levels should be expressed in metres and followed by the word "metres", e.g. FL 8000 metres.

Ideally an aircraft should be assigned the cruising level(s) requested in the flight plan. Whenever this is not practicable and a substantial deviation from the desired cruising level is necessary, the pilot should be advised and an alternative clearance should be offered.

When determining the lowest level which may be assigned in controlled airspace, the Air Traffic Control Authorities should, in addition to terrain clearance requirements and other relevant considerations, ensure that a suitable buffer is provided between this level and the maximum level at which uncontrolled traffic may be permitted to operate below this level.

Assignment of Cruising Levels (cont'd)

Such buffer may be adequately provided through specifying the lower limit of the control area to coincide with, and include, a level which is at least 500 feet below the lowest level required by aircraft operating within the control area.

Terrain Clearance En Route

Under Annex 6, operators are permitted to establish minimum flight altitudes for those routes flown for which minimum flight altitudes have been established by the State flown over. The former usually incorporate a greater terrain clearance margin than the ICAO Standard of 1000 ft. above obstacles within five miles of track. Therefore, if the controller clears an aircraft to the lower of the two, this is unsafe according to the operators' standard, but safe according to the ATS standards laid down by the State. (See also under "RADAR SERVICE - Terrain Clearance".)

Terrain Clearance in the Terminal Control Area

The establishment of minimum levels to provide the required terrain clearance should be resolved on a local basis, in consultation with the operators. A particular problem can be foreseen at those locations situated on or adjacent to high terrain, care being necessary in such cases to compensate safely for extreme variations in local atmospheric conditions. Appropriate allowances should, however, only be made on a local basis in order not to restrict operations at every location and thus waste usable flight levels and altitudes unnecessarily.

Terrain Clearance Responsibility When Vectoring Aircraft

In vectoring aircraft by radar, the responsibility for ensuring adequate terrain clearance rests with the air traffic radar controller.

When terminating radar assistance, the responsibility of ATC with regard to terrain clearance should extend at least to a point from which, thereafter, the pilot is able to establish the position of the aircraft by airborne means with an accuracy sufficient to ensure adequate terrain clearance. Furthermore, ATC are also responsible for ensuring that, in the event of radar failure aircraft have adequate terrain clearance until such time as they can re-establish their position and navigate by pilot-interpreted aids (See also under "RADAR SERVICE - Terrain Clearance".)

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SECTION 16

SEPARATION OF AIRCRAFT

General

Since the operating characteristics of modern and future aircraft types will allow little flexibility in the choice of economical en route altitudes, and since the growth of air traffic will necessitate more extensive use of separation in the horizontal plane, systems and facilities should be provided which will facilitate the use of ATC procedures based on both lateral and longitudinal separation.

In many areas of the world the separation minima currently employed lead to delays in all phases of flight, and to the use of uneconomical cruising levels. As a fundamental principle airspace should be conserved, and every effort should therefore be directed towards reducing the lateral, longitudinal and vertical separation minima to the lowest levels possible consistent with safety.

In the upper flight levels an increased vertical separation standard is currently applied. There is a requirement to restore this as soon as possible to the nominal value of 1000 ft. applicable below these levels. All airspace users should be equipped to permit the application of the agreed minimum separation standards.

Implementation of reduced separation minima, as the result of a general improvement in navigational capability, should not be deferred pending acquisition of the necessary navigational capability by all the airspace users. Aircraft unable to meet the general standard should only be accommodated in the same airspace if this is possible without detriment to the other users. Meanwhile, pending confirmation of a general improvement in navigational capability, the use of composite separation offers an acceptable and effective method of increasing airspace capacity.

Special criteria may be applicable for approach conditions, including spacing for parallel landings. Inevitably denser traffic situations occur in the terminal control areas and it is advisable therefore to concentrate on the application of lower separation standards for landing and take-off, and approach and climb-out, by use of efficient radar equipment in the hands of well-trained radar controllers.

Separation Based on Climb and Descent Performance

The conditions under which separation on the basis of different climb and descent performance can be applied and accepted by operators will require separate study.

At the present time traffic flow can be expedited by taking advantage of different climb and descent performance to obtain the required separation between aircraft, this procedure being applied by correlating plan position, obtained by radar, with vertical position transmitted as necessary by the aircraft. This procedure is not the ideal solution because ATC is obliged to interpolate vertical position on the basis of successive reports from aircraft, and it also occupies air/ground communications time. Neither should that solution be considered ideal whereby the maintenance of vertical separation is based on pilot-to-pilot communication. Such a procedure, besides occupying communications channels, also adds to the workload in the cockpit.

Where the air traffic services are notified of wide differences in aircraft climb and descent performance, such information can be used for strategic planning and to facilitate application of the relevant PANS RAC procedures which permit reduction of separation criteria under particular circumstances. It is obvious that differences in climb gradient and/or CIAS offer a better basis for reduction in separation minima, and that the average TAS currently filed in the ATC Flight Plan is not valid for this purpose.

In summary, therefore, separation based on climb and descent performance is acceptable only between aircraft with a marked difference in performance, and provided agreed procedures are used.

Separation Using Mach Values

The logic of using Mach number as a reference for the provision of longitudinal separation differs somewhat from the concept of separating aircraft based on estimated true airspeeds, or ground speeds, to provide air traffic controllers with a geographical reference. With the Mach technique turbo-jet aircraft operating successively along suitable routes are cleared by ATC to maintain appropriate Mach numbers for a relevant position of the en route phase of their flight,

Separation Using Mach Values (cont'd)

to which the aircraft are required to adhere within close tolerances in order to maintain longitudinal separation between them. Application of the Mach number technique eliminates wind and temperature forecasts as sources of error in the predicted separation between aircraft longitudinally spaced at the same altitude.

Separation between aircraft using Mach values is an established ICAO procedure acceptable to IATA which should be applied where conditions are suitable, and where it can contribute to a reduction in longitudinal separation.

Nevertheless, the use of Mach Techniques does not imply that all aircraft in the system must be limited to using the same Mach value. Refinements of this technique, such as described subsequently, may be used to improve the capacity of the system in which aircraft with widely differing speeds operate.

Mach Technique - Following Aircraft Faster

Considerable experience has been obtained with this technique in certain areas. Over sectors of the order of 1800 nautical miles, for example, safe separation is assured between subsonic jet aircraft by allowing for an extra three minutes of time at the sector entry point, for every hundredth (0.01) Mach by which the second aircraft is faster.

Mach Technique - Following Aircraft Slower

It is equally logical to apply the rule the opposite way for the same stage length (1800 nm). For every 0.01 Mach by which the following aircraft is slower, separation on entry into the sector may be reduced by three minutes. In practice this would permit longitudinal separation to be reduced down to five minutes, the minimum value established in ICAO PANS RAC when the preceding aircraft is maintaining a TAS of 20K or more faster than the succeeding aircraft. In both cases other values would be applicable for different stage lengths.

In applying the Mach Technique, due allowance must be made for the tolerance to which aircraft can adhere to assigned Mach.

Separation During Take-off and Landing

As a general rule, separation between departing aircraft and between departing and arriving aircraft should at all times be such as to ensure that the runway length required for take-off or landing is fully available. Since conditions vary locally, details of the separation to be used should be the subject of prior consultation with, and agreement of, the operators. (See also under "AERODROMES - Turbulent Wake Precautions".)

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SECTION 17

AIRSPACE UTILIZATION

Planning

The present operating problems in certain areas particularly with regard to lack of capacity of the present ATS system result in a build-up of extensive air traffic delays. Therefore, if adequate progress is to be made in interim and long-term planning, it is essential that detailed studies should be made to develop an air traffic control system which evolves progressively.

Such studies should:

- analyse the present traffic situation and determine anticipated density and peak distribution of traffic in the area

- examine means of accommodating as much of the anticipated traffic as possible by redesigning route structure and improving procedures without change of separation standards

- evaluate, if reduction of standards be considered necessary, the cost-effectiveness of all feasible methods to reduce lateral, longitudinal and/or vertical separation, taking into consideration the possible necessary implementation of improved aids and instruments in the aircraft, on the ground, or both.

Flow Control

Flow control implies the authority of ATC to regulate the acceptance of aircraft in a particular situation, in order to organize the resulting flow so that the risk of saturation is reduced.

The application of flow control is undesirable. The restriction of traffic movements through a terminal area or along an air route to a rate stipulated by the Authorities places the burden of the entire economic and operational penalties involved directly on the operators. The air traffic services should instead be adequate to accept the traffic offered and should also be developed to accommodate expected traffic growth, taking into due consideration the cost/benefit aspect.

