Karpagam Academy of Higher Education

(Deemed to be University Established Under Section 3 of UGC Act 1956)
Pollachi Main Road, Eachanari Post, Coimbatore, Tamil Nadu 641021

FACULTY OF ENGINEERING

Department of Mechanical Engineering

(Aerospace Engineering)

Subject Name	**: Air Traffic Control and Aerodrome Design (ATC)**
Subject Code	**: 14BEARE_17 (Credits - 3)**
Name of the Faculty	**: R. Suresh Baalaji**
Designation	**: Asst. Professor**
Year/Semester/Section	**: IV / VII / -**
Branch	**: Aeronautical Engineering**

AIR TRAFFIC CONTROL AND AERODROME DESIGN 3 0 0 3 100

INTENDED OUTCOMES

To study the procedure of the formation of aerodrome and its design and air traffic control.

UNIT - I BASIC CONCEPTS

Objectives of ATS - Parts of ATC service – Scope and Provision of ATCs – VFR & IFR operations – Classification of ATS air spaces – Varies kinds of separation – Altimeter setting procedures – Establishment, designation and identification of units providing ATS – Division of responsibility of control.

UNIT - II AIR TRAFFIC SERVICES

Area control service, assignment of cruising levels minimum flight altitude ATS routes and significant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time / distance –ATC clearances – Flight plans – position report

UNIT - III FLIGHT INFORMATION ALERTING SERVICES, COORDINATION, EMERGENCY PROCEDURES AND RULES OF THE AIR

Radar service, Basic radar terminology – Identification procedures using primary / secondary radar – performance checks – use of radar in area and approach control services – assurance control and co-ordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.

UNIT - IV AERODROME DATA, PHYSICAL CHARACTERISTICS AND OBSTACLE RESTRICTION

Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point – Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical Characteristics; length of primary / secondary runway – Width of runways – Minimum distance between parallel runways etc. – obstacles restriction.

UNIT - V VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY AND OTHER SERVICES

Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements – Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.

TEXTBOOKS:

S.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	AIP(India)	The English Book Store Vol.I & II	Connaught Circus, New Delhi	2007

REFERENCES BOOKS:

S.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	AIP(India)	Aircraft Manual(India) vol I,	Connaught Circus, New Delhi.	2007
2.	PANS-RAC-ICAO DOC 444	The English Book Store	Connaught Circus, New Delhi.	2011

WEB REFERENCES:

liveatc.net/

www.aai.aero/public_notices/manual_ATS.pdf

www.indianairports.com/

worldaerodata.com/

www.aai.aero/

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FACULTY OF ENGINEERING
Department of Mechanical Engineering
(Aerospace Engineering)

COURSE PLAN

Subject Name : **Air Traffic Control and Aerodrome Design (ATC)**
Subject Code : 14BEARE_17 **(Credits - 3)**
Name of the Faculty : R. Suresh Baalaji
Designation : Asst. Professor
Year/Semester/Section : IV / VII / -
Branch : **Aeronautical Engineering**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – I : BASIC CONCEPTS			
1.	1	Introduction to Air Traffic Control	
2.	1	Objectives of ATS - Parts of ATC service.	
3.	1	Scope and Provision of ATCs.	
4.	1	VFR & IFR operations.	AIP(India)
5.	1	Classification of ATS air spaces.	
6.	1	Varies kinds of separation.	
7.	1	Altimeter setting procedures.	
8.	1	Establishment, designation and identification of units providing ATS.	
9.	1	Division of responsibility of control.	
Total No. of Hours Planned for Unit - I			**9 Hours**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – II : AIR TRAFFIC SERVICES			
10.	1	Concept of Air Traffic Services	
11.	1	Area control service.	
12.	1	Assignment of cruising levels minimum flight altitude ATS routes and significant points.	
13.	1	RNAV and RNP	AIP(India)
14.	1	Vertical, lateral and longitudinal separations based on time.	
15.	1	Vertical, lateral and longitudinal separations based on distance.	
16.	1	ATC clearances.	
17.	1	Flight plans.	
18.	1	Position report.	
Total No. of Hours Planned for Unit - II			**9 Hours**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – III : FLIGHT INFORMATION ALERTING SERVICES, COORDINATION, EMERGENCY PROCEDURES AND RULES OF THE AIR			
19.	1	Basics of Flight Information Services.	
20.	1	Radar service, Basic radar.	
21.	1	Terminology – Identification procedures using primary / secondary radar.	
22.	1	Performance checks – use of radar in area and approach control services.	
23.	1	Assurance control and co-ordination between radar / non radar control – emergencies.	AIP(India)
24.	1	Flight information and advisory service.	
25.	1	Alerting service.	
26.	1	Co-ordination and emergency procedures.	
27.	1	Rules of the air.	
Total No. of Hours Planned for Unit - III			**9 Hours**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – IV : AERODROME DATA, PHYSICAL CHARACTERISTICS AND OBSTACLE RESTRICTION			
28.	1	Introduction to Aerodrome Design.	
29.	1	Aerodrome data - Basic terminology.	AIP(India)
30.	1	Aerodrome reference code – Aerodrome reference point.	
31.	1	Aerodrome elevation – Aerodrome reference temperature.	
32.	1	Instrument runway, physical Characteristics.	
33.	1	Length of primary / secondary runway.	
34.	1	Width of runways.	
35.	1	Minimum distance between parallel runways etc.	
36.	1	Obstacles restriction.	
Total No. of Hours Planned for Unit - IV			**9 Hours**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – V : VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY AND OTHER SERVICES			
37.	1	Visual aids for navigation Wind direction indicator.	
38.	1	Landing direction indicator.	
39.	1	Location and characteristics of signal area.	
40.	1	Runway Markings and general requirements.	AIP(India)
41.	1	Various markings – Lights, general requirements.	
42.	1	Aerodrome beacon, identification beacon.	
43.	1	Simple approach lighting system and various lighting systems.	
44.	1	VASI & PAPI - Visual aids for denoting obstacles;	
45.	1	Object to be marked and lighter – Emergency and other services.	
Total No. of Hours Planned for Unit - V			**9 Hours**
46.	1	End Semester Possible Questions Discussion	
47.	1	Part – A / Online Questions Discussion	

TOTAL PERIODS : 45 L + 2 = 47 Hours

TEXT BOOKS

S.No.	Author(s)	Title of the Book	Publisher	Year of Publication
1.	AIP(India)	The English Book Store Vol.I & II	Connaught Circus, New Delhi	2007

REFERENCES

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2.	PANS-RAC-ICAO DOC 444	The English Book Store	Connaught Circus, New Delhi.	2003

WEBSITES

liveatc.net/

www.aai.aero/public_notices/manual_ATS.pdf

www.indianairports.com/

worldaerodata.com/

www.aai.aero/

JOURNALS

J [1] – Journal of Air Traffic services
J [2] – Journal of Airport Design and Constructions
J [3] – Journal of Airport Control and Services

UNIT	Total No. of Periods Planned	Lecture Periods	Tutorial Periods
I	9	9	0
II	9	9	0
III	9	9	0
IV	9	9	0
V	9	9	0
TOTAL	45	45	0

I. CONTINUOUS INTERNAL ASSESSMENT : 40 Marks

(Internal Assessment Tests: 30, Attendance: 5, Assignment/Seminar: 5)

II. END SEMESTER EXAMINATION : 60 Marks

TOTAL : 100 Marks

FACULTY CO-ORDINATOR / AERO HOD / MECH DEAN / FOE

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FACULTY OF ENGINEERING

Department of Mechanical Engineering

(Aerospace Engineering)

Subject Name: Air Traffic Control and Aerodrome Design **Year / Semester**: IV / VII

Subject Code: 14BEAR7E_17 **Programme:** UG / B.E. Aeronautical Engineering

COURSE OBJECTIVES

To provide the student with tools and methods to analyze and plan effectively airports. The course will emphasize in the following issues:

1) Technology of air vehicles related to airport engineering,

2) Operating principles and costs, and

3) Airport planning and systems analysis techniques.

After attending these courses you should be able to do the following:

- Briefly describe important milestones in airport development.
- Describe various aircraft classifications used in airport design.
- Calculate the airport runway length needed for safe airport operations.
- Describe the main elements of an airport master plan.
- Estimate if man-made and natural objects constitute obstacles to navigation in the vicinity of an airport.
- Estimate the capacity of any airport configuration using analytical techniques.
- Estimate airport demand using simple non-linear regression models.
- Estimate airport delays using queueing models.
- Describe the advantages and disadvantages of various airport landside configurations.

COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Plan airport layout incorporating its different features.
ii. Execute construction of runway and taxiway and aprons as per geometric design for all parameters.
iii. Assure desire quality in construction of runway.
iv. Check the requirements of terminal area as per drawing and design v. Check the visual aids for air traffic control system. vi. Explain various elements of Heliports and its planning aspects.

Air Traffic Control And

Aerodrome Design

4. AERODROME DATA, PHYSICAL CHARACTERISTICS AND OBSTACLE RESTRICTION
Aerodrome Data
Basic Terminology
Aerodrome Reference Code
Aerodrome Reference Point
Aerodrome Elevation
Aerodrome Reference Temperature
Instrument Runway
Length Of Primary / Secondary Runway
Width Of Runways
Minimum Distance Between Parallel Runways Etc
Obstacles Restriction
5. VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY AND OTHER SERVICES
Visual Aids For Navigation Wind Direction Indicator
Landing Direction Indicator
Location And Characteristics Of Signal Area
Markings, General Requirements
Various Markings
Lights, General Requirements
Aerodrome Beacon
Identification Beacon
VASI & PAPI
Visual Aids For Denoting Obstacles
Object To Be Marked And Lighter
Emergency And Other Services

Unit- I

Basic Concepts

Objectives of ATS safety Management system

The safety objectives applicable to the provisions of ATS within airspaces and aerodromes controlled by Airports Authority of India have been formally established as below:

(1) Ensure that the established level of safety applicable to the provision of ATS within an Airspace or at an aerodrome is met.

(2) Ensure that safety-related enhancements are implemented whenever necessary.

(3) Ensure that the achievement of satisfactory safety in ATM shall be accorded the highest priority over commercial, environmental and social pressures.

(4) Ensure that Airports Authority of India's safety policy, organizational responsibilities and positional responsibilities are understood by its employees whenever their activities may have impact on safety.

(5) Ensure that there is a system in place to assess the safety implications and safety hazards in ATM operations and to determine the action necessary to minimize those hazards, and to monitor the implementation of that action on a periodic basis.

(6) Control and manage safety hazards in any change to existing systems, equipment or procedures to ensure any unacceptable hazards are eliminated by the time the change is completed.

(7) Ensure that processes are in place which delivers personnel who are adequately trained, motivated and competent to perform the tasks required of them, in addition to being properly rated if so required and to monitor their continuing competence on a periodic basis.

(8) Ensure that processes are in place to facilitate the safe and effective management of the Operations of air traffic services, aeronautical telecommunications services and aeronautical radio navigation facilities on a continuing basis.

(9) Ensure that processes are in place to minimize the impact of any abnormal operation on those utilizing the service and report and record the abnormal operation, thereby providing a mechanism for review, as and when required, after the event.

(10) Ensure that processes are in place to deliver accurate presentation of aeronautical information to the users of that information as and when they require it.

(11) Ensure that the control of entry of personnel into operational fire fighting functions and to periodically monitor and endorse the continuing competency of those personnel.

(12) Comply with ICAO standards for ATS messages recording and access to recordings on a continuing basis.

(14) Ensure that processes are in place which assures the provision of facilities for safe navigation on an on-going basis.

Objectives of the air traffic services

The objectives of the air traffic services shall be to:

a) Prevent collisions between aircraft;

b) Prevent collisions between aircraft on the manoeuvring area and obstructions on that area;

c) Expedite and maintain an orderly flow of air traffic;

d) Provide advice and information useful for the safe and efficient conduct of flights;

e) Notify appropriate organizations regarding aircraft in need of search and rescue aid, and assist such organizations as required.

Parts of ATC service

Divisions of the air traffic services
The air traffic services comprise of three services identified as follows:
i) Air traffic control service
The air traffic control service, to accomplish following objectives:

a) Prevent collisions between aircraft;

b) Prevent collisions between aircraft on the manoeuvring area and obstructions on that area;

c) Expedite and maintain an orderly flow of air traffic the provision of air traffic control service for controlled flights, except for those parts of such flights which are under the jurisdiction of Approach Control or Aerodrome

Control to accomplish following objectives:

a) Prevent collisions between aircraft;

b) Expedite and maintain an orderly flow of air traffic;
ii) Approach control service

The provision of air traffic control service for those parts of controlled flights associated with arrival or departure, in order to accomplish following objectives:

a) Prevent collisions between aircraft;

b) Expedite and maintain an orderly flow of air traffic;

iii) Aerodrome control service:

The provision of air traffic control service for aerodrome traffic, except for those parts of flights which are under the jurisdiction Approach Control to accomplish objectives:

a) prevent collisions between aircraft;

b) Prevent collisions between aircraft on the manoeuvring area and obstructions on that area;

c) Expedite and maintain an orderly flow of air traffic;

Flight information service

Air traffic control services have been divided in three parts as follows:

i) Area control service

The flight information service, to accomplish following objective:

Provide advice and information useful for the safe and efficient conduct of flights.