Flow Control (cont'd)

In some cases the practice of flow control may have to be accepted to ensure safety, but it should not be resorted to as a substitute for improving the efficiency of the ATC system. Flow control can only be accepted when States and operators are satisfied that the system and the airspace is being used to its maximum capacity, as applicable to the area concerned and not just on an individual route basis.

If it is necessary to impose temporary flow control measures or to route some traffic away from preferred routes, in order to avoid saturation, due consideration should be given to the consequent disruption to operations if scheduled flights are unduly diverted from their regular routes. Preference should therefore be given to such flights to follow their planned routes as far as practicable.

It is pointed out that when flow control is implemented in one area this often affects the traffic flow in other areas. Due to these far-reaching effects of flow control on adjacent centres there is a need for a multi-lateral machinery to ensure coordination between all ATC units concerned.

Schedule Control

Schedule control implies the limitation or rearrangement of planned times of arrival and/or departure in a manner intended to reduce congestion at peak periods.

The effectiveness of schedule control would be limited by the degree of accuracy to which operators could guarantee the timing of traffic movements in advance.

For a number of reasons, including its effect on the economic, commercial and operational aspects of operations not only locally but at other points much further afield, operators strongly oppose any attempt by Authorities to regulate or control the arrangement of schedules as a substitute for adequate air traffic control services.

In some cases there may be merit in considering minor modifications to planned operating times at aerodromes where acute problems arise at peak periods. In such cases organization of any such adjustment should be the prerogative of the operators. Such measures should then apply to all users of the aerodrome concerned.

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SECTION 18

AIRMISSES AND OTHER AIR TRAFFIC INCIDENTS

Definitions

In order to clarify the situation and to differentiate between airmisses and air traffic incidents, IATA has found it useful to develop the following definitions:

> An airmiss exists whenever a pilot considers his aircraft endangered by the undue proximity of another aircraft.
>
> An air traffic incident, apart from an airmiss, is considered to have occurred whenever any aircraft has been brought into difficulty resulting from faulty procedures, lack of compliance with applicable procedures, or failure of ground facilities.

General

Airmisses and air traffic incidents are a result of either deficiencies in the system, deficiencies in the application of established procedures, or of human factors. It is an obvious objective that effective organization of the airspace, application of rules and procedures, and the type of service provided, will eliminate air traffic incidents or at least reduce them to a very rare occurrence.

Airmisses - Contributing Factors

One of the main factors contributing to airmisses is a mixture of controlled and uncontrolled traffic irrespective of the latter being known or unknown to ATC, the most typical being where one or both aircraft are operating in accordance with VFR. This factor is particularly evident in high density traffic areas (TMAs) at low altitudes, and in the enroute phase at higher altitudes.

Due to the increased speed of current aircraft, and the workload necessary to comply with navigational, ATC and communication requirements, it must be emphasized that separation of aircraft can no longer be safely accomplished through the "see-and-be-seen" concept. This applies not only to terminal control areas, but also to the enroute climb, level flight and descent, where detection is almost impossible due to the limited capability of the human eye. Segregation of controlled and uncontrolled aircraft would undoubtedly eliminate the majority of airmiss

Airmisses-Contributing Factors

incidents. The imposition of arbitrary speed restrictions is not felt to contribute towards a solution to the problem. Other factors contributing to airmisses are:

- lack of efficient coordination and/or communication between military and civil ATC Centres
- deficiencies in the ATC organizations
- lack of ATC facilities
- insufficient pilot proficiency or lack of knowledge with regard to the airspace environment
- lack of coordination between air traffic control functions
- practice intercepts conducted for military training purposes.

Reporting of Airmisses

Responsibility for the avoidance of collisions rests with the Air Traffic Control authorities. Therefore there must be an organized method for reporting, investigating and taking corrective action on such incidents.

It is essential that if airmisses are to be dealt with effectively there must be immediate action to obtain, record and preserve all relevant information and data.

The pilot of an aircraft involved in an airmiss will immediately report details of the incident by RTF to the appropriate ATS unit. This initial contact should be regarded as the signal to start the information and data gathering process mentioned above.

As soon as practicable the incident reported by radio should be confirmed by a written report. Where this is submitted by the operator, account should be taken by ATC authorities of the time which may elapse until details of the incident are in the hands of the operator, particularly when intercontinental flights are involved.

Reporting of Airmisses (cont'd)

It must be emphasized that investigation of the incident should not be delayed pending receipt of the written report. If no report is received, it should be requested from the operator, and should not constitute a reason to cancel the investigation.

The State responsible for investigating an airmiss is also responsible for informing the operator in detail of the result of this investigation

Reporting of Serious Air Traffic Incidents

When a serious air traffic incident is reported, similar action should be taken as in the case of an airmiss incident report.

Action on Airmiss Reports

It is most important that early action be taken to deal with any incidents, that the result of the enquiry be finalized as soon as possible, and that suitable action be put in hand to prevent further incidents from the same cause. Early action to investigate the incident is particularly important since clarification of the cause may in many instances only emerge from careful discussion and questions covering points which are not normally recorded in either the aircraft or on the ground. In those cases where a playback of the RTF is deemed necessary, the transcript may be of primary interest and the operator should be provided with a copy.

Over a period of time, a careful analysis of the circumstances, causes and types of traffic involved in airmiss incidents may be an invaluable source of data in planning more permanent and long term solutions for the organization of the Air Traffic Services, and also as a means of educating personnel concerned on the problems of expediting air traffic in safety. Therefore, examinations of causes and circumstances are likely to provide more compelling evidence of implementation problems than are mere listings of incidents which occur in any one particular Region or State.

Action on Airmiss Reports (cont'd)

Some States have set up an Airmiss Working Group or Committee composed of experts of the Air Traffic Control Service, military representatives, the national operators, and pilots' representative of commercial and private flying. The outcome of such activities has been extremely effective, indicating that this is the correct way to proceed. The concept should therefore be extended, so that all States (or even ICAO) set up suitable machinery for dealing with the problem. One of the objectives of airmiss investigations should be to classify each incident, e.g.

A - actual risk of collision
B - possible risk of collision
C - no risk of collision - appropriate separation was provided.

An obvious extension of this would be an exchange of views, ideas and any pertinent points on the findings between different national committees (Working Groups), particularly where they are concerned with contiguous airspace.

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SECTION 19

NAVIGATION AND NAVIGATIONAL AIDS

General

Since a close relationship exists between separation standards and the navigational capability of aircraft, the navigation system used should provide the accuracy and a suitable pilot presentation so as to enable close adherence to ATC clearances or instructions.

Where navigation is conducted by reference to ground based radio navigation facilities these should be deployed in the most efficient and economical manner to permit the optimum use of airspace and to provide for an expeditious traffic flow. In a radar environment, where radar vectoring is applied, the navigational aids should provide adequate position information so as to enable the pilot to monitor his flight path. It is expected that in the future new criteria for the deployment of navigational ground facilities will have to be developed once area navigation is generally implemented. (See this Section - "Area Navigation".)

Pre-Departure Checks

ATC must assume that all aircraft can comply with relevant procedures. The operator has the responsibility of ensuring that the aircraft equipment provides the required navigational and communications capability. Procedures for checking radio and navigation equipment will not generally require any action by controllers, nor result in any delay after taxi clearance has been received. (See also under "AERODROMES - Serviceability of Aids and Facilities").

Responsibility for Navigation

The navigational functions should primarily be executed by the flight crew, whereas the use of air-derived position information and its correlation with ground-derived information form part of the controller's functions.

In many situations the use of radar for monitoring and guidance materially assists in promoting the safe and expeditious flow of traffic. Surveillance radar is a particularly valuable tool in terminal control areas providing a high degree of flexibility in exploiting the available airspace in the most efficient manner.

Responsibility for Navigation (cont'd)

A special case affecting responsibilities arises where radar vectoring is used in an environment where pilots have insufficient knowledge of position to monitor the flight paths followed as a consequence of vectoring procedures. Under such circumstances the responsibility for ensuring that the instructions given provide the required terrain clearance is assumed by the radar controller. This problem is dealt with in more detail in the section "RADAR - Terrain Clearance".

Where and when the capacity limit of the air traffic control services is approached as a consequence of extensive use of radar vectoring, the introduction of area navigation is expected to bring relief through a reduction in controllers' workload. Area navigation will provide for a wider selection of routings independent of the location of ground based radio navigation aids.

Navigation in the Vertical Plane

It is expected that the pressure altimeter will continue to provide the reference for vertical navigation.

The presently used airborne navigation equipment does not lend itself easily as a suitable means for close adherence to a defined vertical profile. This problem may become more critical with the introduction of SST and of V/STOL aircraft. An extension of area navigation in the vertical plane (3 D - Navigation) could possibly provide aircraft with the capability to adhere closely to three-dimensional flight paths, thereby facilitating the separation of aircraft in a diversified route structure - particularly in TMAs involving numerous crossing points.

Navigation Accuracy

From an operator's point of view the primary navigational objective for an aircraft is to proceed from the airport of departure to its destination in the most economical manner. In the light of the present state-of-the-art, and as established by experience, the fulfilment of this task during the enroute phase of flight does not require a specific degree of navigational accuracy. It is only in connection with the air traffic control environment that higher navigation accuracy is required in

Navigation Accuracy (cont'd)

order to obtain a reduction in separation minima and to make a more rational use of airspace. However, the application of reduced separation minima should not be predicated exclusively on the accuracy of the airborne navigation system.

Associated with the question of navigation accuracy, and particularly RNAV system accuracy, is the question of radar surveillance. In areas of high traffic density, considerable value is seen in continuation of radar surveillance for such purposes as blunder protection, the provision of a back-up radar vectoring service in the event of failure of equipment or facilities, or as a means of limiting the navigational errors. Radar monitoring should not be regarded as a prerequisite to the introduction of reduced separation minima or RNAV techniques, but it should be considered as a means of back-up in those areas where airspace limitations would otherwise demand an extremely high order of navigational accuracy.

The provision of a colocated VOR/DME suitably positioned at the aerodrome is considered advantageous to navigation in the Terminal Area (e.g. in the intermediate approach phase for establishment of approach gate and proper ILS localizer interception, as well as in the departure phase for establishment of departure route fixing).

Area Navigation (RNAV)

Although many advantages are claimed to be achievable with RNAV, the most important considerations are related to the air traffic services and, in particular, to increasing the capacity of the air traffic control system. The interest in RNAV has been stimulated by the knowledge that in many areas of the world traffic density is expected to exceed the capacity of the existing ATC system in the foreseeable future. Nevertheless, it is important to realize that traffic delays can result from reasons other than limitations or deficiencies in the air traffic services. Therefore, in each case where remedy is sought to relieve air traffic congestion, its cause should first be carefully determined.

If the capacity of the system is found to be the cause of congestion and delays, a number of means can be considered to improve the situation, for example:

Area Navigation (RNAV) (cont'd)

- better organization of control centres
- more efficient control procedures
- the provision of advanced display methods to controllers
- automation of part of the controllers' functions, such as conflict detection and resolution, etc.

Systems analysis must furnish the answer as to which of the possible means or combination of means would achieve the necessary improvement in the most effective and economical manner.

In areas where controllers' workload has reached, or is approaching, the saturation level and where other means of increasing the ATC capacity have been exhausted, RNAV techniques appear to offer the promise of accomplishing the greatest benefits.

In low density traffic areas of the world, which in many cases are also less well-equipped, RNAV flexibility could be used to shorten, simplify and standardize procedures. In areas of sparse VOR coverage, many of the existing dog-legs could be eliminated, thereby reducing route mileage and flight time. It would also be possible to programme straight-in visual approaches which normally would have necessitated routing via established fixes. In short, much of the cost/benefit to airlines of suitably designed RNAV systems could in fact occur in the less busy regions of the world.

The theoretical advantages to be gained from RNAV are influenced by two very important factors. The first is the fact that the accuracy achievable by an aircraft cannot be better than the basic accuracy of the system utilized in providing the RNAV capability. The second is that any improvement in traffic handling or airspace traffic capacity depends upon ATC acceptance of the aircraft's improved navigational capability.

ATC authorities have so far given no clear indication as to how area navigation techniques would be applied to expedite the handling of traffic, and this information must be forthcoming before aircraft RNAV systems can be realistically developed. ATC must therefore define their objectives vis-a-vis area navigation, as well as stating aircraft navigational accuracy requirements to meet the declared objectives.

Area Navigation (RNAV) (cont'd)

If an area navigation system is to be contemplated, steps must be taken to ensure that the system is based on currently existing ICAO standard navigational aids, as well as self-contained navigational aids, and that sufficient airspace for aircraft navigating in an RNAV environment is available. International standardization on a waypoint designator system is necessary, recognizing also the need for economy in the use of waypoints when ATC procedures are established.

The system concept must be of an evolutionary nature in order that operations can continue satisfactorily with aircraft equipped in the current conventional manner, whilst providing scope for exploiting advanced navigational capability. Requirements for excessive orders of accuracy and reliability in airborne RNAV systems are likely to discourage small operators entirely from equipping their aircraft and would also inhibit retrofit programmes which might have to be undertaken by the largest operators. Accordingly, in the general interest, the basis should be a simple system and, where necessary, ATC practices and procedures must be simplified for this purpose.

RNAV appears to be an operational requirement to permit full exploitation of the unique flight characteristics of V/STOL aircraft and to meet their needs for freedom from fixed tracks, segregated arrivals and departures, and the ability to fly flexible approach patterns.

Long Range Navigation

Long range jet transport aircraft have demonstrated their truly worldwide potential, and are largely used in operations of a global character. Consequently, both the aircraft and the crew can be subjected in a short space of time to the wide range of required navigational ability and related procedures which exist in the world today.

The navigational principles and operational objectives agreed by the operators recognize that the standard of performance of the navigation system for long distance operations need not be constant throughout the world, and that the required positional accuracy of the system is a

Long Range Navigation (cont'd)

function of the traffic density in a particular ATC environment. It is essential therefore that the operators be free to determine individually, on the basis of areas overflown and their operating practices, the type and characteristics of airborne navigation systems.

In recent years inertial navigation systems have shown a high degree of accuracy and reliability permitting their use as a primary means of navigation independent of ground based navigational facilities. Although primarily intended for application in oceanic airspace, they could also be used to advantage over continental areas on special routes implemented for this purpose. This could result in relieving congested ATS routes, and in economical advantages by permitting more direct routings.

Serviceability of Aids and Facilities

The status of radio aids must be taken into consideration when ATC clearances are issued, and aircraft should not be routed via radio aids which are reported out-of-service, "on test" or unreliable.

A Navaid should only be reported "on test" if it is awaiting the corresponding ground or flight test, but otherwise operating satisfactorily. Wherever minor adjustments are being made which do not affect the operational performance adversely there is no requirement for NOTAM action, and in particular the facility should not be reported as being "on test". Similarly, Navaids which do not meet all tolerances, but which are reliable and usable with limitation, should be promulgated as being available for limited use, together with a precise indication of the operational limitation. For example, a VOR might be operationally unsatisfactory over a particular sector, which would therefore be notified, but it could be otherwise satisfactory and within limits, and should therefore be kept available for navigational use.

Routine maintenance schedules should be sufficiently flexible to take into account bad weather situations or traffic peaks where the Navaid scheduled for maintenance is necessary for safe or expeditious operations.

Serviceability of Approach Aids

In a number of cases, any unserviceability of a navigational aid, remedied by a routine servicing, automatically results in the aid being promulgated as "subject to flight test" and consequently not being usable operationally. Such a practice should be avoided, and the extent of flight testing should be kept to a minimum, consistent with the requirement for correlation between signal patterns observed in flight and from the ground only after major modification or repairs to parts of the equipment affecting the signal in space (e.g. alteration in the antenna system), or after significant changes in reflecting characteristics of the site have occurred as a result of new constructions nearby. In all other cases, ground testing and maintenance on a routine and continuous basis, and past history of the effect of routine servicing on the behaviour of the signal in space, should be the primary means of achieving and maintaining operational reliability of Navaids.

Reversion to Lower Category of ILS Performance

In the event of potentially reduced reliability (non-availability of standby equipment) or, less likely, out-of-tolerance operation of Facility Performance Category 2 and 3 ILS, consideration should be given to a reversion to an appropriate lower category performance in preference to a shutdown of the facility. However, this should be applied only if the safety of the reversion procedure has been substantiated and the means of providing information to the pilot on the change of performance category have adequate integrity. (See also "AIRSPACE ORGANIZATION - Optimum Utilization of Terminal Control Areas to Facilitate Arrivals".)

Continuity of Operation

Because of the dependence of ATC on the navigation aids defining the route pattern it is essential there be satisfactory means for ensuring continuity of operation, in that suitable back-up facilities must be provided not only for the radio/radar equipment but also for the monitoring equipment and power supplies. This is of even greater importance in relation to landing and approach aids since any outage will inevitably slow up the landing rate, causing traffic congestion, a drop in airport utilization, and may generate a demand for diversions.

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SECTION 20

RADAR SERVICE

General

Surveillance radar has proved a valuable tool in expediting traffic while maintaining appropriate separation minima. In addition, surveillance radar may be used for one or more of the following functions:

- for positioning aircraft onto the final approach course of an instrument approach procedure (ILS, PAR, SRE etc.) or for positioning aircraft for visual approaches

- to vector aircraft around adverse weather conditions

- to reduce the amount of position reporting

- to provide a navigation service in the event of an emergency

- to assist pilots in maintaining prescribed arrival and departure routes where noise problems necessitate close adherence to such routes.