Alerting service

The alerting service to accomplish following objective
Notify appropriate organizations regarding aircraft in need of search and rescue aid and assist such organizations as required.

Scope & Provision of air traffic services

Scope

Flight information service shall include the provision of pertinent:

a) SIGMET and AIRMET information;

b) Information concerning pre-eruption volcanic activity, volcanic eruptions and volcanic ash clouds;

c) Information concerning the release into the atmosphere of radioactive materials or toxic chemicals;

d) Information on changes in the serviceability of navigation aids;

e) information on changes in condition of aerodromes and associated facilities, including information on the state of the aerodrome movement areas when they are affected by snow, ice or significant depth of water;

f) Information on unmanned free balloons; and of any other information likely to affect safety. Provision of air traffic control service The parts of air traffic control shall be provided by the various units as follows:

a) Area control service:

1) By an area control centre; or

2) by the unit providing approach control service in a control zone or in a control area of limited extent which is designated primarily for the provision of approach control service and where no area control centre is established.

b) Approach control service:

1) by an aerodrome control tower or area control centre when it is necessary or desirable to combine under the responsibility of one unit the functions of the approach control service with those of the aerodrome control service or the area control service;

2) by an approach control unit when it is necessary or desirable to establish a separate unit.

c) Aerodrome control service: by an aerodrome control tower.

VFR & IFR Operations

VFR Operations:

Visual flight rules (VFR) are a set of regulations under which a pilot operates an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going. Specifically, the weather must be better than basic VFR weather minimums, as specified in the rules of the relevant aviation authority. The pilot must be able to operate the aircraft with visual reference to the ground, and by visually avoiding obstructions and other aircraft.
If the weather is below VFR minimums, pilots are required to use instrument flight rules, and operation of the aircraft will primarily be through referencing the instruments rather than visual reference.

Requirement

VFR requires a pilot to be able to see outside the cockpit, to control the aircraft's attitude, navigate, and avoid obstacles and other aircraft. Governing agencies establish specific requirements for VFR flight, including minimum visibility, and distance from clouds, to ensure that aircraft operating under VFR are visible from enough distance to ensure safety.

Under Visual meteorological conditions the minimum visual range, distance from cloud, and heights to be maintained above ground vary by jurisdiction, and may also vary according to the airspace in which the aircraft is operating.

The VFR pilot is required to "see and avoid" obstacles and other aircraft. Pilots flying under VFR assume responsibility for their separation from all other aircraft and are generally not assigned routes or altitudes by air traffic control. Depending on the category of airspace in which the flight is being conducted, VFR aircraft may be required to have a transponder to help Air Traffic Control identify the aircraft on radar in order that ATC can provide separation guidance to IFR aircraft.

In the United States, a pilot operating VFR outside of class B airspace can request "VFR flight following" from ATC. This service is provided by ATC if workload permits it, but is an advisory service only. The responsibility for maintaining separation with other aircraft and proper navigation still remains with the pilot. In the United Kingdom, a pilot can request for "Deconfliction Service", which is similar to flight following.

Meteorological conditions that meet the minimum requirements for VFR flight are termed visual meteorological conditions (VMC). If they are not met, the conditions are considered instrument meteorological conditions (IMC), and a flight may only operate under IFR. IFR operations have specific training requirements and certification required of the pilot, and increased equipment requirements for the aircraft. Additionally, an IFR flight plan must usually be filed in advance. For efficiency of operations, some ATC operations will routinely provide "pop-up" IFR clearances for aircraft operating VFR, but that are arriving at an airport that does not meet VMC requirements. For example, in the United States, California's Oakland (KOAK), Monterey (KMRY) and Santa Ana (KSNA) airports routinely grant temporary IFR clearance when a low coastal overcast forces instrument approaches, while the rest of the state is still under visual flight rules.

In the United States and Canada, VFR pilots also have an option for requesting Special VFR when meteorological conditions at an airport are below normal VMC minimums, but above Special VFR requirements. Special VFR is only intended to enable takeoffs and landings from airports that are near to VMC conditions, and may only be performed during daytime hours if a pilot does not possess an instrument rating.

VFR flight is not allowed in airspace known as class A, regardless of the meteorological conditions. In the United States, class A airspace begins at 18,000 feet msl, and extends to an altitude of 60,000 feet msl.

Pilot certifications

In the United States and Canada, any certified pilot who meets specific recency of experience criteria may operate an airworthy aircraft under VFR.

Controlled visual flight rules

CVFR flight is used in locations where aviation authorities have determined that VFR flight should be allowed, but that ATC separation and minimal guidance are necessary. In this respect, CVFR is similar to Instrument flight rules (IFR) in that ATC will give pilots headings and altitudes at which to fly, and will provide separation and conflict resolution. However, pilots and aircraft do not need to be IFR rated to fly in CVFR areas, which is highly advantageous. An example of airspace where CVFR is common would be Canadian Class B airspace.

The CVFR concept is used in Canada and certain European countries, but not in the U.S., where the Private Pilot certificate itself authorizes the pilot to accept clearances under VFR.

In Israel and the Palestinian territory, for example, VFR does not exist. All visual flights must be performed under CVFR rules.

IFR Operations:

(See highlighted sections below)

Instrument flight rules (IFR) is one of two sets of regulations governing all aspects of civil aviation aircraft operations; the other is visual flight rules (VFR).

Federal Aviation Regulations (FAR) defines IFR as: “Rules and regulations established by the FAA to govern flight under conditions in which flight by outside visual reference is not safe. IFR flight depends upon flying by reference to instruments in the flight deck, and navigation is accomplished by reference to electronic signals. It is also a term used by pilots and controllers to indicate the type of flight plan an aircraft is flying, such as an IFR or VFR flight plan

Weather reports and forecasts.

(a) Whenever a person operating an aircraft under this part is required to use a weather report or forecast, that person shall use that of the U.S. National Weather Service, a source approved by the U.S. National Weather Service, or a source approved by the Administrator. However, for operations under VFR, the pilot in command may, if such a report is not available, use weather information based on that pilot's own observations or on those of other persons competent to supply appropriate observations.

(b) For the purposes of paragraph (a) of this section, weather observations made and furnished to pilots to conduct IFR operations at an airport must be taken at the airport where those IFR operations are conducted, unless the Administrator issues operations specifications allowing the use of weather observations taken at a location not at the airport where the IFR operations are conducted. The Administrator issues such operations specifications when, after investigation by the U.S. National Weather Service and the certificate-holding district office, it is found that the standards of safety for that operation would allow the deviation from this paragraph for a particular operation for which an air carrier operating certificate or operating certificate has been issued.

IFR: Takeoff limitations

No person may takeoff an aircraft under IFR from an airport where weather conditions are at or above takeoff minimums but are below authorized IFR landing minimums unless there is an alternate airport within 1 hour's flying time (at normal cruising speed, in still air) of the airport of departure.

IFR: Destination airport weather minimums.

No person may take off an aircraft under IFR or begin an IFR or over-the-top operation unless the latest weather reports or forecasts, or any combination of them, indicate that weather conditions at the estimated time of arrival at the next airport of intended landing will be at or above authorized IFR landing minimums.

IFR: Alternate airport weather minimums.

No person may designate an alternate airport unless the weather reports or forecasts, or any combination of them, indicate that the weather conditions will be at or above authorized alternate airport landing minimums for that airport at the estimated time of arrival.

Airport requirements.

(a) No certificate holder may use any airport unless it is adequate for the proposed operation, considering such items as size, surface, obstructions, and lighting.

(b) No pilot of an aircraft carrying passengers at night may takeoff from, or land on, an airport unless—

(1) That pilot has determined the wind direction from an illuminated wind direction indicator or local ground communications or, in the case of takeoff, that pilot's personal observations; and

(2) The limits of the area to be used for landing or takeoff are clearly shown—

(i) For airplanes, by boundary or runway marker lights;

(ii) For helicopters, by boundary or runway marker lights or reflective material.

(c) For the purpose of paragraph (b) of this section, if the area to be used for takeoff or landing is marked by flare pots or lanterns, their use must be approved by the Administrator.

Classification of ATS Air Spaces

ATS airspaces in India are classified and designated in accordance with the following.

Class D:

IFR and VFR flights are permitted and all flights are provided with Air Traffic Control service, IFR flights are separated from other IFR flights and receive traffic information in respect of VFR flights. VFR flights receive traffic information in respect of all other flights. Airspaces in terminal areas, control areas, control zones and
aerodrome traffic zones have been classified and designated as class D airspace.

Class E:

IFR and VFR flights are permitted; IFR flights are provided with Air Traffic Control service and are separated from other IFR flights. IFR flights receive traffic information in respect of VFR flights; VFR flights receive traffic information in respect of all other flights, as far as is practical. Class E is not be used for control zones. Airspaces in designated ATS routes outside terminal areas, control areas and control zones, where air traffic control service is provided, have been classified and designated as class E airspace.

Class F:

IFR and VFR flights are permitted. All IFR flights receive an air traffic advisory service and all flights receive flight information service, if requested. Airspaces in designated ATS route segments outside terminal areas, control areas and control zones, where air traffic advisory service is provided, have been classified and designated as class F airspace.

Class G:

IFR and VFR flights are permitted and receive flight information service if requested. Airspaces other than those in Class D, E and F have been classified and designated as class G airspace.

Varies kinds of Separations

In air traffic control, separation is the name for the concept of keeping an aircraft outside a minimum distance from another aircraft to reduce the risk of those aircraft colliding, as well as prevent accidents due to wake turbulence.

Air traffic controllers apply rules, known as separation minima to do this. Pairs of aircraft to which these rules have been successfully applied are said to be separated: the risk of these aircraft colliding is therefore remote. If separation is lost between two aircraft, they are said to be in a conflict.

When an aircraft passes behind or follows another aircraft, wake turbulence minima are applied due to the effect of the wingtip vortices of the preceding aircraft on the following aircraft. These minima vary depending on the relative size of the two aircraft. This is particularly acute on final approach with a smaller aircraft following larger aircraft.

Which aircraft need separating?

It is a common misconception that air traffic controllers keep all aircraft separated. Whether aircraft actually need separating depends upon the class of airspace in which the aircraft are flying, and the flight rules under which the pilot is operating the aircraft. As stated by the U.S. FAA, The pilot has the ultimate responsibility for ensuring appropriate separations and positioning of the aircraft in the terminal area to avoid the wake turbulence created by a preceding aircraft

There are three sets of flight rules under which an aircraft can be flown:

- Visual Flight Rules (VFR)
- Special Visual Flight Rules (SVFR)
- Instrument Flight Rules (IFR)

Public transport flights are almost exclusively operated under IFR, as this set of rules allows flight in regions of low visibility (e.g. cloud). On the other hand a large amount of private flying in light aircraft is done under VFR since this requires a lower level of flying skill on the part of the pilot, and meteorological conditions in which a pilot can see and avoid other aircraft. As its name suggests, SVFR is a special infrequently-used set of rules. For the purposes of separation, controllers consider SVFR to be the same as IFR.

Airspace exists in seven classes, A to G, in decreasing order of air traffic control regulation. Classes A to E are controlled airspace and classes F and G are uncontrolled airspace. At one end of the scale in classes A and B airspace, all aircraft must be separated from each other. At the other end of the scale in class G airspace there is no requirement for any aircraft to be separated from each other. In the intermediate classes some aircraft are separated from each other depending on the flight rules under which the aircraft are operating. For example in class D airspace, IFR aircraft are separated from other IFR aircraft, but not from VFR aircraft, nor are VFR aircraft separated from each other.

Vertical separation

Between the surface and an altitude of 29,000 feet (8,800 m), no aircraft should come closer vertically than 300 metres or 1,000 feet (in those countries that express altitude in feet), unless some form of horizontal separation is provided. Above 29,000 feet (8,800 m) no aircraft shall come closer than 600 m (or 2,000 feet), except in airspace where Reduced Vertical Separation Minima (RVSM) can be applied.

In areas where RVSM capabilities exist, 1,000ft vertical separation may be utilized up to FL410, and 2,000 between FL410-FL600. 5,000 ft vertical separation must be applied to all aircraft above FL600, RVSM or not.

"MARSA" separation can be applied by military aircraft, which overrides all of these rules. Under MARSA conditions (Military Assumes Responsibility for Separating Aircraft), air traffic controllers protect only a block of airspace around multiple military aircraft. They are treated as one, and given only one data tag
on the controller's scope.

Horizontal separation

If any two aircraft are separated by less than the vertical separation minimum, then some form of horizontal separation must exist.

Procedural separation

Procedural separation is separation based upon the position of the aircraft, based upon reports made by the pilots over the radio. It therefore does not necessarily require the use of radar to provide air traffic control using procedural separation minima. In procedural control, any period during which two aircraft are not vertically separated is said to be "level change". In some cases, procedural separation minima are provided for use with radar assistance, however it is important not to get this mixed up with radar separation as in the former case the radar need not necessarily be certified for use for radar separation purposes, the separation is still procedural.

Lateral separation

Lateral separation minima are usually based upon the position of the aircraft as derived visually, from dead reckoning or internal navigation sources, or from radio navigation aids ('beacons').

In the case of beacons, to be separated, the aircraft must be a certain distance from the beacon (measured by time or by DME) and their tracks to or from the beacon must diverge by a minimum angle.

Other lateral separation may be defined by the geography of pre-determined routes, for example the North Atlantic Track system.

Longitudinal separation

If two aircraft are not laterally separated, and are following tracks within 45 degrees of each other (or the reciprocal), then they are said to be following the same route and some form of longitudinal separation must exist.

Longitudinal separation can be based upon time or distance as measure by DME. The golden rule is the 10 minute rule: no two aircraft following the same route must come within 15 minutes flying time of each other. In areas with good navaid cover this reduces to 10 minutes; if the preceding aircraft is faster than the following one then this can be reduced further depending of the difference in speed.

Aircraft whose tracks bisect at more than 45 degrees are said to be crossing, in this case longitudinal separation cannot be applied as it will not be very long before lateral separation will exist again.

Radar separation

Radar separation is applied by a controller observing that the radar returns from the two aircraft are a certain minimum horizontal distance away from each other, as observed on a suitably calibrated radar system. The actual distance used varies: 5 nmi (9 km) is common in en route airspace, 3 NM is common in terminal airspace at lower levels. On occasion 10 NM may be used, especially at long range or in regions of less reliable radar cover.

By US FAA Rules, when an aircraft is:

1. Less than 40 miles from the [radar] antenna, horizontal separation is 3 miles from obstructions or other aircraft.

2. 40 miles or more from the [radar] antenna, horizontal separation is 5 miles from obstructions or other aircraft.

3. Terminal Area For single sensor ASR-9 with Mode S, when less than 60 miles from the antenna, horizontal separation is 3 miles from other aircraft.

Reduced separation

In certain special cases, controllers may reduce separation below the usually required minima.

In the vicinity of an aerodrome

Aerodrome or "Tower" controllers work in tall towers with large windows allowing them, in good weather, to see the aircraft flying in the vicinity of the aerodrome, unless the aircraft is not in sight from the tower (e.g. a helicopter departing from a ramp area). Also, aircraft in the vicinity of an aerodrome tend to be flying at lower speeds. Therefore, if the aerodrome controller can see both aircraft, or both aircraft report that they can see each other, or a following aircraft reports that it can see the preceding one, controllers may reduce the standard separation to whatever is adequate to prevent a collision.

Altimeter Setting Procedures

For flight at or below the transition altitude, the altimeter reference will be Local QNH/Area QNH. Flight will therefore be conducted in altitudes.
Change from Local QNH (set for departure) to the Area QNH will be made on leaving the TMA/CTR/ATZ after take-off. From Area QNH to Local QNH will be made on entry at TMA/CTR/ATZ or on commencement of final approach to land Aircraft transiting through TMA/CTR/ATZ at or below the transition altitude will change to the local QNH on entering the TMA/CTR/ATZ boundaries and to Area QNH on leaving the boundaries.
Vertical displacement of aircraft climbing through the transition layer is expressed in terms of flight levels and when descending through the transition layer is expressed in terms of altitudes. For flight at and above the transition level, the standard altimeter setting of 1013.2 hPa will be used. Change from Local QNH/Area QNH to 1013.2 hPa will be made on climbing through the transition altitude. Change from 1013.2 hPa to Local QNH/Area QNH will be made on descending through the transition level. Cruising within the transition layer is not permitted unless specifically cleared by the Area Control Centre of that FIR.

Establishment and designation of the units providing air traffic services

The air traffic services shall be provided by units established and designated as follows:
Flight information centers shall be established to provide flight information service and alerting service within flight information regions, unless the responsibility of providing such services within a flight information region is assigned to an air traffic control unit having adequate facilities for the discharge of such responsibility.

Air traffic control units shall be established to provide air traffic control service, flight information service and alerting service within control areas, control zones and at controlled aerodromes.

Identification of air traffic services units and airspaces An area control centre or flight information centre shall be identified by the name of a nearby town or city or geographic feature.
An aerodrome control tower or approach control unit shall be identified by the name of the aerodrome at which it is located. A control zone, control area or flight information region shall

Division of responsibility of control

Division Of Responsibility For Control Between Air Traffic Control Units

Between a units providing aerodrome control service and a unit providing approach control service. Except for flights which are provided aerodrome control service only, the control of arriving and departing controlled flights shall be divided between units providing aerodrome control service and units providing approach control service as follows:

Arriving aircraft: The responsibility for the control of an aircraft approaching to land shall be transferred from the unit providing approach control service to the unit providing aerodrome control service when the aircraft:
a) is in the vicinity of the aerodrome, and
i) it is considered that approach and landing will be completed in visual reference to the ground, or
ii) it has reached uninterrupted visual meteorological conditions, or
b) has landed, whichever is the earlier.

Departing aircraft:

The responsibility for control of a departing aircraft shall be transferred from the unit providing aerodrome control service to the unit providing approach control service:

a) when visual meteorological conditions prevail in the vicinity of the aerodrome.
i) prior to the time the aircraft leaves the vicinity of the aerodrome, or
ii) prior to the aircraft entering instrument meteorological conditions, whichever is the earlier;

b) when instrument meteorological conditions prevail at the aerodrome.
i) immediately before the aircraft enters the runwayin- use for take-off, or
ii) immediately after the aircraft is airborne, if local procedures render such action preferable.

Between a unit providing approach control service and a unit providing area control service
When area control service and approach control service are not provided by the same air traffic control unit, responsibility for controlled flights shall rest with the unit providing area control service except that a unit providing approach control service shall be responsible for the control of:
a) arriving aircraft that have been released to it by the area control centre;
b) departing aircraft until such aircraft are released to the area control centre.

Under approach sequence conditions the unit providing area control service shall normally be responsible for clearing aircraft to the holding point, and for including holding instructions and expected approach time in such clearances.

A unit providing approach control service shall assume control of arriving aircraft, provided such aircraft have been released to it, upon arrival of the aircraft at the point agreed for transfer of control, and shall maintain control during approach to the aerodrome.

The control of more than one approach sequence may be effected by a unit providing approach control service, provided the division of control between the unit providing area control service and the unit providing approach control service is defined in instructions approved by the appropriate ATS authority and is basically consistent with the foregoing procedures.

Responsibility in regard to military traffic

It is recognized that some military aeronautical operations necessitate non-compliance with certain air traffic procedures. In order to ensure the safety of flight operations the appropriate military authorities shall be asked, whenever practicable, to notify the proper air traffic control unit prior to undertaking such manoeuvres.

A reduction of separation minima required by military necessity or other extraordinary circumstances shall only be accepted by an air traffic control unit when a specific request in some recorded form has been obtained from the authority having jurisdiction over the aircraft concerned and the lower minima then to be observed shall apply only between those aircraft. Some recorded form of instruction fully covering this reduction of separation minima must be issued by the air traffic control unit concerned.

Temporary airspace reservation, either stationary or mobile, may be established for the use of large formation flights or other military air operations. Arrangements for the reservation of such airspace shall be accomplished by coordination between the user and the appropriate ATS authority.
The co-ordination shall be affected in accordance with the provisions of Annex 11 and completed early enough to permit timely promulgation of information in accordance with the provisions.

Responsibility in regard to unmanned free balloons On receipt of notification of the intended flight of a medium or heavy unmanned free balloon, the air traffic services unit shall arrange for the information to be disseminated to all concerned.

The information shall include:

a) the balloon flight identification or project code name;
b) balloon classification and description;
c) SSR Code or NDB frequency as applicable;
d) the launch site;
e) the estimated time of the commencement of the launch
or the planned period of the launches;
f) the expected direction of ascent;
g) the cruising level(s) (pressure-altitude); and
h) the estimated elapsed time to pass 18 000 m (60 000 ft) pressure-altitude, or to reach cruising level if at or below 18 000 m (60 000 ft), together with the estimated location.

On receipt of notification that a medium or heavy unmanned free balloon has-been launched, the air traffic services unit shall arrange for the information to be disseminated to all concerned. The information shall include:

a) The balloon flight identification or project code name;
b) Balloon classification and description;
c) SSR Code or NDB frequency as applicable;
d) The launch site;
e) The time of launch (es);
f) The estimated time at which 18 000 m (60 000 ft) pressure-altitude will be passed, or the estimated time at which the cruising level will be reached if at or below 18 000 m (60 000 ft), and the estimated location;
g) The estimated date and time of termination of the flight; and
h) The planned location of ground contact, when applicable.

When there is reasonable expectation that a heavy or medium unmanned free balloon will cross international borders, the appropriate ATS unit shall arrange for the prelaunch and the launch notifications to be sent to the ATS unit(s) in the State(s) concerned by NOTAM Class 1. If agreed between the States concerned, the launch notification may be transmitted orally by direct ATS speech circuit between the area control centres/flight information centres involved.

Air traffic services units shall maintain radar surveillance of medium and heavy unmanned free balloons to the extent possible and, if necessary and on the request of the pilot of an aircraft, provide radar separation between the aircraft and such balloons which are radar identified or their exact position is known.

Unit- II

Air Traffic Services

Area control service

Air traffic control service for controlled flights in control areas. It is provided by an area control service or by the unit providing approach control service in a controlled zone. The service may also be in a control area of limited extent that has been designated primarily to provide approach control service where no area control center is established.

Aerothai provides Air Traffic Control Services in accordance with international standards and regulations as well as providing Flight Information Services and Alerting Services to ensure safe, convenient and expeditious air travel. The role also includes coordinating search and rescue operations.

The services are divided into the following three sectors:
1.Aerodrome Control Service
2.Approach Control Service
3.Area Control Service

Aerodrome and Approach Control Services are provided at all commercial airports throughout Thailand within a 30 nautcal mile radius from each airport and at altitudes 11,000 feet and below. Beyond these limites, the responsibility is transferred to the Area Control Services which covers the whole of Thai airspace or Bangkok Flight Information Region as well as the airspace over part of the South China Sea west of Cambodia at an altitude of 13,500 feet up to FL 460 (46,000 feet). However, for Bangkok International Airport, the coverage area is extended to 50 nautical miles radius and an altitude of 16,000 feet and below. This is due to the high traffic volume and the need to be able to transfer air traffic directly to nearby airports, such as U-Tapao and Kampangsaen, without having to pass through Area Control Center.

AEROTHAI provides Air Traffic Services to both civilian and military flights using Radar System and Automatic Dependent Surveillance System, or ADS. Both systems can provide aircraft information such as call sign, position, heading and altitude as welll as other information necessary for effective Air Traffic Control Operations.

The Company's aeronautical infrastructure comprises a network of VHF radio systems for communicating with commercial aircraft and UHF radio systems for military aircraft. The base station is at the Head Office in Bangkok with relay stations located around the country enabling continuous communication with all aircraft at an altitude of 5,500 feet and above. Furthermore, there are communication networks that link all the Air Traffic Control facilities within the country to the Military Air Defense Unit and the adjacent Flight

Information Region, i.e. Singapore, Kuala Lumpur, Yangon, Vientiane, Ho Chi Minh and Phnom Penh.

There are also Navigation Aid facilities located at all commercial airports nationwide to provide vital navigational aid for pilots. The Facilities consist of three main elements: first the Non Directional Beacon (NDB) and Doppler Very High Frequency Omni Directional Range (DVOR) indicate the direction to airports for aircraft, second the Distance Measuring Equipment (DME) indicates the distance between aircraft and airport, and third the Instrument Landing System (ILS) indicates the optimum glide slope, which helps land the aircraft at the centerline of the runway.

Assignment of Cruising Levels Minimum Flight Altitude ATS Routes And Significant Points

Minimum cruising level

Except when specifically authorized by the appropriate authority, cruising levels below the minimum flight altitudes established by the State shall not be assigned.

Area control centres shall, when circumstances warrant it, determine the lowest usable flight level or levels for the whole or parts of the control area for which they are responsible, and use it when assigning flight levels and pass it to pilots on request.

Assignment of cruising levels

Except when traffic conditions and co-ordination procedures permit authorization of cruise climb, an area control centre shall normally authorize only one cruising level for an aircraft beyond its control area, i.e. that cruising level at which the aircraft will enter the next control area whether contiguous or not. Aircraft will be advised to request en route any subsequent cruising level changes desired.

Aircraft authorized to employ cruise climb techniques shall be cleared to operate between two levels or above a level.

If it is necessary to adjust the cruising level of an aircraft operating along an established ATS route extending partly within and partly outside controlled airspace and where the respective series of cruising levels are not identical, such adjustment shall, whenever possible, be effected within controlled airspace and, if suitably located, over a radio navigation aid.

When an aircraft has been cleared into a centre’s control area at a cruising level which is below the established minimum cruising level for a subsequent portion of the route, action should be initiated by that area control centre to issue a revised clearance to the aircraft even though the pilot has not requested the necessary cruising level change.

When necessary, an aircraft may be cleared to change cruising level at a specified time, place or rate.

In so far as practicable, cruising levels of aircraft flying to the same destination shall be assigned in a manner that will be correct for an approach sequence at destination.

An aircraft at a cruising level shall normally have priority over other aircraft desiring that cruising level. When two or more aircraft are at the same cruising level, the preceding aircraft shall normally have priority.