Radar should be regarded as a means of facilitating the provision of safe and efficient air traffic service. In its present form it should not be used in lieu of a basic system of ground navigational aids. It can, however, be used for vectoring aircraft, but in such cases the aircraft must be able safely and efficiently to take up a procedural flight path in the event of radar failure.

When radar is installed, the objective should be the provision of radar control service and not merely radar advisory service. Where 24 hour service cannot be provided immediately, the hours of operation should be determined in consultation with the operators.

In planning for radar services, account should be taken of variations in the theoretical coverage which varies with aircraft type and size and which may occasionally arise due to adverse weather conditions. Administrations should ensure that their air traffic controllers are thoroughly conversant with limiting characteristics appropriate to the radar equipment used.

General (cont'd) Radar control and procedural control should preferably be performed by one person or integrated element of the complete unit.

Where military aircraft penetrate controlled airspace (e.g. cross airways), and where military aircraft may be operating within controlled airspace under the radar control of separate military ATS units, the same safeguards provided by civil procedures should also apply, and the following principles should be adopted:

- At radar control stations in a particular State, only the controllers who are approved by the national authority having prime interest in, and responsibility for, civil aviation, should be employed.

- The national, civil and military authorities should satisfy themselves as to the proficiency of the radar personnel, the capacity and performance of the equipment, and the standard of maintenance of the equipment.

- Controllers should be instructed only to provide radar control when the radar picture is clear and covers the airspace concerned.

- The separation applied between aircraft should not be less than ICAO Standards and should take into consideration the equipment used, siting, etc.

- There should exist two-way radiotelephony contact between pilot and radar controller during the period concerned.

- Direct speech circuits should be provided between the area control centres and the radar centres concerned. Where practicable, maximum use should be made of parallel radar displays and the furnishing of information to the responsible control agencies concerning the relative movements of air traffic in the pertinent sectors.

General (cont'd)

- Separation should be achieved by reference to the plan position indicator only and no vertical separation should be deemed to exist, unless properly determined that vertical separation does exist.

- The closest possible cooperation should exist between the civil and military authorities concerned and the advice of the users of the airspace should be solicited prior to the introduction of the actual procedures.

The above principles also apply when the control of military traffic in a given airspace is delegated to a military ATC unit.

Criteria for Installation of En Route Radar

Use of en route radar should be considered:

- where it is necessary to increase the efficiency of control and/or the utilization of airspace when otherwise separation is effected by procedural means

- where the absence of long range radar would underemploy the potential capacity of a terminal area due to a lesser capacity of the en route system

- where efficient transfer of control between area control centres would be facilitated

- where coordinated control of civil and military air traffic would be facilitated.

The main advantage of radar to the air traffic services is that it can facilitate reductions in separation, expedite the traffic flow, and thereby increase departure and arrival rates.

Terminal Control Radar

A prerequisite for the provision of radar service in the terminal control area is the prior existence of the basic features of an efficient air traffic control system, including adequate radio navigational and communication aids and high standard of individual controller efficiency. When these features exist, the need for radar service should be assessed on the basis of the following considerations:

Terminal Control Radar (cont'd)

- whether or not the existing system has the capacity to control all the existing traffic without causing frequent delays to take-off, climb, descent or landing

- whether or not a study of traffic trends indicates that the system will not have the capacity to control all the future traffic without causing frequent delays to take-off, climb, descent, or landing

- whether or not there are aircraft operating in the terminal control area which cannot be efficiently controlled because they are not being equipped with the required navigational and/or communications aids

- whether or not topographical features such as terrain or water prevent the establishment of the required navigational aids or required routings within a procedural control system.

Secondary Surveillance Radar

Potential Advantages of SSR to ATC

There exists a requirement to reduce the radar controller's workload and increase his efficiency. This can be facilitated by use of SSR which would give the radar controller the following advantages:

- a simple and rapid means of establishing continuous identity of aircraft under his control

- the ability to indicate to other radar controllers who select his code that these aircraft are under his control

- the ability to display traffic in different sectors separately, or to facilitate tracking, by selective filtering of the radar response according to the desired control or monitoring function

- the ability to recognize military aircraft carrying out an agreed ATC procedure involving the penetration of civil controlled airspace

Secondary Surveillance Radar (cont'd)

- equal responses from all targets at the same range, whatever their size and regardless of weather conditions

- the elimination of permanent echoes and other unwanted responses, as well as increased and predictable cover compared with the existing surveillance radars

- a continual indication of aircraft altitude.

Potential Advantages of SSR to the Operator

- The advantages of SSR to the air traffic services serves to increase their efficiency and thereby expedite the traffic flow.

- SSR provides a ready means of establishing aircraft identity and eliminates the identification manoeuvres needed with primary surveillance radar.

- Position reporting requirements can be reduced or eliminated.

- More effective use is made of the airspace, particularly where there are conflicting civil and military requirements.

- More extensive application of existing radar separation criteria is feasible.

- Use of Mode C automatic altitude reporting can provide the controller with improved height information and thus permit the application of more efficient procedures to separate aircraft during climb and descent. Greater advantage can thus be gained from the use of vertical separation criteria.

Therefore, IATA supports Secondary Surveillance Radar having the system characteristics outlined in ICAO Annex 10 and recommends that it be installed in aircraft operated in those areas where it will justifiably promote the safe and expeditious flow of air traffic.

Secondary Surveillance Radar (cont'd)

Procedures for the use of SSR must be established in conformity with international standards. Where international standard procedures have not yet been agreed, interim procedures should be developed in consultation with the operators and, where practicable, on a regional basis. The development of suitable standardized procedures is an essential factor in the satisfactory application of SSR, and consultation with the operators at an early stage will ensure that the procedures to be used are practical and do not impose an unacceptable workload on the flight crew. Precautions must also be taken to ensure that the associated ATC system is capable of evolutionary development, and that data derivation, processing and presentation do not impose an unacceptable workload on controllers. SSR procedures, including the applicable modes and codes, must be promulgated.

Carriage of SSR

IATA advocates the development of application criteria, but in the absence of specific prior agreement, supports mandatory carriage of SSR only when the following conditions are satisfied:

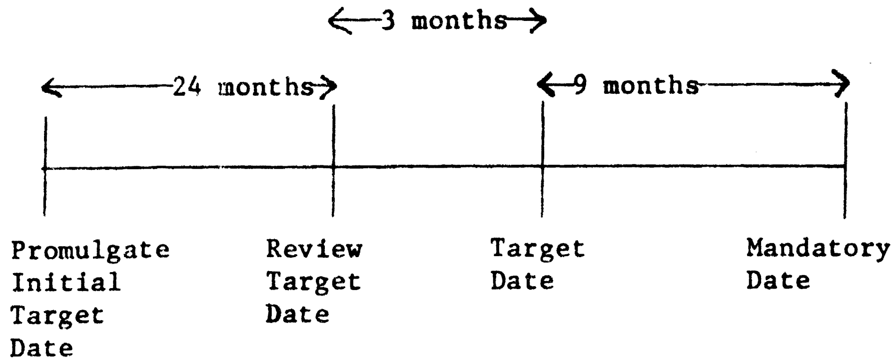
- regional agreement on the application of SSR has been established and a date has been determined by which it becomes a basic element of the overall ATC system

- firm plans have been established requiring aircraft of all other users in the designated airspace, in which civil transport aircraft are expected to carry SSR transponders, to carry compatible airborne equipment

- the area concerned is designated or planned as controlled airspace

- operators are given sufficient advance notice to fit the required airborne equipment in accordance with an agreed time programme, such as illustrated on the following page:

Carriage of SSR (cont'd)



- prior to promulgating any initial target date, coordination should take place between the State and operators to make sure that the programme envisaged is realistic with respect to ground and airborne equipment availability

- similar coordination should take place at the review target date to determine whether or not the proposed mandatory date is realistic

- there are, as far as is feasible, common target dates for contiguous areas where SSR coverage should be established.

The value of SSR to the air traffic services will be much enhanced when all aircraft within the coverage of the system are able to cooperate. In those portions where the carriage of SSR is made mandatory for airlines, it must therefore be made likewise mandatory for all other users of the airspace. In this respect, it is recognized that military aircraft may possibly use different kinds of equipment, but its capabilities (e.g. side lobe suppression capabilities) and the procedures for its use must be compatible with those used by civil aircraft.

Uniform application of SSR is necessary, at least on a regional basis.

Authorities which have already taken action to implement SSR have found it more convenient to apply mandatory carriage firstly in the upper airspace, and then extending downwards. However, circumstances can be envisaged in which benefits would accrue from making the first area of mandatory carriage applicable elsewhere than in the upper airspace. As an example, it is in busy terminal areas that advantages of SSR have been shown to be the most effective.