An aircraft may be assigned a level previously occupied by another aircraft after the latter has reported vacating it. If, however, severe turbulence is known to exist, or the aircraft concerned is effecting a cruise climb, such assignment shall be withheld until the aircraft vacating the level has reported at another level separated by the required minimum.

RNAV and RNP

- RNP & RNAV is referenced to the aircraft Defined Path

Area Navigation (RNAV) is a method of Instrument Flight Rules (IFR) navigation that allows an aircraft to choose any course within a network of navigation beacons, rather than navigating directly to and from the beacons. This can conserve flight distance, reduce congestion, and allow flights into airports without beacons. Area navigation used to be called Random Navigation and therefore the acronym is RNAV.

RNAV can be defined as a method of navigation that permits aircraft operation on any desired course within the coverage of station-referenced navigation signals or within the limits of a self-contained system capability, or a combination of these.

Functional requirements

RNAV specifications include requirements for certain navigation functions. These functional requirements include:

1. Continuous indication of aircraft position relative to track to be displayed to the pilot flying on a navigation display situated in his primary field of view;
2. Display of distance and bearing to the active (To) waypoint;
3. Display of ground speed or time to the active (To) waypoint;
4. Navigation data storage function; and
5. Appropriate failure indication of the RNAV system including its sensors.

Required Navigation Performance (RNP) is a type of performance-based navigation (PBN) that allows an aircraft to fly a specific path between two 3-dimensionally defined points in space. RNAV and RNP systems are fundamentally similar. The key difference between them is the requirement for on-board performance monitoring and alerting.

A navigation specification that includes requirement for on-board navigation performance monitoring and alerting is referred to as an RNP specification. One not having such a requirement is referred to as an RNAV specification.

RNP also refers to the level of performance required for a specific procedure or a specific block of airspace. An RNP of 10 means that a navigation system must be able to calculate its position to within a circle with a radius of 10 nautical miles. An RNP of 0.3 means the aircraft navigation system must be able to calculate its position to within a circle with a radius of 3 tenths of a nautical mile.

A related term is ANP which stands for "actual navigation performance". ANP refers to the current performance of a navigation system while "RNP" refers to the accuracy required for a given block of airspace or a specific instrument procedure.

Some oceanic airspace has an RNP of 4 or 10. The level of RNP an aircraft is capable of determines the separation required between aircraft.

RNP approaches with RNP values currently down to 0.1 allow aircraft to follow precise 3 dimensional curved flight paths through congested airspace, around noise sensitive areas, or through difficult terrain.

Performance monitoring and alerting requirements

The performance monitoring and alerting requirements for RNP 4, Basic-RNP 1 and RNP APCH have common terminology and application. Each of these specifications includes requirements for the following

Characteristic Accuracy:

The accuracy requirement defines the 95% Total System Error (TSE) for those dimensions where an accuracy requirement is specified. The accuracy requirement is harmonized with the RNAV navigation specifications and is always equal to the accuracy value. A unique aspect of the RNP navigation specifications is that the accuracy is one of the performance characteristics that is monitored.

- Performance monitoring: The aircraft, or aircraft and pilot combination, is required to monitor the TSE, and to provide an alert if the accuracy requirement is not met or if the probability that the TSE exceeds two- times the accuracy value is larger than

10−5. To the extent operational procedures are used to satisfy this requirement, the crew procedure, equipment characteristics, and installation are evaluated for their effectiveness and equivalence.

• Aircraft failures: Failure of the aircraft equipment is considered within airworthiness regulations. Failures are categorised by the severity of the aircraft level effect, and the system must be designed to reduce the likelihood of the failure or mitigate its effects. Both malfunction (equipment operating but not providing appropriate output) and loss of function (equipment ceases to function) are addressed. Dual system requirements are determined based on operational continuity (e.g. oceanic and remote operations). The requirements on aircraft failure characteristics are not unique to RNP navigation specifications.

• Signal-in-space failures: Signal-in- space characteristics of navigation signals are the responsibility of the ANSP.

The net effect of RNP navigation specifications is to provide bounding of the TSE distribution. Since path definition error is assumed to be negligible, the monitoring requirement is reduced to the other two components of TSE, i.e. flight technical error (FTE) and navigation system error (NSE). It is assumed that FTE is an ergodic stochastic process within a given flight control mode. As a result, the FTE distribution is constant over time within a given flight control mode. However, in contrast, the NSE distribution varies over time due to a number of changing characteristics, most notably:

• Selected navigation sensors: the navigation sensors which are being used to estimate position, such as Global Navigation Satellite System (GNSS) or DME/DME;

• the relative geometry of the aircraft position to the supporting navigation aids: all radio navaids have this basic variability, although the specific characteristics change. GNSS performance is affected by the relative geometry of the satellites compared to the aircraft [12] DME/DME navigation solutions are affected by the inclusion angle between the two DMEs at the aircraft (90° being optimal) and the distance to the DMEs, since the aircraft DME transponder can have increasing range errors with increasing distance;

• Inertial reference units: errors increase over time since last updated.

Application of performance monitoring and alerting to aircraft above, the RNP navigation specifications provide assurance that the TSE distribution remains suitable to the operation.
This result from two requirements associated with the TSE distribution, namely:

• the requirement that the TSE remains equal to or better than the required accuracy for 95% of the flight time; and

• the probability that the TSE of each aircraft exceeds the specified TSE limit (equal to two times the accuracy value) without annunciation is less than 10^{-5}.

Typically, the 10^{-5} TSE requirement provides a greater restriction on performance. For example, with any system that has TSE with a normal distribution of cross-track error, the 10^{-5} monitoring requirement constrains the standard deviation to be 2 x (accuracy value)/4.45 = accuracy value/2.23, while the 95% requirement would have allowed the standard deviation to be as large as the accuracy value/1.96.

It is important to understand that while these characteristics define minimum requirements that must be met, they do not define the actual TSE distribution. The actual TSE distribution may be expected to be typically better than the requirement, but there must be evidence on the actual performance if a lower TSE value is to be used.

In applying the performance monitoring requirement to aircraft, there can be significant variability in how individual errors are managed:

• some systems monitor the actual cross- trackand along-track errors individually, whereas others monitor the radial NSE to simplify the monitoring and eliminate dependency on the aircraft track, e.g. based on typical elliptical 2-D
error distributions.

• some systems include the FTE in the monitor by taking the current value of FTE as a bias on the TSE distribution.

• for basic GNSS systems, the accuracy and 10^{-5} requirements are met as a by- product of the ABAS requirements that have been definedin equipment standards and the FTE distribution for standardized course deviation indicator (CDI) displays.

It is important that performance monitoring is not regarded as error monitoring. A performance monitoring alert will be issued when the system cannot guarantee, with sufficient integrity, that the position meets the accuracy requirement. When such an alert is issued, the probable reason is the loss of capability to validate the position data (insufficient satellites being a potential reason). For such a situation, the most likely position of the aircraft at that time is exactly the same position indicated on the pilot display. Assuming the desired track has been flown correctly, the FTE would be within the required limits and therefore the likelihood of the TSE exceeding twice the accuracy value just prior to the alert is approximately 10^{-5}. However, it cannot be assumed that simply because there is no alert the TSE is less than twice the accuracy value: the TSE can be larger. An example is for those aircraft that account for the FTE based on a fixed error distribution: for such systems, if the FTE grows large, no alert is issued by the system even when the TSE is many times larger than the accuracy value. For this reason, the operational procedures to monitor the FTE are important.

Vertical, lateral and longitudinal separations based on time / distance

RULES OF THE AIR AND AIR TRAFFIC SERVICES

Air Traffic Control Clearances Issuance of air traffic control clearances

Departing aircraft

Area control centres shall forward a clearance to approach control offices or aerodrome control towers with the least possible delay after receipt of request made by these units, or prior to such request if practicable.

En-route aircraft

Air traffic control clearances must be issued early enough to ensure that they are transmitted to the aircraft in sufficient time for it to comply with them.

Aircraft on flight plans specifying that the initial portion of the flight will be uncontrolled, and that the subsequent portion of the flight will be subject to air traffic control by an area control centre after the control area of origin, shall be advised to contact the area control centre in whose area controlled flight will be commenced for clearance.

Aircraft on flight plans specifying that the first portion of the flight will be subject to air traffic control, and that the subsequent portion will be uncontrolled shall normally be cleared to the point at which the controlled flight terminates.

An area control centre may request an adjacent area control centre to clear aircraft to a specified point during a specified period.

After the initial clearance has been issued to an aircraft at the point of departure, it will be the responsibility of the appropriate area control centre to issue an amended clearance whenever necessary and to issue traffic information if required.

During the transonic and supersonic phases of a flight, amendments to the clearance should be kept to a minimum and must take due account of the operational limitations of the aircraft in these flight phases.

When so requested by the pilot, an aircraft shall be cleared for cruise climb whenever traffic conditions and coordination procedures permit. Such clearance shall be for cruise climb either above a specified level or between specified levels.

When so requested by the pilot, an aircraft should, in so far as practicable, be authorized to absorb a specified period of notified terminal delay by cruising at a reduced speed for the latter portion of its flight. The specified period may be the whole or part of the notified terminal delay.

Where an aircraft files, at the departure aerodrome, flight plans for the various stages of flight through intermediate stops, the initial clearance limit will be the first destination aerodrome and new clearances must be issued for subsequent portions of the flight.

The flight plan for the second stage, and that for each subsequent stage, of a flight through intermediate stops will become active for ATS and SAR purposes only when the appropriate ATS unit has received notification that the aircraft has departed from the relevant departure aerodrome, except as provided for in 10.2.9.2.

10.2.9.2 By prior arrangement between air traffic control units and the operators, aircraft operating on an established schedule may be cleared through intermediate stops provided, if the proposed route of flight is through more than one control area, scheduled aircraft may be cleared through intermediate stops within other control areas only after co-ordination between the area control centres concerned.

Contents of air traffic control clearances

Clearances shall contain positive and concise data and shall, as far as practicable, be phrased in a standard manner.

Description of air traffic control clearances Clearance limit

A clearance limit shall be described by specifying the name of the appropriate reporting point, or aerodrome, or controlled airspace boundary.

When prior co-ordination has been effected with units under whose control the aircraft will subsequently come, or if there is reasonable assurance that it can be effected a reasonable time prior to their assumption of control, the clearance limit shall be the destination aerodrome or, if not practicable, an appropriate intermediate point, and coordination shall be expedited so that a clearance to the destination aerodrome may be issued as soon as possible.

If an aircraft has been cleared to an intermediate point in an adjacent control area, the appropriate area control centre will then be responsible for issuing, as soon as practicable, an amended clearance to the destination aerodrome.

When the destination aerodrome is outside a control area, the area control centre responsible for the last control area through which an aircraft will pass shall issue appropriate clearance for flight to the limit of that control area.

Route of flight

The route of flight shall be detailed in each clearance when deemed necessary. The phrase "cleared via flight planned route" may be used to describe any route or portion thereof, provided the route or portion thereof is identical to that filed in the flight plan and sufficient routing details are given to definitely establish the aircraft on its route.

The phrases"cleared via (designation) departure" or "cleared via (designation) arrival" may be used when standard departure or arrival routes have been established by the appropriate ATS authority and published in Aeronautical Information Publications.

The phrase "cleared via flight planned route" shall not be used when granting a reclearance.

Clearances to fly maintaining own separation while in visual meteorological conditions

When so requested by an aircraft and provided it is agreed by the pilot of the other aircraft and so authorized by the appropriate ATS authority, an area control centre may clear a controlled flight operating in airspace Classes D and E in visual meteorological conditions during the hours of daylight to fly subject to maintaining own separation to one other aircraft and remaining in visual meteorologicalconditions. When a controlled flight is so cleared, the following shall apply:

a) the clearance shall be for a specified portion of the flight at or below 3 050 m (10 000 ft), during climb or descent and subject to further restrictions as and when prescribed on the basis of regional air navigation agreements;

b) if there is a possibility that flight under visual meteorological conditions may become impracticable, an IFR flight shall be provided with alternative instructions to be complied with in the event that flight in VMC cannot be maintained for the term of the clearance;

c) the pilot of an IFR flight, on observing that conditions are deteriorating and considering that operation in VMC will become impossible, shall inform ATC before entering IMC and shall proceed in accordance with the alternative instructions given.

Essential traffic information Essential traffic is that controlled traffic to which the provision of separation by ATC is applicable, but which, in relation to a particular controlled flight, is not

Essential traffic information shall be given to controlled flights concerned whenever they constitute essential traffic to each other.

Essential traffic information shall include: a) direction of flight of aircraft concerned; b) type of aircraft concerned;

c) cruising level of aircraft concerned and estimated time over the reporting point nearest to where the level will be crossed.

Clearance of a requested change in flight plan

When issuing a clearance covering a requested change in flight plan (route or cruising level) the exact nature of the change shall be included in the clearance.

If a level change is involved and more than one level is contained in the flight plan, all such levels shall be included in the clearance. When traffic conditions will not permit clearance of a requested change in a flight plan, the words “unable to clear” shall be used. When warranted by circumstances, an alternative flight plan should be offered.

When the alternative flight plan is offered, the complete clearance, as amended, or that part of the clearance containing the alternative shall be included.

Flight plans

Submission of a flight plan Information relative to an intended flight or portion of a flight, to be provided to air traffic services units, shall be in the form of a flight plan.
A flight plan shall be submitted prior to operating:
a) Any flight or portion thereof to be provided with air traffic control service;
b) Any IFR flight within advisory airspace;
c) Any flight within or into designated areas, or along designated routes, when so required by the appropriate ATS authority to facilitate the provision of flight information, alerting and search and rescue services;
d) Any flight within or into designated areas, or along designated routes, when so required by the appropriate ATS authority to facilitate co- ordination with appropriate military units or with air traffic services units in adjacent States in order to avoid the possible need for interception for the purpose of identification;
e) Any flight across International borders.

A flight plan shall be submitted, before departure, to an air traffic services reporting office or, during flight, transmitted to the appropriate air traffic services unit or air ground control radio station, unless arrangements have been made for submission of repetitive flight plans

Unless otherwise prescribed by the appropriate ATS authority, a flight plan for a flight to be provided with air traffic control service or air traffic advisory service shall be submitted at least sixty minutes before departure, or, if submitted during flight, at a time which will ensure its receipt by the appropriate air traffic services unit at least ten minutes before the aircraft is estimated to reach:

a) the intended point of entry into a control area or advisory area; or
b) the point of crossing an airway or advisory route.

Contents of a flight plan

A flight plan shall comprise information regarding such of the following items as are considered relevant by the appropriate ATS authority:
— Aircraft identification
— Flight rules and type of flight
— Number and type(s) of aircraft and wake turbulence category
— Equipment
— Departure aerodrome
— Estimated off-block time
— Cruising speed(s)
— Cruising level(s)
— Route to be followed
— Destination aerodrome and total estimated elapsed time
— Alternate aerodrome(s)
— Fuel endurance
— Total number of persons on board
— Emergency and survival equipment
— Other information.

Completion of a flight plan

Whatever the purpose for which it is submitted, a flight plan shall contain information, as applicable, on relevant items up to and including "Alternate aerodrome(s)" regarding the whole route or the portion thereof for which the flight plan is submitted.

It shall, in addition, contain information, as applicable, on all other items when so prescribed by the appropriate ATS authority or when otherwise deemed necessary by the person submitting the flight plan.

Changes to a flight plan

Subject to the provisions, all changes to a flight plan submitted for an IFR flight, or a VFR flight operated as a controlled flight, shall be reported as soon as practicable to the appropriate air traffic services unit. For other VFR flights, significant changes to a flight plan shall be reported as soon as practicable to the appropriate air traffic services unit.

Closing a flight plan

Unless otherwise prescribed by the appropriate ATS authority, a report of arrival shall be made in person, by radiotelephony or via data link at the earliest possible moment after landing, to the appropriate air traffic services unit at the arrival aerodrome, by any flight for which a flight plan has been submitted covering the entire flight or the remaining portion of a flight to the destination aerodrome.

When a flight plan has been submitted only in respect of a portion of a flight, other than the remaining portion of a flight to destination, it shall, when required, be closed by an appropriate report to the relevant air traffic services unit.

When no air traffic services unit exists at the arrival aerodrome, the arrival report, shall be made as soon as practicable after landing and by the quickest means available to the nearest air traffic services unit/ Flight Information Centre.

When communication facilities at the arrival aerodrome are known to be inadequate and alternate arrangements for the handling of arrival reports on the ground are not available, the following action shall be taken. Immediately prior to landing the aircraft shall, if practicable, transmit to the appropriate air traffic services unit, a message comparable to an arrival report, where such a report is required. Normally, this transmission shall be made to the aeronautical station serving the air traffic services unit in charge of the flight information region in which the aircraft is operated.

Arrival reports made by aircraft shall contain the following elements of information:

a) aircraft identification;
b) departure aerodrome;
c) destination aerodrome (only in the case of a diversionary landing);
d) arrival aerodrome;
e) time of arrival.

Position reports

Transmission of position reports

On routes defined by designated significant points, position reports shall be made when over, or as soon as possible after passing, each designated compulsory reporting point, except as provided. Additional reports over other points may be requested by the appropriate air traffic services unit when so required for air traffic services purposes.

On routes not defined by designated significant points, position reports shall be made as soon as possible after the first half hour of flight and at hourly intervals thereafter, except as provided in

Additional reports at shorter intervals of time may be requested by the appropriate air traffic services unit when so required for air traffic services purposes.

Under conditions specified by the appropriate ATS authority, flights may be exempted from the requirement to make position reports at each designated compulsory reporting point or interval. In applying this paragraph, account should be taken of the meteorological requirement for the making and reporting of routine aircraft observations.

The position reports required shall be made to the air traffic services unit serving the airspace in which the aircraft is operated. In addition, when so prescribed by the appropriate ATS authority in aeronautical information publications or requested by the appropriate air traffic services unit, the last position report before passing from one flight information region or control area to an adjacent flight information region or control area shall be made to the air traffic services unit serving the airspace about to be entered.

If a position report is not received at the expected time, subsequent control shall not be based on the assumption that the estimated time is accurate. Immediate action shall be taken to obtain the report if it is likely to have any bearing on the control of other aircraft.

Contents of position reports

The position reports required shall contain the following elements of information, except that elements (4), (5) and (6) may be omitted from position reports transmitted by radiotelephony, when so prescribed on the basis of regional air navigation agreements:
1) Aircraft identification
2) Position
3) Time
4) Flight level or altitude
5) Next position and time over
6) Ensuing significant point.

Transmission of ADS reports

The position reports shall be made automatically to the air traffic services unit serving the airspace in which the aircraft is operating. The requirements for the transmission and contents of ADS reports shall be established by the controlling ATC unit on the basis of current operational conditions, and communicated to the aircraft and acknowledged through an ADS agreement.

Contents of ADS reports

ADS reports shall be composed of data blocks selected from the following:

a) Basic ADS Latitude Longitude Altitude

Estimated altitude at next way-point Estimated time at next way-point (Next + 1) way-point

Estimated altitude at (next + 1) way- point

Estimated time at (next + 1) way-point e) Meteorological information

Wind speed Wind direction Temperature

Turbulence (if available) Humidity (if available)

f) Short-term intent

Latitude at projected intent point Longitude at projected intent point Altitude at projected intent point Time of projection

If an altitude, track or speed change is predicted to occur between the aircraft's current position and the projected intent point, additional

a) Time Figure of merit

b) Ground vector Track Ground speed

Rate of climb or descent

c) Air vector Heading Mach or IAS

Rate of climb or descent

d) Projected profile

Next way-point information would be provided in an intermediate intent block as follows:

Distance from current point to change point Track from current point to change point Altitude at change point Predicted time to change point

g) Extended projected profile (in response to an interrogation from the ground system)

Next way-point

Estimated altitude at next way-point Estimated time at next way-point (Next + 1) way-point

Estimated altitude at (next + 1) way- point

Estimated time at (next + 1) way-point

(Next + 2) way-point

Estimated altitude at (next + 2) way- point

Estimated time at (next + 2) way-point

[repeated for up to (next + 128) way- points]

Unit – III

Flight Information Alerting Services, Coordination, Emergency Procedures And Rules Of the Air

Radar Services

Radar systems capabilities

Radar systems used in the provision of air traffic services shall have a very high lSevel of reliability, availability and integrity. The possibility of system failures or significant system degradations which may cause complete or partial interruptions of service shall be very remote. Back-up facilities shall be provided.

Multi-radar systems, i.e. systems utilizing more than one radar sensor, should have the capability to receive, process and display, in an integrated manner, data from all the connected sensors.

Radar systems should be capable of integration with other automated systems used in the provision of ATS, and should provide for an appropriate level of automation with the objectives of improving the accuracy and timeliness of data displayed to the controller and reducing controller workload and the need for verbal co-ordination between adjacent control positions and ATC units.

Radar systems should provide for the display of safety-related alerts and warnings, including conflict alert, minimum safe altitude warning, conflict prediction and unintentionally duplicated SSR codes.

States should, to the extent possible, facilitate the sharing of radar information in order to extend and improve radar coverage in adjacent control areas. States should, on the basis of regional air navigation agreements, provide for the automated exchange of co-ordination data relevant to aircraft being provided with radar services, and establish automated co-ordination procedures.

Primary surveillance radar (PSR) and secondary Surveillance radar (SSR) may be used either alone or in combination in the provision of air traffic services, including in the provision of separation between aircraft, provided:

a) reliable coverage exists in the area; and

b) the probability of detection, the accuracy and the integrity of the radar system(s) are satisfactory.

PSR systems should be used in circumstances where SSR alone would not meet the air traffic services requirements.

SSR systems, especially those with monopulse technique or Mode S capability, may be used alone, including in the provision of separation between aircraft, provided:
a) the carriage of SSR transponders is mandatory within the area; and
b) aircraft identification is established and maintained by use of assigned discrete SSR codes.

The use of radar in air traffic services shall be limited to specified areas of radar coverage and shall be subject to such other limitations as have been specified by the appropriate ATS authority. Adequate information on the operating methods used shall be published in aeronautical information publications, as well as operating practices and/or equipment limitations having direct effects on the operation of the air traffic services.

Where PSR and SSR are required to be used in combination, SSR alone may be used in the event of PSR failure to provide separation between identified transponder equipped aircraft, provided the accuracy of the SSR position indications has been verified by monitor equipment or other means.

Basic radar terminology

Radar is an acronym for Radio Detection and Ranging.

The term "radio" refers to the use of electromagnetic waves with wavelengths in the so-called radio wave portion of the spectrum, which covers a wide range from 104 km to 1 cm. Radar systems typically use wavelengths on the order of 10 cm, corresponding to frequencies of about 3 GHz. The detection and ranging part of the acronym is accomplished by timing the delay between transmission of a pulse of radio energy and its subsequent return.

Principle of Operation

The basic principle of operation of primary radar is simple to understand. However, the theory can be quite complex. An understanding of the theory is essential in order to be able to specify and operate primary radar systems correctly. The implementation and operation of primary radars systems involve a wide range of disciplines such as building works, heavy mechanical and electrical engineering, high power microwave engineering, and advanced high speed signal and data processing techniques. Some laws of nature
have a greater importance here.

Radar measurement of range, or distance, is made possible because of the properties of radiated electromagnetic energy.

1. Reflection of electromagnetic waves The electromagnetic waves are reflected if they meet an electrically leading surface. If these reflected waves are received again at the place of their origin, then that means an obstacle is in the propagation direction.

2. Electromagnetic energy travels through air at a constant speed, at approximately the speed of light,

- 300,000 kilometers per second or
- 186,000 statute miles per second or
- 162,000 nautical miles per second.

This constant speed allows the determination of the distance between the reflecting objects (airplanes, ships or cars) and the radar site by measuring the running time of the transmitted pulses.

3. This energy normally travels through space in a straight line, and will vary only slightly because of atmospheric and weather conditions. By using of special radar antennas this energy can be focused into a desired direction. Thus the direction (in azimuth and elevation of the reflecting objects can be measured.

These principles can basically be implemented in a radar system, and allow the determination of the distance, the direction and the height of the reflecting object.

Identification procedures using primary / secondary radar

General radar procedures Identification of aircraft Establishment of radar identification:
Before providing radar service to an aircraft, radar identification shall be established and the pilot informed. Thereafter, radar identification shall be maintained until termination of the radar service.
If radar identification is subsequently lost, the pilot shall be informed accordingly and, when applicable, appropriate instructions issued.

Radar identification shall be established by at least one of the following methods.

SSR identification procedures
Where SSR is used, aircraft may be identified by one or more of the following procedures:
a) recognition of the aircraft identification in a radar label;
b) recognition of an assigned discrete code, the setting of which has been verified, in a radar label;
c) direct recognition of the aircraft identification of a Mode S-equipped aircraft in a radar label;

d) by transfer of radar identification
e) observation of compliance with an instruction to set a specific code;
f) observation of compliance with an instruction to squawk IDENT;

When a discrete code has been assigned to an aircraft, a check shall be made at the earliest opportunity to ensure that the code set by the pilot is identical to that assigned for the flight. Only after this check has been made shall the discrete code be used as a basis for identification.

PSR identification procedures

Where SSR is not used or available, radar identification shall be established by at least one of the following methods:

a) by correlating a particular radar position indication with an aircraft reporting its position over, or as bearing and distance from, a point displayed on the radar map, and by ascertaining that the track of the particular radar position is consistent with the aircraft path or reported heading;

b) by correlating an observed radar position indication with an aircraft which is known to have just departed, provided that the identification is established within 2 km (1 NM) from the end of the runway used.

Particular care should be taken to avoid confusion with aircraft holding over or overflying the aerodrome, or with aircraft departing from or making a missed approach over adjacent runways;

c) by transfer of radar identification (see 6.3);

d) by ascertaining the aircraft heading, if circumstances require, and following a period of track observation:

— instructing the pilot to execute one or more changes of heading of 30 degrees or more and correlating the movements of one particular radar position indication with the aircraft's acknowledged execution of the instructions given; or

— correlating the movements of a particular radar position indication with manoeuvres currently executed by an aircraft having so reported.