Carriage of SSR (cont'd)

The proven reliability of aircraft SSR equipment is considered sufficient to obviate any need for carriage of dual installations in order to comply with mandatory carriage requirements. In areas where mandatory carriage of SSR has been introduced, one acceptable means of compliance endorsed by IATA is the practice of ensuring that at least one SSR unit is installed and working at the time of departure, such assurance being based on satisfactory operation of the equipment on the previous flight.

SSR Ground Equipment

In high density traffic situations, IATA strongly advocates implementation of SSR with 4096 codes and Mode C automatic altitude reporting. In low density areas, and where necessary from a cost/benefit viewpoint, States should take advantage of the possibility to procure SSR equipment capable of being expanded when the traffic situation so requires, i.e. having the basic 4096 codes capability.

SSR Mode C

There is a need to exploit SSR on an overall system basis, and automatic altitude telemetering can greatly enhance the effectiveness of ATC and decrease workload on the flight deck. The application of Mode C is however likely to be ineffectual unless Authorities also ensure that satisfactory ground equipment is provided on which to display the information to the controller and, furthermore, that the operating procedures permit its use by the controller without imposing an unacceptable workload.

Therefore, IATA supports the application of SSR Interrogation Mode C for automatic altitude reporting provided it is integrated in an adequate ATC organization. Such application must be related to evolutionary development of the ATC system on a system planning basis, insofar as data derivation, processing and presentation are concerned. It is essential that plans for automatic altitude reporting be related to the provision of effective means for processing, display and application.

Application of SSR Mode C

IATA believes that SSR Mode C automatic altitude reporting should be regarded as a communications tool which permits air traffic controllers a direct and continuous presentation of aircraft flight levels, without need for voice communication. Its interest is in its ability to decrease the workload of controllers and flight crews, and to permit the application of more efficient procedures to separate aircraft during climb and descent. While Mode C could be useful for detecting exceptional blunders (errors in assigned flight level or wrong altimeter setting), IATA does not support its use as a tool primarily to monitor exact altitude keeping by aircraft for the following reasons:

- Present values of vertical separation have been in use for many years and take into account the combination of all possible errors; there is no evidence that an additional means is needed to justify the present criteria.

- The action to be taken, in the event that the altitude as read by the controller is slightly different from the altitude as indicated in the cockpit, would be difficult to specify, and, contrary to the fundamental advantage of this tool, controllers' workload would be increased.

For these reasons procedures should not call for action by ATC until aircraft are in level flight and the Mode C readout indicates a discrepancy of 300 feet or more from the assigned level.

Application of SSR Data without Primary Radar Information

Because it is a cooperative system relying on an airborne SSR element and effective communications for its proper systematic use, SSR should at this stage of its development be employed basically in conjunction with primary surveillance radar. However, there may be cases where it is advantageous to use SSR information by itself, e.g.:

- on an occasional basis, to overcome some deficiency in the primary radar, or

- on a systematic basis, to facilitate ATC.

Application of SSR Data without Primary Radar Information (cont'd)

Where primary radar information is normally available in addition, the conditions under which occasional use of SSR by itself could be authorized are as follows:

- to overcome the known deficiencies of primary radar, or
- to continue radar service, where possible, in the event of primary radar failure, or
- to provide radar service beyond the coverage of the associated primary radar, or
- to assist in the case of aircraft emergency.

In the above situations, prerequisites are: firstly, the establishment of SSR accuracy (e.g. by means of monitor equipment or by correlation with primary radar information) and, secondly, the ability to maintain procedural separation between SSR-equipped and non-equipped aircraft.

Primary Radar Normally Available

Where primary radar information is normally available when needed, the conditions under which routine use of SSR by itself could be authorized are as follows:

- to provide information on identification or position of aircraft where procedural separation is being applied, or
- on exceptional occasions to permit the use of reduced separation standards to resolve individual procedural conflicts between identified aircraft, or
- as a means of controlling aircraft using radar techniques, provided that:
  - the requirement has been established for all aircraft to obtain ATC clearance before penetrating the airspace concerned, to operate as controlled flights within the airspace, and to be equipped with transponders if subject to radar control
  - control of all aircraft operating within the area is exercised by a single ATS unit

Primary Radar Normally Available (cont'd)

- full SSR coverage of the airspace has been proved, and it is unlikely that any of the participating aircraft will engage in manoeuvres which may result in loss of signal (e.g. military aircraft)
- appropriate procedures have been defined to permit smooth reversal to primary radar control. (Particularly for future high traffic density applications.)

In the above situations:

- SSR accuracy must be verified by means of monitor equipment, or by correlation with primary information

- the airspace within which SSR will be so used must be suitably designated (e.g. permanent IFR) to ensure that all aircraft therein are required to operate on an ATC clearance.

Primary Radar not Available

Without primary radar back-up, the conditions under which routine use of SSR by itself could be authorized, are as follows:

- to provide information on identification or position of aircraft where procedural separation is being applied, or

- on exceptional occasions to permit the use of reduced separation standards to resolve individual procedural conflicts between identified aircraft, or

- as a means of controlling aircraft using radar techniques, provided that:
  - the requirement has been established for all aircraft to obtain ATC clearance before penetrating the airspace concerned, to operate as controlled flights within the airspace and to be equipped with transponders if subject to radar control
  - control of all aircraft operating within the area is exercised by a single ATS unit
  - full SSR coverage of the airspace has been proved and it is unlikely that any of the participating aircraft will engage manoeuvres which may result in loss of signal (e.g. military aircraft)
  - the density of traffic, navigational environment, and controller proficiency permit a quick reversal to non-radar separation in the case of SSR failure or malfunction.

Primary Radar not Available

In the above situations:

- where no primary radar back-up is installed, there must be prior consultation with the operators concerned before SSR is used by itself
- SSR accuracy must be verified by means of monitor equipment
- the airspace within which SSR will be so used must be suitably designated (e.g. permanent IFR) to ensure that all aircraft therein are required to operate on an ATC clearance.

NOTE: Attention is drawn to the fact that SSR by itself does not depict weather information, and this information is also normally not presented on current displays of primary radar. (See also this Section - Weather Avoidance.)

Precision Approach Radar

At the present time PAR is an adjunct to ILS where simultaneous instrument approaches on parallel runways are permitted. It should no longer be considered a requirement once the monitoring of such approaches can be achieved by other means, or where the separation between the runways is sufficient to obviate the need for approach monitoring.

IATA endorses the ICAO Annex 10 requirement that PAR should be installed as the primary aid to final approach and landing where siting and other technical difficulties preclude the use of ILS. In such cases the PAR should be supplemented by the installation of a facility to establish position and give azimuth guidance in the direction of approach to the main instrument runway. Where full ICAO Standard ILS has been installed, and has been flight checked as satisfactory for autocoupled approaches to minima, IATA does not consider the provision of Precision Approach Radar an operational requirement that can be justified in the light of current operational techniques.

Aerodrome Surface Detection Equipment (ASDE)

The monitoring of surface traffic movements at busy aerodromes, or under reduced visibility conditions, may be facilitated by the use of aerodrome surface detection equipment (ASDE). Improved ASDE is available and adoption of this aid is urged at locations where its use will expedite the

Aerodrome Surface Detection Equipment (ASDE) (cont'd)

traffic flow, e.g. to confirm that aircraft are holding clear of active runways, or have cleared the runway after landing. Although suitable as a monitor, ASDE is not considered an acceptable method for directing aircraft ground movements - for which purpose visual aids should be provided by aerodrome authorities.

Radar Reliability

Wherever radar is used as a controlling tool, the highest degree of protection must be afforded against the consequences of unserviceability and malfunctions which are not immediately apparent (e.g. misalignment).

Where radar is being used to control traffic in a terminal control area, a failure could have calamitous results and operators are therefore justified in requiring that authorities provide an adequate back-up capability, comprising dual systems including power supplies, communications facilities and supervisory equipment capable of independent operation. With a complex system of radars, computers and display equipment of various types, there must be an adequate overlap so that alternative data presentation is immediately available. In the event of a failure the system should "fail soft", albeit with a temporary increase in the manual workload and some reduction in system capability.

In the en route phase, radar failure would normally result in a return to procedural control with a delay to traffic as a possible consequence. This cannot be considered sufficient justification in most areas for complete duplication of radar coverage, although it should not be ruled out entirely.

For the immediate future, duplication of secondary radar does not appear necessary, either on the ground or in the air. In the event of SSR failure in one aircraft, the aircraft would still be known traffic. The possibility of multiple SSR failures appears unlikely and even in this event use can still be made of primary radar in most cases.