When using these methods, the radar controller shall:

i) verify that the movements of not more than one radar position indication correspond with those of the aircraft; and

ii) ensure that the manoeuvre(s) will not carry the aircraft outside the coverage of the radar display;

Use may be made of direction-finding bearings to assist in radar identification of an aircraft. This method, however, shall not be used as the sole means of establishing radar identification, unless so prescribed by the appropriate ATS authority for particular cases under specified conditions.

When two or more radar position indications are observed in close proximity, or are observed to be making similar movements at the same time, or when doubt exists as to the identity of a radar position indication for any other reason, changes of heading should be prescribed or repeated as many times as necessary, or additional methods of identification should be employed, until all risk of error in identification is eliminated.

Performance checks

The radar controller shall adjust the radar display(s) and carry out adequate checks on the accuracy thereof, in accordance with the technical instructions prescribed by the appropriate authority for the radar equipment concerned.

The radar controller shall be satisfied that the available functional capabilities of the radar system as well as the information presented on the radar display(s) is adequate for the functions to be performed.

The radar controller shall report, in accordance with local procedures, any fault in the equipment, or any incident requiring investigation, or any circumstances which make it difficult or impractical to provide radar services.

Use of Radar In The Approach

Control Service

General provisions

Radar systems used in the provision of approach control service shall be appropriate to the functions and level of service to be provided.

Radar systems used to monitor parallel ILS approaches shall meet the requirements for such operations

Use of radar in the air traffic control (Area) service

Functions:

The information presented on a radar display may be used to perform the following functions in the provision of air traffic control service:

a) provide radar services as necessary in order to improve airspace utilization, reduce delays, provide for direct routings and more optimum flight profiles, as well as to enhance safety;

b) provide radar vectoring to departing aircraft for the purpose of facilitating an expeditious and efficient departure flow and expediting climb to cruising level;

c) provide radar vectoring to aircraft for the purpose of resolving potential conflicts;

d) provide radar vectoring to arriving aircraft for the purpose of establishing an expeditious and efficient approach sequence;

e) provide radar vectoring to assist pilots in their navigation, e.g. to or from a radio navigation aid, away from or around areas of adverse weather, etc.;

f) provide separation and maintain normal traffic flow when an aircraft experiences communication failure within the area of the radar coverage;

g) maintain radar monitoring of air traffic;

h) when applicable, maintain a watch on the progress of air traffic, in order to provide a non-radar controller with:

i) improved position information regarding aircraft under control;

ii) supplementary information regarding other traffic; and

iii) information regarding any significant deviations, by aircraft, from the terms of their respective air traffic control clearances, including their cleared routes as well as levels when appropriate.

Assurance Control & Co-ordination of traffic under radar and
non-radar control Appropriate arrangements shall be made in any air traffic control unit using radar to ensure the co-ordination of traffic under radar control with traffic under non-radar control, and to ensure the provision of adequate separation between the radar-controlled aircraft and all other controlled aircraft. To this end, close liaison shall be maintained at all times between radar controllers and non-radar controllers.

Flight information and advisory service

Flight information service
Recording and transmission of information on the progress of flights

Information on the actual progress of flights, including those of heavy or medium unmanned free balloons, under neither air traffic control service nor air traffic advisory service shall be:

a) recorded by the air traffic services unit serving the flight information region within which the aircraft is flying in such a manner that it is available for reference and in case it is requested for search and rescue action;

b) transmitted by the air traffic services unit receiving the information to other air traffic services units.

Transfer of responsibility for theprovision of flight information service
The responsibility for the provision of flight information service to a flight normally passes from the appropriate ATS unit in a flight information region to the appropriate ATS unit in the adjacent flight information region at the time of crossing the common flight information region boundary. However, when co-ordination is required in accordance with Part VIII, 2.1, but communication facilities are inadequate, the former ATS unit shall, as far as practicable, continue to provide flight information service to the flight until it has established two-way communication with the appropriate ATS unit in the flight information region it is entering.

Transmission of information

Means of transmission

Except as provided in 1.3.2.1, information shall be disseminated to aircraft by one or more of the following means as determined by the appropriate ATS authority:

a) the preferred method of directed transmission on the initiative of the appropriate ATS unit to an aircraft, ensuring that receipt is acknowledged; or

b) a general call, unacknowledged transmission to all aircraft concerned; or

c) broadcast; or

d) data link.

The use of general calls shall be limited to cases where it is necessary to disseminate essential information to several aircraft without delay, e.g. the sudden occurrence of hazards, a change of the runway-in-use, or the failure of a key approach and landing aid.

Transmission of special air-reports, SIGMET and AIRMET information Appropriate SIGMET and AIRMET infor-mation, as well as special air-reports which have not been used for the preparation of a SIGMET, shall be disseminated to aircraft by one or more of the means on the basis of regional air navigation agreements.

The special air-report, SIGMET and AIRMET information to be passed to aircraft on ground initiative should cover a portion of the route up to one hour's flying time ahead of the aircraft except when another period has been determined on the basis of regional air navigation agreements.

Transmission of information concerning volcanic activity

Information concerning pre-eruption volcanic activity, volcanic eruptions and volcanic ash clouds shall be disseminated to aircraft by one or more of the means specified on the basis of regional air navigation agreements.

Transmission of information concerning radio- active materials and toxic chemical "clouds" Information on the release into the atmosphere of radioactive materials or toxic chemicals which could affect airspace within the area of responsibility of the ATS unit shall be transmitted to aircraft by one or more.

Transmission of selected special reports and amended aerodrome forecasts

Selected special reports and amended aerodrome forecasts shall be transmitted on request and supplemented by:

a) directed transmission from the appropriate air traffic services unit of selected special reports and amended aerodrome forecasts for the departure, destination and its alternate aerodromes, as listed in the flight plan; or

b) a general call on appropriate frequencies for the unacknowledged transmission to affected aircraft of selected special reports and amended aerodrome forecasts; or

c) continuous or frequent broadcast of current aerodrome reports and forecasts in areas determined on the basis of regional air navigation agreements where traffic congestion dictates.

The passing of amended aerodrome forecasts to aircraft on the initiative of the appropriate air traffic services unit should be limited to that portion of the flight where the aircraft is within a specified time from the aerodrome of destination, such time being established on the basis of regional air navigation agreements.

Transmission of information on heavy or medium unmanned free balloons
Appropriate information on heavy or medium unmanned free balloons shall be disseminated to aircraft by one or
Transmission of information to supersonic aircraft
The following information shall be available at appropriate area control centres or flight information centres for aerodromes determined on the basis of regional air navigation agreements and shall be transmitted on request to supersonic aircraft prior to commencement of deceleration/ descent from supersonic cruise:
a) current meteorological reports and forecasts, except that where communications difficulties are encountered under conditions of poor propagation, the elements transmitted may be limited to:
i) mean surface wind, direction and speed (including gusts);
ii) visibility or runway visual range;
iii) amount and height of base of low clouds;
iv) other significant information;
v) if appropriate, information regarding expected changes;
b) operationally significant information on the status of facilities relating to the runway in use, including the precision approach category in the event that the lowest approach category promulgated for the runway is not available;

c) sufficient information on the runway surface conditions to permit assessment of the runway braking action.

Alerting service

Aircraft

When so required by the appropriate ATS authority to facilitate the provision of alerting and search and rescue services, an aircraft, prior to and when operating, within or into designated areas or along designated routes, shall comply with the provisions concerning the submission, completion, changing and closing of a flight plan.

In addition to the above, aircraft equipped with suitable two-way radio communications shall report during the period twenty to forty minutes following the time of last contact, whatever the purpose of such contact, merely to indicate that the flight is progressing according to plan, such report to comprise identification of the aircraft and the words "Operations normal" or the signal QRU.

The "Operations normal" message shall be transmitted air-ground to an appropriate air traffic services unit (e.g. normally to the aeronautical telecommunication station serving the air traffic services unit in charge of the flight information region in which the aircraft is flying, otherwise to anotheraeronautical telecommunication station to be retransmitted as required to the air traffic services unit in charge of the flight information region).

It may be advisable, in case of a SAR operation of a substantial duration, to promulgate by NOTAM the lateral and vertical limits of the area of SAR action, and to warn aircraft not engaged in actual SAR operations and not controlled by air traffic control to avoid such areas unless otherwise authorized by the appropriate ATS unit.

Air traffic services units

When no report from an aircraft has been received within a reasonable period of time (which may be a specified interval prescribed on the basis of regional air navigation agreements) after a scheduled or expected reporting time, the ATS unit shall, within the stipulated period of thirty minutes, endeavour to obtain such report in order to be in a position to apply the provisions relevant to the "Uncertainty Phase" should circumstances warrant such application.

When alerting service is required in respect of a flight operated through more than one flight information region or control area, and when the position of the aircraft is in doubt, responsibility for coordinating such service shall rest with the ATS unit of the flight information region or control area:

1) within which the aircraft was flying at the time of last air-ground radio contact;

2) that the aircraft was about to enter when last airground contact was established at or close to the boundary of two flight information regions or control areas;
3) within which the aircraft's intermediate stop or final destination point is located:
a) if the aircraft was not equipped with suitable two way radio communication equipment; or
b) was not under obligation to transmit position reports.

The unit responsible for alerting service, shall — notify units providing alerting service in other affected flight information regions or control areas of the emergency phase or phases, in addition to notifying the rescue co-ordination centre associated with it;
— request those units to assist in the search for any useful information pertaining to the aircraft presumed to be in an emergency.
— collect the information gathered during each phase of the emergency and, after verifying it as a necessary, transmit it to the rescue co-ordination centre;
— announce the termination of the state of emergency as circumstances dictate.

Emergency procedures
General
The various circumstances surrounding each emergency situation preclude the establishment of exact detailed procedures to be followed. The procedures outlined herein are intended as a general guide to air traffic services personnel. Air traffic control units shall maintain full and complete co-ordination, and personnel shall use their best judgment in handling emergency situations.

Priority
An aircraft known or believed to be in a state of emergency, including being subjected to unlawful interference, shall be given priority over other aircraft.

Unlawful interference
Air traffic services personnel shall be prepared to recognize any indication of the occurrence of unlawful interference with an aircraft.

Whenever unlawful interference with an aircraft is suspected, and where automatic distinct display of SSR Mode A Code 7500 and Code
7700 is not provided, the radar controller shall attempt to verify his suspicion by setting the SSR decoder to Mode A Code 7500 and thereafter to Code 7700.

Whenever unlawful interference with an aircraft is known or suspected, ATS units shall promptly attend to requests by or to anticipated needs of the aircraft, including requests for relevant information relating to air navigation facilities, procedures and services along the route of flight and at any aerodrome of intended landing, and shall take such action as is necessary to expedite the conduct of all phases of the flight.

ATS units shall also:

a) transmit, and continue to transmit, information pertinent to the safe conduct of the flight, without expecting a reply from the aircraft;

b) monitor and plot the progress of the flight with the means available, and co-ordinate transfer of control with adjacent ATS units without requiring transmissions or other responses from the aircraft, unless communication with the aircraft remains normal; c) inform and continue to keep informed, appropriate ATS units, including those in adjacent flight information regions, which may be concerned with the progress of the flight;

d) notify:

i) the operator or his designated representative; ii) the appropriate rescue co-ordination centre in accordance with appropriate alerting procedures; iii) the designated security authority;

e) relay appropriate messages, relating to the circumstances associated with the unlawful interference, between the aircraft and designated authorities.

Emergency descent

Upon receipt of advice that an aircraft is making an emergency descent through other traffic, all possible action shall be taken immediately to safeguard all aircraft concerned. When deemed necessary, air traffic control units shall immediately broadcast by means of the appropriate radio aids, or if not possible, request the appropriate communications stations immediately to broadcast an emergency message.

Action by the pilot-in-command

It is expected that aircraft receiving such a broadcast will clear the specified areas and stand by on the appropriate radio frequency for further clearances from the air traffic control unit.

Subsequent action by the air traffic control unit Immediately after such an emergency broadcast has been made the area control centre, the approach control office, or the aerodrome control tower concerned shall forward further clearances to all aircraft involved as to additional procedures to be followed during and subsequent to the emergency descent.

Rules of the Air

The operation of an aircraft either in flight or on the movement area of an aerodrome shall be in compliance with the general rules and, in addition, when in flight, either with:

a) the visual flight rules, or

b) the instrument flight rules.

Visual flight rules (VFR) are a set of regulations under which a pilot operates an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going. Specifically, the weather must be better than basic VFR weather minimums, as specified in the rules of the relevant aviation authority. The pilot must be able to operate the aircraft with visual reference to the ground, and by visually avoiding obstructions and other aircraft.

If the weather is below VFR minimums, pilots are required to use instrument flight rules, and operation of the aircraft will primarily be through referencing the instruments rather than visual reference.

Requirements

VFR require a pilot to be able to see outside the cockpit, to control the aircraft's attitude, navigate, and avoidobstacles and other aircraft.[2] Governing agencies establish specific requirements for VFR flight, including minimum visibility, and distance from clouds, to ensure that aircraft operating under VFR are visible from enough distance to ensure safety.

Under Visual meteorological conditions the minimum visual range, distance from cloud, and heights to be maintained above ground vary by jurisdiction, and may also vary according to the airspace in which the aircraft is operating.

The VFR pilot is required to "see and avoid" obstacles and other aircraft. Pilots flying under VFR assume responsibility for their separation from all other aircraft and are generally not assigned routes or altitudes by air traffic control. Depending on the category of airspace in which the flight is being conducted, VFR aircraft may be required to have a transponder to help Air Traffic Control identify the aircraft on radar in order that ATC can provide separation guidance to IFR aircraft.

Instrument flight rules (IFR) is one of two sets of regulations governing all aspects of civil aviation aircraft operations; the other is visual flight rules (VFR).

Federal Aviation Regulations (FAR) defines IFR as: “Rules and regulations established by the FAA to govern flight under conditions in which flight by outside visual reference is not safe. IFR flight depends upon flying by reference to instruments in the flight deck, and navigation is accomplished by reference to electronic signals.” It is also a term used by pilots and controllers to indicate the type of flight plan an aircraft is flying, such as an IFR or VFR flight plan.

Unit - IV
Aerodrome Data, Physical Characteristics and Obstacle Restriction

Aerodrome Data

Aerodrome information to be provided for a certified aerodrome

Aerodrome chart: An aerodrome chart will contain the following information:

a) layout of runways, taxiways and apron(s);
b) type of the runway surfaces;
c) designations and length of runways;
d) designations of the taxiways, where applicable;
e) location of illuminated and non- illuminated wind direction indicators;
f) location of the aerodrome reference point;
g) location of terminal buildings;
h) location of control tower;
i) location of fire station;
j) location of navigation aids;
k) location of isolation bay; and
l) location of helipads; where provided.

Aerodrome administration. This will include:

a) name, address, telephone and facsimile numbers of the aerodrome operator;
b) aerodrome usage;
c) aerodrome charges.

Aerodrome location. This information will include:

a) name of aerodrome;
b) latitude and longitude, based on the aerodrome reference point;
c) magnetic variation;
d) aerodrome elevation.

Movement area. The following information will be included:

a) aerodrome reference code number;
b) runway bearings- in degrees magnetic and true;
c) runway length and surface type;
d) runway pavement strength rating/ load bearing strength;
e) runway and runway strip width;
f) runway slopes;
g) runway declared distances;
h) elevation of the mid point of runway threshold, for instrument runways;
i) runway turning area;
j) Taxiway designation, width, surface type;
k) Apron surface type and aircraft stands.

Visual aids (aeronautical marking and lighting system)

This information will include:

a) Marking and lighting systems for runways;
b) approach lighting system;
c) visual approach slope indicator system;
d) aerodrome beacon;
e) marking and lighting systems for taxiways; and
f) any other marking and lighting systems.

Navigation aids

Details of all navigational aids serving the aerodromes will be provided.

Rescue and fire -fighting services

The category of aerodrome-based rescue and fire-fighting services will be provided.

Ground services

This information will include:
a) availability of fuel (ATF);
b) automatic terminal information service where provided;
c) ground to air communication facilities d) any other services available to pilots.

Basic radar terminology

Radar is an acronym for Radio Detection and Ranging.

The term "radio" refers to the use of electromagnetic waves with wavelengths in the so-called radio wave portion of the spectrum, which covers a wide range from 104 km to 1 cm.

Radar systems typically use wavelengths on the order of 10 cm, corresponding frequencies of about 3 GHz. The detection and ranging part of the acronym is accomplished by timing the delay between transmission of a pulse of radio energy and its subsequent return.

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2. Electromagnetic energy travels through air at a constant speed, at approximately the speed of light,

- 300,000 kilometers per second or
- 186,000 statute miles per second or
- 162,000 nautical miles per second.

This constant speed allows the determination of the distance between the reflecting objects (airplanes, ships or cars) and the radar site by measuring the running time of the transmitted pulses.

3. This energy normally travels through space in a straight line, and will vary only slightly because of atmospheric and weather conditions. By using of special radar antennas this energy can be focused into a desired direction. Thus the direction (in azimuth and elevation of the reflecting objects can be measured.

These principles can basically be implemented in a radar system, and allow the determination of the distance, the direction and the height of the reflecting object.

Aerodrome Reference Code Airports Authority of India has adopted the International Civil Aviation Organization (ICAO) methodology for using a code system, known as the Aerodrome Reference Code, to specify the standards for individual aerodrome facilities which are suitable for use by aeroplanes within a range of performances and sizes. The Code is composed of two elements: element 1 is a number related to the aeroplane reference field length; and element 2 is a letter related to the aeroplane wing span and outer main gear wheel span. A particular specification is related to the more appropriate of the two elements of the Code or to an appropriate combination of the two Code elements. The Code letter or number within an element selected for design purposes is related to the critical aeroplane characteristics for which the facility is provided. There could be more than one critical aeroplane, as the critical aeroplane for a particular facility, such as a runway, may not be the critical aeroplane for another facility, such as the taxiway.

Aerodrome reference point

An airport (or aerodrome) reference point (ARP) is the notional centre point of an airport, located at the geometric centre of all the usable.

A point on the airport designated as the official airport location. It is generally indicated in six-digit coordinates. The ARP is located as near as is practical to the geometric center of the landing area, taking into account possible future development. Magnetic bearings and distances of obstructions within 4 NM that may constitute

1 Less than 800 mA Up to but not Up to but not hazards are measured from the ARP. The same as aerodrome reference point.

along the runway shall be measured to the accuracy of one-half metre or foot and reported to the aeronautical information services authority.

Aerodrome Reference Temperature

Aerodrome Elevation

The elevation of the highest point of the landing area (ICAO). Aerodrome elevation is measured to an accuracy of 1 ft (or 1/2 m). The aerodrome elevation is prominently displayed at the air traffic control tower. Also called above airfield elevation and airport elevation.

Aerodrome elevation as it appears on approach charts.

Aerodrome elevation is displayed at the control tower.

Aerodrome and runway elevations

The aerodrome elevation and geoid undulation at the aerodrome elevation position shall be measured to the accuracy of one-half metre or foot and reported to the aeronautical information services authority.

For an aerodrome used by international civil aviation for non-precision approaches, the elevation and geoid undulation of each threshold, the elevation of the runway end and any significant high and low intermediate points An aerodrome reference temperature shall be determined for an aerodrome in degrees Celsius.

The aerodrome reference temperature shall be the monthly mean of the daily maximum temperatures for the hottest month of the year.

Instrument Runway/Instrument
Approach Runway

A runway equipped with visual and electronic navigational aids for which a precision or a non-precision approach with straight-in landing minimums has been approved. There may be more than one instrument runway on an airfield. The various types of instrument runways are the:

i. Non-precision approach runway. An instrument runway served by visual aids and a non-visual aid providing at least directional guidance adequate for a straight-in approach.

ii. Precision approach runway category I. An instrument runway served by an ILS (instrument landing system) and/or an MLS (microwave landing system) and visual aids intended for operations with a decision height not lower than
200 ft (60 m) and a runway visual range of the order of 800 m (2600 ft). (When RVR is not available, 0.5 statute miles ground visibility is substituted.) Rotorcraft visibility limits may be half those published for airplanes.

iii. Precision approach runway category II. An instrument runway served by an ILS and/or an

MLS and visual aids intended for operation with a decision height lower than 200 ft (60 m) but not lower than 100 ft (30 m) and a runway visual range not less than 400 m (1200 ft). Rotorcraft visibility limits may be lower than those published for airplanes.

iv. Precision approach runway category III. An instrument runway served by an ILS to and along the surface of the runway and intended for operations down to an RVR (runway visual range) of the order of 200 m (600 ft) (no decision height is applicable), using visual aids during the final phase of landing; or intended for operations down to an RVR of the order of 50 m (150 ft) (no decision height is applicable), using visual aids for taxiing; or intended for operations without reliance on visual reference for landing or taxiing. The visual aids need not necessarily be matched to the scale of the non-visual aids provided. The criterion for the selection of visual aids is the condition under which operations are intended to be conducted.

A layout of an instrument runway

Length of Primary & Secondary Runway

Primary runway

The actual runway length to be provided for a primary runway shall be adequate to meet the operational requirements of the aeroplanes for which the runway is intended and shall be not less than the longest length determined by applying the corrections for local conditions to the operations and performance characteristics of the relevant aero planes.

Secondary runway

The length of a secondary runway shall be determined similarly to primary runways except that it needs only to be adequate for those aeroplanes which require to use that secondary runway in addition to the other runway or runways in order to obtain a usability factor of at least 95 per cent.

Runways with stopways or clearways Where a runway is associated with a stopway or clearway, an actual runway length less than that resulting from application of 3.1.6 or 3.1.7, as appropriate, may be considered satisfactory, but in such a case any combination of runway, stopway and clearway provided shall permit compliance with the operational requirements for take-off and landing of the aeroplanes the runway is intended to serve.

Length

A runway of at least 6,000 ft (1,800 m) in length is usually adequate for aircraft weights below approximately 200,000 lb (90,000 kg). Larger aircraft including widebodies will usually require at least 8,000 ft (2,400 m) at sea level and somewhat more at higher altitude airports. International widebody flights, which carry substantial amounts of fuel and are therefore heavier, may also have landing requirements of 10,000 ft (3,000 m) or more and takeoff requirements of 13,000 ft (4,000 m).

At sea level, 10,000 ft (3,000 m) can be considered an adequate length to land virtually any aircraft. For example, at O'Hare International, when landing simultaneously on 22R and 28 or parallel 27L, it is routine for arrivals from the Far East which would normally be vectored for 22R (7,500 ft (2,286 m)) or 27L (7,967 ft (2,428 m)) to request 28 (13,001 ft (3,963 m)). It is always accommodated, although occasionally with a delay. Another example is that the Luleå Airport in Sweden was extended to 10,990 ft (3,350 m) to allow any fully loaded freight aircraft to take off.

An aircraft will need a longer runway at a higher altitude due to decreased density of air at higher altitudes, which reduces lift and engine power, requiring higher take-off and landing speed. An aircraft will also require a longer runway in Width of Runways
The width of a runway is dependent on the normal prevalent visibility, maneuverability, and stability of aircraft during landing.

Runway widths recommended by ICAO hotter or more humid conditions (see density altitude). Most commercial aircraft carry manufacturer's tables showing the adjustments Code number Runway width for code letter required for a given temperature.

Runway safety area

A runway safety area (RSA) or runway end safety area (RESA) is defined as "the surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway."

Past standards called for the RSA to extend only 60m (200 feet) from the ends of the runway.

A	B	C	D	E	
1	18	18	23	_ _	_ _
2	23	23	30	_ _	_ _
3	30	30	30	45	_ _
4	_ _	_ _	45	45	45

For precision approach runway, the width should not be less than 30 m

Runway design characteristics (FAA) Aircraft design group

Characteristic	I	II	III	IV	V	VI

Currently the international standard ICAO requires a 90m (300 feet) RESA starting from the end of the runway strip (which itself is 60m from the end of the runway), and recommends but not requires a 240m RESA beyond that. In the U.S., the recommended RSA may extend to 500 feet in width, and 1,000 feet beyond each runway end (according to U.S. Federal Aviation Administration recommendations; 1000 feet is equivalent to the international ICAO-RESA of 240m plus 60m strip). The standard dimensions have increased over time to accommodate larger and faster aircraft, and to improve safety.

Runway width (m)
Runway shoulder
width (m) Runway blast
pad width (m)
Runway blast pad length(m)
Runway safety area width (m)
Runway safety area

Length (m)

- 300 m beyond each runway end

Values of runway widths recommended by the ICAO (International Civil Aviation Organization) and the FAA (Federal Aviation Administration) are given in the tables. All measurements are in meters.

Minimum distance between parallel runways

Minimum distance between parallel runways Where parallel non-instrument runways are intended for simultaneous use, the minimum distance between their centre lines shall be:
C 210 m where the higher code number is 3 or 4; C 150 m where the higher code number is 2; and C 120 m where the higher code number is 1.

Where parallel instrument runways are intended for simultaneous use subject to conditions specified in the ICAO PANS-RAC (Doc 4444) and the PANS-OPS (Doc 8168), Volume I, the minimum distance between their centre lines
shall be:
C 1 035 m for independent parallel approaches; C 915 m for dependent parallel approaches;
C 760 m for independent parallel departures;
C 760 m for segregated parallel operations;
except that:
a) for segregated paralleloperations the specified minimum distance:
1) may be decreased by 30 m for each 150 m that the arrival runway is staggered toward the arriving aircraft, to a minimum of 300 m; and
2) shall be increased by 30 m for each 150 m that the arrival runway is staggered away from the arriving aircraft;

b) for independent parallelapproaches, combinations of minimum distances and associated conditions other than those specified in the ICAO PANS-RAC (Doc 4444) may be applied when it is determined that such combinations would not adversely affect the safety of aircraft operations.

Obstacles Restriction Restrictions/prohibition of new constructions, the height of which does not constitute obstruction but which is nevertheless considered hazardous to the safety of aircraft operations:
New construction/installation which will adversely affect the performance of radio/radar/navigational aids which will adversely affect the published instrument approach to land procedures or which will

necessitate a probable change in the published procedures, shall be restricted/prohibited as deemed fit.

Overhead HT/LT lines or telephone/telegraph lines will not be permitted in the approach/take-off climb areas within 3000 m of the Inner edge of these areas. Construction of butcheries, tanneries and refuse dumps will not be permitted within a radius of
10 kms from the Runway ends/ARP.