Radar Identification

Ultimately, there should be an automatic means of aircraft identification for use with radar. Meanwhile positive identification should be established in relation to navigational facilities. Vectoring as a means of identification should not be normal practice.

Radar Identification (cont'd)

The preferred means of identifying the aircraft is by the use of SSR and appropriate procedures. It is expected that increasing use will be made of this technique as aircraft become equipped with transponders and ATC units with corresponding ground equipment. Where the equipment is not available in the air or on the ground, procedural methods as described above must be used.

A special case arises when radar identification is deemed to have been made if the aircraft response is observed a short distance from the runway after take-off. An RTF transmission is normally required in order to complete the identification process, but as previously mentioned must not interfere with cockpit activities in this busy stage of flight.

The need to ensure proper identification of aircraft is stressed, bearing in mind the possible consequences which could follow a mis-identification. The procedures used should permit no assumptions on the part of the radar controller, who should exercise every precaution and cross-check whenever necessary with the aircraft concerned to minimize the possibility of error. Radar identification procedures are contained in Section 10 of the ICAO PANS RAC Document.

Experience has shown that use of the "ident" mode for identification purposes is not fool-proof, especially in areas of radar overlap. More widespread application of 4096 code capability should however serve to minimize this problem. In accordance with ICAO PANS RAC, positive identification must be confirmed by the controller to the pilot.

Radar Arrivals and Departures

Radar controlled climbs for the purpose of more efficient utilization of airspace are desirable. Some adjustment to climb-out paths conducted under radar control can be tolerated, but it is important that ATC should not fundamentally change the planned route and climb profile unless the change constitutes a compensating improvement.

In high density terminal control areas, radar is essential in order to expedite the flow of departing and arriving aircraft. Radar should be used to assist adherence to SIDs, STARs, and noise abatement routings. It is assumed that under these circumstances extensive use will be made of lateral separation under radar surveillance.

Radar Arrivals and Departures (cont'd)	Vectoring for this purpose should take account of aircraft manoeuvrability limitations, in particular turn radius and climb rates. Radar control must be established as soon as possible after take-off to facilitate identification, bearing in mind also the need to minimize RTF communication in this phase of flight. Positive identification of the radar response by the two controllers involved in the transfer of an aircraft from one ATS unit to another is essential, and the transfer of responsibility between ATS units, certainly during the initial critical take-off phase, should be such that no action is required from pilots. Transfer of control between ATS units necessitates aircraft identification and normally entails communication with the aircraft and a change of frequency. To minimize interference with cockpit activities during the busy take-off and initial climb phase of flight, transfer of control of departing aircraft should not be effected prior to the termination of initial climb. (See also under "ATS COMMUNICATIONS".)
Radar Descents	Radar controlled descents are desirable. However, the pilot should be notified of approximate routing and expected descent rate (vertical speed and airspeed) expected in sufficient time to orientate and maintain knowledge of the aircraft's position. Also where practicable, advance notification of the time descent is to be started should be given.
Radar Vectoring	Controllers should be informed that the operational characteristics of the automatic approach coupler are such that, to ensure proper alignment with the runway, the aircraft should be stabilized on the ILS localizer prior to glide slope interception. Normally, the aircraft should intercept the localizer at a distance sufficient to permit it to stabilize and establish on the localizer course prior to intercepting the glide path, taking into consideration the angle of interception with the localizer course. Guidance indicating the relationship between angles of interception and acceptable distances is given in ICAO PANS OPS, Chapter 2 - ILS. The landing runway should not be changed after the pilot has commenced his final approach.

Terrain Clearance

Radar vectoring is becoming a frequent and accepted practice in high density terminal control areas and has resulted in a significant increase in capacity. However, under extensive radar vectoring, pilots may have insufficient knowledge of their position and of their minimum safe altitudes, which are generally specified only for well-defined tracks based on radio aids. When aircraft are vectored by radar, therefore, the responsibility for ensuring adequate terrain clearance rests with the controller in accordance with the prescribed ICAO procedures in PANS RAC, Section 10.

Information indicating the minimum sector or area altitudes used by radar controllers should be made available to operators. The prerogative of accepting or rejecting clearance must remain with the pilot. To enable controllers to carry out their responsibilities radar scopes should, wherever Possible, be provided with video mapping, while adequate navigational aids should also be provided to assist pilots in their monitoring of radar instructions. (ICAO 6th Air Navigation Conference, Recommendation 7/4)

Under Annex 6, operators are permitted to establish minimum flight altitudes on routes for which minimum flight altitudes have previously been established by the State being overflown. The operators usually incorporate a greater terrain clearance margin than the ICAO Standard of 1000 ft. above obstacles within five miles of track. Therefore, if ATC clears an aircraft to the lower of the two, this is unsafe according to the operators' standard, but safe according to the controller's standards laid down by the State.

Minimum safe heights are, in the majority of cases, calculated for sectors between two navigation facilities based on x miles either side of track. In all cases the common factor is the track between the facilities, but when radar gives a change of heading the aircraft leaves the track on which the minimum safe height is determined. In ICAO PANS OPS, radar separation standards permit traffic to be directed as low as 1000 ft. above the highest obstacle within three miles of the aircraft's position. Thus, there is yet another standard of vertical clearance which is different from that used by the operator.

Terrain Clearance (cont'd)

Because of these differences, radar descent clearances involving changes of heading, particularly when these take the aircraft towards high terrain, may cause pilot apprehension, since the altitude to which he is cleared may be lower than the minimum safe altitude authorized by the operator.

The above considerations indicate a need:

- to clarify the precise responsibilities of pilots and controllers in relation to terrain clearance particularly in respect of radar control

- for States to promulgate the means by which radar controllers are provided with guidance on minimum safe altitudes, and the parameters applied. (ICAO Annex 6, Chapter 4, paras 4.2.4.1 and 4.2.4.2). (See also under "Cruising Levels - Terrain Clearance Responsibility when Vectoring Aircraft.")

Weather Avoidance

With the extensive use of radar vectors by ATC, and particularly with synthetic radar displays, there is an increased risk that controllers inadvertently direct aircraft through hazardous weather, especially through severe thunderstorm cells. However, except with synthetic displays, by proper manipulation of the radar equipment and with sufficient experience in the interpretation of the radar picture, at least severe thunderstorm areas are detectable by means of the ATC radar equipment currently in use, even when operated in the circular polarization mode. With advanced types of equipment, involving synthetic displays and data processing, the weather data should also be reproduced by automatic means. The information on thunderstorm activity available on ATC radar scopes should be used by controllers:

- to avoid vectoring aircraft into areas of hazardous weather

- to issue information on radar-observed weather and, on request to assist pilots in avoiding the areas affected

- to anticipate pilots' requests to change flight path in order to avoid hazardous weather, and to plan suitable alternate routes.

Weather Avoidance (cont'd)	Means of improving the display of adverse weather areas on ATC radars should be actively pursued by the authorities concerned, and suitable techniques introduced as soon as their feasibility is proven. One example warranting encouragement is the provision of weather contour information on displays of processed radar data, if this can be achieved without degrading the primary function of displaying responses received from aircraft.

All radar controllers should be properly familiarized with the use of ATC radar for weather detection. When extensive thunderstorm activity is observed to be approaching a terminal control area, procedures should be implemented with the objective of minimizing in-flight requests for re-routings, and should be developed along the following lines:

- Departure clearances should provide a route avoiding the activity, the re-routing procedure to be introduced when the storm is approximately fifty miles away.
- The operators should be informed as soon as possible that re-routing for weather avoidance is in effect.
- The revised clearance should indicate the reason for the re-routing and the extent to which the aircraft will be detoured from its original route.
- Pilots should retain the prerogative to request the original filed route.

Distance-to -Touchdown Indicators	(See under section on "Traffic Sequencing".)
Proficiency of Radar Controllers, Maintenance of Radar Equipment etc.	Guidance Material relating to the performance and limitations of radar equipment and radar controllers is contained in ICAO PANS RAC, Attachment C. Procedures for the use of radar in air traffic services is in Part 10 of the same ICAO Document.

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SECTION 21

OPERATIONAL CONTROL

Operational control must remain the prerogative of the operator and any assumption of this responsibility by States is unacceptable and impracticable. Individual operators must be free to exercise complete operational control of their aircraft with regard to exercise of authority over initiation, continuation, diversion or termination of a flight, the use of regular, provisional and alternate aerodromes and the application of cruise regimes, scheduling, turn around times, routings, and other related control functions.

ATS units should provide operators with relevant information required for the exercise of operational control.

In order to reduce the communications loading on ATC channels, and to permit rapid communication between operator and aircraft, separate operational control facilities or frequencies should be made available.

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SECTION 22

HOLDING PROCEDURES

Basically, the pattern of routes and the ATC organization in terminal control areas should enable aircraft to descend without interruption from cruising level. However, this is not always possible and holding patterns should be defined at appropriate locations to permit an efficient sequencing of traffic.

The configuration and criteria for holding patterns and holding areas laid down in the ICAO PANS OPS Document are generally acceptable. However, two points should be borne in mind when the establishment of holding procedures is under consideration:

- The defined entry procedures should only be considered as general guidance and should not preclude operators from devising more practical entry procedures which can be demonstrated to give equivalent or more accurate results equally acceptable to the Authorities.

- Where it is considered necessary to economize in the use of airspace allocated to protecting holding patterns, the following are some of the acceptable methods of decreasing the dimensions of the holding area which should be employed before any consideration is given to the introduction of mandatory entry procedures:

    - restriction in the permissible direction of entry
    - installation of additional navigation facilities, or improved siting of existing facilities, to ensure more accurate navigation and/or provision for adjustment of heading and speed to allow for a smooth entry
    - radar vectoring of aircraft into the holding pattern.

- When the dimensions of a holding area are based on normal speeds instead of turbulence penetration speeds, appropriate measures should be defined for application when aircraft are forced to use the higher speed, in order to ensure safe separation between aircraft and terrain.

Holding patterns should be so located (position and level) as to permit an efficient sequencing of traffic with the least deviation from the normal descent profile of aircraft, and to minimize interference with other terminal control area traffic. Generally, these patterns will consist of high altitude patterns along the main arrival tracks located 45/60 nm from the final approach, and one or more low altitude feeding fixes for final sequencing of aircraft. The latter should be suitably located near the aerodrome so as to achieve maximum runway utilization.

Expected Approach Times

The concept of Expected Approach Time or Expected Approach Clearance Time was developed before the widespread application of radar, in order to accommodate the case of radio failure prior to landing, and to enable pilots to determine whether or not to divert. If an aircraft experiences a radio failure, ICAO Annex 2 states that "after arrival over the designated navigational aid, commence descent at, or as closely as possible to, the expected approach time last received and acknowledged". Incidents of radio failure in aircraft are extremely rare, but EATs based on current landing rates are still useful for the following purposes:

- to assist pilots in the calculation of available fuel reserves and assessment of diversion probability

- as general advice to the operators, the flight crews and the passengers concerned.

The calculation of EAT adds considerably to the controllers' workload and they need not therefore be provided unless delays exceed fifteen minutes.

The controller should advise the pilot of his number in the approach sequence when the aircraft leaves the holding pattern in order that he can assess the traffic situation and determine whether the subsequent approach path is likely to be significantly time-consuming.

It is recommended that information concerning its expected approach time should be given to an aircraft before it reaches the holding pattern or arrives over its destination, in one of the following forms:

Expected Approach Times (cont'd)

- no delay expected (i.e. less than five minutes

- landing delay not expected to exceed fifteen minutes

- EAT based on the estimate of arrival time over the holding facility plus more than fifteen minutes. Subsequently this should be reviewed approximately every ten minutes and amended if a significant change has occurred

- landing delay expected to be indefinite and a provisional EAT can only be given (e.g. because of weather conditions or a blocked runway).

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SECTION 23

TRAFFIC SEQUENCING

Take-off Sequence

The air traffic services do not normally afford any priority in take-off sequencing, nor is it considered that they should. The principle of "first come - first served" is generally endorsed but rigid adherence to it may not always be practicable in the interests of expediting the flow of traffic. At the present time, exceptions to the sequencing of take-off traffic on a "first come - first served" basis are acceptable under two sets of circumstances.

Firstly, should ATC restrictions exist, based on direction of flight, aircraft may be selected out of sequence in order to take advantage of an immediately available ATC clearance, rather than be required to wait behind other aircraft which are being held on the ground through lack of space on their desired routes.

Secondly, a high performance aircraft may be released before an aircraft with lower performance if the overall capacity of the system can be improved by this means, (e.g. separation by speed, or climb gradient). This is only applicable if both aircraft are ready for take-off at approximately the same time.

In the future, more advanced methods of sequencing departures may be possible as improved airspace utilization techniques are developed. In view of the numerous factors involved, including commercial interests, such methods should be coordinated beforehand with all concerned.

Approach and Landing Sequence

Approach and landing sequencing presents a somewhat different situation. Compared with the take-off case, aircraft cannot necessarily be considered in relation to a fixed datum, as they are at different flight levels and have a wide range of descent rates. An exception occurs when aircraft are extracted from the lowest level of a holding pattern on a "first come - first served" basis.

The Flight Plan ETA, or ETO given by the aircraft no longer provides a good sequencing basis where jet aircraft are concerned. This is because early descent for sequencing purposes leads to delayed arrival, while delayed descent has the opposite effect.

Approach and Landing Sequence (cont'd)

Furthermore, under procedural control, the aircraft at the lower level often receives priority over an earlier aircraft at a higher level. This is acceptable only if the consequent delay to the aircraft at the higher level is not excessive. Where the organization of the terminal control area permits (especially under radar control) the actual time over a fix at the boundary might serve as a criterion to establish the approach sequence.

The desirable goal is maximum runway utilization which may possibly only be achieved by allocating to the approach control unit some degree of flexibility in the selection of aircraft for landing. Under no circumstances, however, should VFR aircraft be cleared by the tower to land without proper sequence coordination with approach control.

Distance-to-Touchdown Indicators

At many aerodromes it is still necessary to conduct take-off and landing operations on the same runways and/or to coordinate both operations on intersecting or converging runways. In high traffic density situations under these circumstances it is unrealistic to delay departures excessively in order to comply with the traditional requirement that gives landing aircraft priority over those taking off. Accordingly, sequencing should to a large extent be left to the judgment of the controller to provide the best runway utilization, and in this respect he can receive valuable assistance if "distance to touchdown" indicators are available. As evident from their name, these instruments provide the controller with accurate radar information on the distance to touchdown of approaching aircraft, thereby facilitating judgments regarding the movement of other aircraft on or across the active runway.

Flow Control Schedule Control Speed Control

Except for the use of speed control in the terminal control area under certain circumstances, and possibly to facilitate reduced longitudinal separation en route, (e.g. by the use of Mach techniques) neither flow control, schedule control nor speed control is favoured by operators. Objections to them are based largely on the improbability that impending traffic situations can be predicted with sufficient accuracy. For this reason speed control techniques do not contribute to the efficiency of operations. The following is a clarification of the terms used.

Flow Control Flow control implies the authority of ATC to regulate the acceptance of aircraft in a particular situation, in order to organize the resulting flow so that the risk of saturation is reduced. (See also under "AIRSPACE UTILIZATION - Flow Control".)

Schedule Control Schedule control implies the limitation or rearrangement of planned times of arrival and/or departure in a manner intended to reduce congestion at peak periods. (See also under "AIRSPACE UTILIZATION - Schedule Control".)

Speed Control Speed control is a term applied to cover two sets of circumstances, viz:

Speed Control En Route

ATC regulation of traffic in the en route phase of flight involving modification of planned speeds in order to adjust arrival time for the purpose of alleviating congestion. Usually, but not necessarily, it implies a reduction of speed to absorb delay but may also be used as a means of maintaining longitudinal separation or facilitating reduced separation.

Speed Control Within the Terminal Control Area

The use by ATC of a selection of agreed speeds in order to manoeuvre aircraft within the terminal control area, so that they are arranged in an orderly fashion to expedite the general flow of traffic. Normally speed control should only be adopted when arriving aircraft, within close proximity to destination, are being marshalled for approach sequencing under radar surveillance.

Speed control measures are acceptable to operators in the following circumstances:

- as a means of reducing longitudinal separation en route by application of the Mach technique
- to facilitate final approach sequencing in the terminal control area, thereby expediting traffic flow

Speed Control (cont'd)

- as a temporary measure to lose time in arriving overhead a facility, as an alternative to holding or being required to accept a change in flight level

- as a temporary measure to restore or maintain longitudinal separation

- to expedite departures, by application of lower longitudinal separation values when a faster aircraft is following a slower. (In this case, and provided it can remain in a clean configuration, the faster aircraft may elect to accept a speed reduction in order to eliminate a potential overtaking problem.)

Circumstances under which speed control measures would be unacceptable are as follows:

- when applied to en route aircraft overflying TMAs

- as a means of adjusting arrival times for ATC purposes. (The mandatory use of speed control in the en route phase of flight as a means of adjusting arrival time is unacceptable to operators, in view of the resulting operational inflexibility and the inability to predict traffic situations with any accuracy under the present ATC system.)

- as an attempt to prolong application of the "see and be seen" concept in areas where uncontrolled VFR aircraft are permitted to mix with high speed jet transport traffic

- as a convenience for ATC, or substitute for an effective ATC system. (In this case it is equally unacceptable to require aircraft to maintain excessive speed until a late stage in the approach, as to demand a routine slow-down of all traffic to compensate for the inability of the ATC system to handle fast aircraft.)

- as a means of losing time during the climb. (In contrast to the case where the following aircraft elects to accept a speed reduction in order to expedite departure, during the climb phase itself it is undesirable and impractical for aircraft to lose time by

Speed Control (cont'd)

imposition of speed control measures. Separation should be accomplished mainly by pre-determined longitudinal separation at departure, or by the application of lateral or vertical separation. However, small corrections may be accepted and accomplished by means of temporary deviations from track.)

Losing Time

Three methods; deviation from track, speed reduction, and holding, can restore longitudinal separation, the choice of the best method in a given situation depending upon the amount and degree of predictability of the time to be lost and the phase of flight. Some observations on appropriate methods under the different phases of flight follow:

Departure

Acceptable methods are covered in Section 8 - Pre-Departure.

Climb

As covered in the preceding text dealing with acceptable and unacceptable speed control measures.

En Route

With present types of aircraft, it is difficult to lose a substantial amount of time, except by conventional holding. However, from the viewpoint of fuel consumption this is particularly undesirable.

When applied for a short period speed control is the method which penalizes least. Provisional deviations of track may be used to solve specific traffic conflicts, except for long-range flights where preservation of fuel reserves is important.

The use of speed control to regulate the entry of aircraft into a terminal control area, although theoretically sound, should be used only when the degree of predictability of approach time is such that there is no risk of significant errors which may impose additional delays on aircraft.

Losing Time (cont'd)

Descent - Initial Approach

Any necessary adjustments of arrival times should have been made before entry into the terminal control area, but small residual adjustments may be required within the terminal control area and can be achieved by means of speed control and path stretching techniques. However, in the present and immediate future it is unlikely that holding can be avoided completely, particularly for short periods prior to intermediate approach for sequencing purposes.

Intermediate and Final Approach

The suitability of speed control procedures, in addition to being effective in improving the traffic flow, must satisfy a number of broad general principles or operational requirements, as follows:

- They should permit aircraft to continue flight as long as possible in a clean configuration, in order to expedite arrival and to eliminate unnecessary noise.

- They should facilitate use of the auto-pilot to execute coupled approaches as a routine operation.

- Where speed changes are required for traffic sequencing these should be requested by ATC on the basis of radar position information, and not by means of pre-programmed flight profiles which could impose additional navigational requirements on the aircraft and thereby increase cockpit workload.

- There must be a specified point on the final approach beyond which the aircraft must be permitted to apply its optimum speed for the operating conditions, and where no speed control by ATC can be tolerated except in emergency.

- The procedures must take into consideration the significance of altitude in altitude/speed combinations, and be such that pilots will have some knowledge of the controllers' plans with regard to altitudes and speeds.

Losing Time (cont'd)

Some of the numerous operational considerations which preclude the application of speed control measures during the final approach stage, down to the runway threshold, are as follows:

- Depending on aircraft weight, flap configuration, etc. there could be a significant spread in approach and threshold speeds for a given type of aircraft (e.g. 35K between B727 and 737 aircraft).

- Autocoupler approach techniques do not permit rapid speed reductions on final approach.

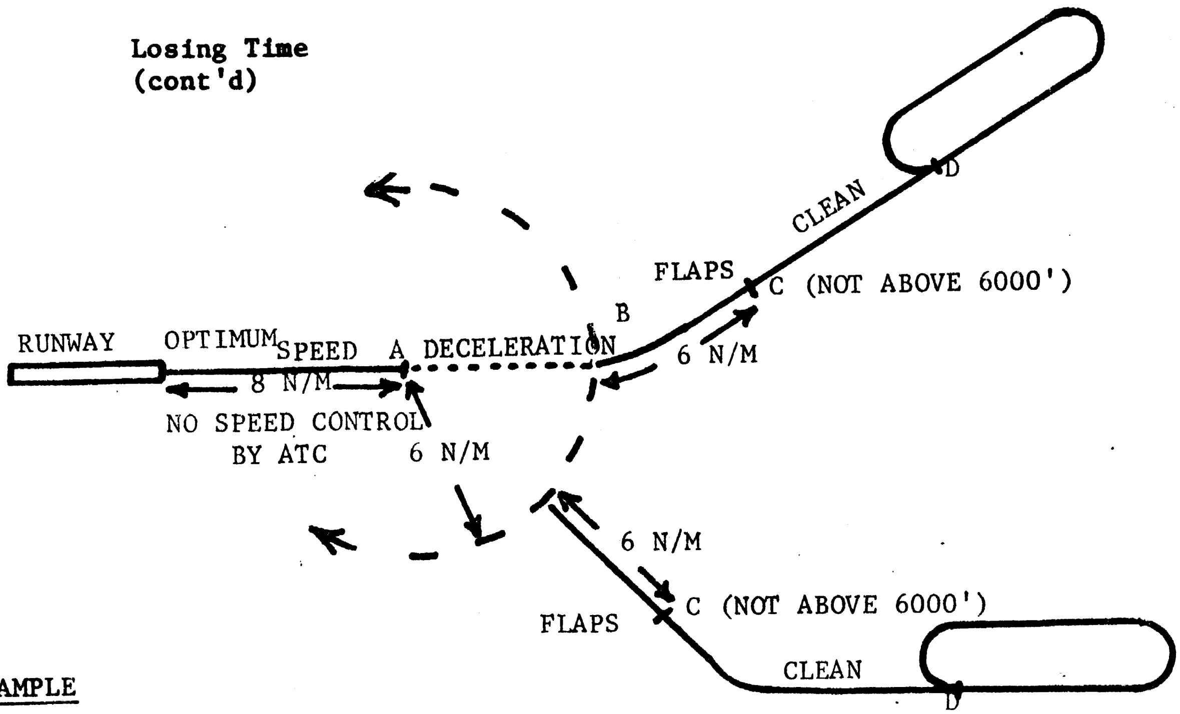
- Each aircraft type must comply with an optimum threshhold speed in order to achieve the predicted landing distance Performance. A stabilized approach is required to ensure that the optimum threshold speed will be achieved.

- It is undesirable to permit speed to fluctuate, and particularly to bleed off during the latter part of the approach since this can lead to undershoot or overrun incidents.

- Passenger comfort is adversely affected if speeds are significantly varied during this segment of a coupled approach.

The figure on page 23-8 illustrates in a general manner how a speed control profile for traffic sequencing purposes should be developed, together with an indication of the operationally significant points and their relationship to the runway threshold. Where such procedures are contemplated, the operators should first be consulted for more detailed guidance, particularly regarding the range of approach speeds likely to be used by different aircraft types.

Losing Time (cont'd)



EXAMPLE

D	C		B		A
Clean Configuration	Flaps etc.	- - - - - - - - - - - -			
210K	Reducing to		180K	to	170K to Optimum Appr.Speed

Separation Between Departure and Transit Traffic

Theoretically the relationship between the flow of departure traffic and transit traffic is not a special problem, and control should be exercised in this case as it is in all other situations. The system should accommodate both types of traffic without interference to either.

The objective should be a smooth merging of both types of traffic, so that segregation is unnecessary. However, in practice, difficulties are encountered at some locations which result in departures being held on the ground due to particularly heavy transit traffic. This calls for study mainly on a local basis. However, some general guidance can be established as follows:

Transit routes and departure profiles should be planned so as to provide the required separation strategically. When this is not possible ATC should not hold a departing aircraft on the ground solely because its

Separation Between Departure and Transit Traffic (cont'd)	estimated route will cross the path of an overflying aircraft with less than the required longitudinal separation, but should provide the separation tactically after the aircraft has taken off. (See also under "ATC Clearances - Uncoordinated Clearance").

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SECTION 24

DIVERSION AND MISSED APPROACH

Diversion

When marginal weather conditions prevail it is essential that ATC planning includes the possibility of an aircraft diverting to one of its alternate aerodromes following a missed approach. ATC planning should also include the possibility of an aircraft wishing to divert prior to making an approach. Where appropriate, ATC should obtain the required information from the aircraft in order to have the diversion clearance ready for transmission to the aircraft immediately a diversion is declared.

When diversion to an alternate aerodrome is required, the aircraft should be cleared by ATC to proceed immediately on the shortest route to the desired alternate.

Missed Approach

Following a missed approach, should an aircraft wish to make a second attempt to land at the same aerodrome, it should be enabled to do so without undue penalties to itself or to other traffic. However, if the second approach is also unsuccessful, the aircraft concerned shall no longer be given any such special sequencing in respect of other approaching traffic, for any subsequent attempts.

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