NOTE: Incinerators could be permitted clear of approach/take-off climb areas.

Factory chimneys proposed to be constructed within a radius of 8 km of runway ends/ARP will not be permitted unless the owners give a written undertaking that oil- fired or electric furnaces or any other fuel which will not cause smoke- hazard will only be used.

A 3 m deduction will be made from the permissible elevation of the proposed structure falling in approach/take-off climb surfaces and transition surfaces in the close proximity of approach funnels. This provision is kept for super structures of any kind, such as, have to give an undertaking in the prescribed Performa to the effect that he is aware of the fact that no complaints of claims against the noise, vibration, nuisance or other damage to buildings/property/individuals, caused by the regular aircraft operations from/to the aerodrome, shall be entertained by the Central Government/Airports Authority of India.

For mobile obstructions, the following additional heights will be considered:
Rail Track : 7.62 m Road : 5.0 m

Operational criteria

The heights of structures will be restricted with reference to the Obstacle Clearance Altitudes as Wireless/TV antennas, coolingtowers, lift machine rooms, overhead water tanks, etc.

For the buildings/structures to be constructed in the vicinity of an aerodrome, the owner will published in Notices to Airmen and amended from time to time.

The vertical clearance between the structure and the aircraft making an instrument approach to land shall be up to 150 m.

Note: To have the effective control over the construction activities of the Government or private agencies within the areas specified for obstacle limitation surfaces, all in-charges of aerodromes are enjoined to exercise continuous vigilance over such activities. They are to take immediate action to bring any violation of the laid down criteria to the notice of Local Administrative Authorities for stoppage of such construction activities and also keep Headquarters informed in this regard.

Unit - V

Visual Aids for Navigation, Visual Aids For Denoting Obstacles Emergency and Other Services

Visual aids for navigation Wind direction indicator

Application

Standard - An aerodrome shall be equipped with at least one wind direction indicator.

Location

Standard - A wind direction indicator shall be located so as to be visible from aircraft in flight or on the movement area and in such a way as to be free from the effects of air disturbances caused by nearby objects.

Recommendation - Aerodromes with runways greater than 1200 m should have a wind direction indicator located at each end of the runway at a point approximately 60 m outwards from the runway edge and approximately 150 m inwards from the approach end.

Recommendation - Aerodromes with runways

1200 m or less in length should have a wind direction indicator centrally located on the aerodrome except that at aerodromes with only one runway the wind direction indicator should be centrally located along the runway and approximately 60 m from the edge.

Characteristics

Standard - The height of wind direction indicators shall not exceed a height of 7.5 m when located in the runway strip.

Wind Direction Indicator

Recommendation - The wind direction indicator should be in the form of a truncated cone made of fabric and should have a length of not less than 3.6 m and a diameter, at the larger end, of not less than 0.9 m. It should be constructed so that it gives a clear indication of the direction of the surface wind and a general indication of the wind speed. The colour or colours should be so selected as to make the wind direction indicator clearly visible and understandable from a height of at least 300 m, having regard to background. Where practicable, a single colour, preferably white or orange, should be used. Where a combination of two colours is required to give adequate conspicuity against changing backgrounds, they should preferably be orange and white, red and white, or black and white, and should be arranged in five alternate bands, the first and last bands being the darker colour.

Standard - Provision shall be made for illuminating at least one wind indicator at an aerodrome intended for use at night.

Landing direction indicator

A device to indicate visually the direction currently designated for landing and take-off (ICAO). Wind cones, windsocks, landing T, and tetrahedron are some of the devices used as landing direction indicators.

Traffic Patterns

At those airports without an operating control tower, a segmented circle visual indicator system [Figure], if installed, is designed to provide traffic pattern information. Usually located in a position affording maximum visibility to pilots in the air and on the ground and providing a centralized location for other elements of the system, the segmented circle consists of the following components: wind direction indicators, landing direction indicators, landing strip indicators, and traffic pattern indicators.

A tetrahedron is installed to indicate the direction of landings and takeoffs when conditions at the airport warrant its use. It may be located at the center of a segmented circle and may be lighted for night operations. The small end of the tetrahedron points in the direction of landing. Pilots are cautioned against using a tetrahedron for any purpose other than as an indicator of landing direction. At airports with control towers, the tetrahedron should only be referenced when the control tower is not in operation. Tower instructions supersede tetrahedron indications.

Landing strip indicators are installed in pairs as shown in Figure and are used to show the alignment of landing strips. Traffic pattern indicators are arranged in pairs in conjunction with landing strip indicators and used to indicate the direction of turns when there is a variation from the normal left traffic pattern. (If there is no segmented circle installed at the airport, traffic pattern indicators may be installed on or near the end of the runway.)

At most airports and military air bases, traffic pattern altitudes for propeller-driven aircraft generally extend from 600 feet to as high as 1,500 feet above ground level (AGL). Pilots can obtain the traffic pattern altitude for an airport from the A/FD. Also, traffic pattern altitudes for military turbojet aircraft sometimes extend up to 2,500 feet AGL. Therefore, pilots of en route aircraft should be constantly on the alert for other aircraft in traffic patterns and avoid these areas whenever possible. When operating at an airport, traffic pattern altitudes should be maintained unless otherwise required by the applicable distance from cloud criteria. Pilots can find traffic pattern information and restrictions such as noise abatement in the A/FD.

Location and characteristics of signal area

The Aerodrome Signal Area

The operator of a certified aerodrome (a term that has replaced 'licensed aerodrome') that does not have a continuous air traffic service provided by ATC during the day must provide a signal area consisting of a black circle of 9 m diameter with either a 1 m white border or 6 white edge markers. The signal area replaced the earlier signal square.

The signals that must be displayed are a white cross if the aerodrome is unserviceable, a white dumb-bell if aircraft are only to use sealed movement areas, and a white double-cross when glider operations are being conducted. In the case of Narromine, a major gliding centre, the double cross symbol is permanently displayed. The other two symbols are, somewhat unusually, mounted on frames such that they can be rotated to display either a white or black face upward - both set to black in the photo above.

Behind the signal area is the aerodrome's primary illuminated wind indicator.

Signal Square

The Signal Square was neither fish nor fowl. It was installed and maintained at aerodromes by Airports staff, and operated by the resident groundsman or airport fireman on the instruction of the air traffic controller or flight service officer.

The Signal Square, or signal area, contained symbols to indicate visually to over-flying aircraft conditions on the aerodrome. It had pre- War origins, and was intended for aircraft that carried no radio communications equipment (which included most light aircraft well into the 1960s). As soon as ICAO was created in 1947, Annexe 14 contained (and still does) instructions on the size and construction of the Signal Square. Annex 2 describes its use by aircraft. Ground signals are still used at aerodromes to this day – the landing T and the gliding-in- operation symbol being the most common ones, but the general use of the signal square had fallen into disuse by the late 1950s when VHF air-ground communications had been largely introduced.

The square was marked out on the ground in the vicinity of the control tower and the wind- sock. It had sides 40 feet long, with a white-painted border. The surface inside the square was smooth and level, surfaced in bitumen, ashes, sealed gravel, turf or even bare earth. It was usually blackened with sump oil or black ashes to provide a contrasting background to the symbols that conveyed the information. The were four basic signals; the red square signal, the dumb bell signals, the landing T, and the right hand circuit indicator. All of these objects were made of timber and painted black on the reverse side. They were made of a series of hinged sections so that they could be folded up when not in use, and would not be visible from the air as the reverse side was showing, and appeared black.

The function of these elements was as follows

Red Signal Square:

A red square with no diagonals indicated that the aerodrome rules were temporarily suspended, and that special arrangements were in operation. If this square had one yellow diagonal cross-bar, it indicated that the bad state of the landing ground or a temporary obstruction required caution by the pilot when landing. If the Red Square had two yellow diagonal cross-bars, this meant a total prohibition of landing for a prolonged period.

Dumb Bell Signals:

These were only displayed only on aerodromes with sealed runways. A white dumb bell indicated that the airfield surface was unserviceable except for the runways and that take-offs and landings were to be made on the runways only, and that all taxying must be on paved surfaces only. A white dumb bell with black bars superimposed across the centres of each circular portion of the dumb bell meant that landings and take-offs must be on runways only, but grass surfaces may be used for taxying, subject to standard serviceability markings. A red "L" on the dumb bell indicated that light aircraft may land or taxi off the runways, but that heavy aircraft must use runways only.

Landing 'T':

This was probably the best known of the signals, and was used at all-over landing fields. It was mounted on a pivot for ease of turning, and supported on castor wheels or skids. It was lined up with the wind direction, and an aircraft landed along the shaft of the "T" towards the cross arm. While not commonly used, a white disc at the centre of the cross piece of the "T" indicated that take-offs and landings were being made in more than one direction, and that pilots must be 'on the alert'. Of course, the air traffic controller or Aeradio operator on-duty had to vigilant, and change the direction of the T whenever the wind direction changed.

White Cross:

This symbol indicated that parachute dropping was in progress, and that aircraft were not to take-off or land.

Double White Cross:

This symbol, a vertical arm with two parallel cross arms, is still in use at some aerodromes and indicates that glider flying is in progress.

Right Hand Circuit Arrow:

If right hand circuits were to be used by aircraft instead of the normal convention of left-hand circuits a large red arrow, bending right, was employed. It was superimposed on two adjacent sides of the Signal Area, in close proximity to the horizontal red square panel.

There were some other symbols used only at military airfields, for obvious reasons. A white hollow square indicated bombing practice with dummy bombs and diving practice were being carried out, with a white square as the bombing target.

Markings, general requirements

Markings and Signs:

a. Check markings for correct colour coding, peeling, blistering, chipping and fading.
b. Check signs to ensure they are of the correct colour coding, easy to read and that all lights are working and not obscure by vegetation, dirt snow etc.
c. Check all taxi way hold position markings and runway designation signs are in good condition, clearly visible and the sign lights are working.
d. Check signs to ensure they are frangibly mounted.
e. Check that the signs are not missing and they have correct legend and orientation with no broken panels.

Various Runway markings

- Designation Centerline
- Threshold
- Rwy End
- Aiming Point
- Touchdown Zone
- Side Strip
- Turnpad
- Holding Position
- Mandatory
- Information Marking

Various markings

General

a. Airport pavement markings and signs provide information that is useful to a pilot during takeoff, landing, and taxiing.

b. Uniformity in airport markings and signs from one airport to another enhances safety and improves efficiency. Pilots are encouraged to work with the operators of the airports they use to achieve the marking and sign standards described in this section.

c. Pilots who encounter ineffective, incorrect, or confusing markings or signs on an airport should make the operator of the airport aware of the problem. These situations may also be reported under the Aviation Safety Reporting Program.

Pilots may also report these situations to the FAA regional airports division.

d. The markings and signs described in this section of the AIM reflect the current FAA recommended standards.

Airport Pavement Markings

General

For the purpose of this presentation the Airport Pavement Markings have been grouped into four areas:

1. Runway Markings.

2. Taxiway Markings.

3. Holding Position Markings.

4. Other Markings.

Marking Colors

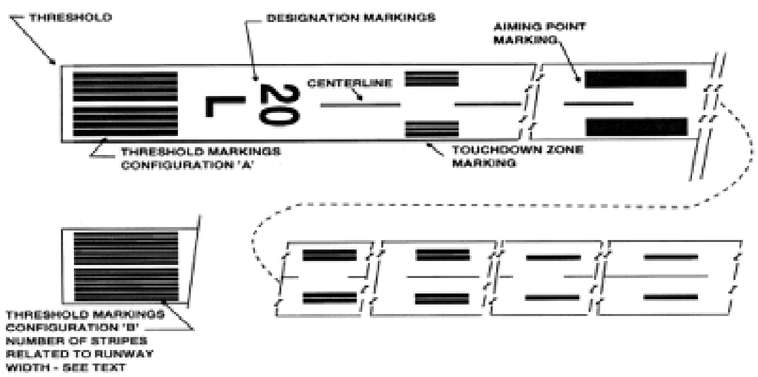
Markings for runways are white. Markings defining the landing area on a heliport are also white except for hospital heliports which use a red "H" on a white cross. Markings for taxiways, areas not intended for use by aircraft (closed and hazardous areas), and holding positions (even if they are on a runway) are yellow.

Runway Markings

General.

There are three types of markings for runways: visual, non-precision instrument, and precision instrument.

Precision Instrument Runway Markings



Runway Designators.

Runway numbers and letters are determined from the approach direction. The runway number is the whole number nearest one-tenth the magnetic azimuth of the centerline of the runway, measured clockwise from the magnetic north. The letters, differentiate between left (L), right (R), or center (C), parallel runways, as applicable:

1. For two parallel runways "L" "R."

2. For three parallel runways "L" "C" "R."

Runway Centerline Marking.

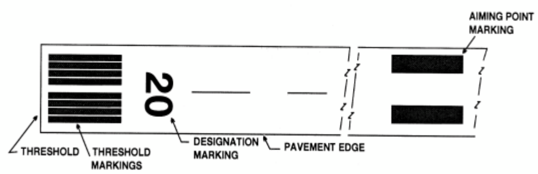
The runway centerline identifies the center of the runway and provides alignment guidance during takeoff and landings. The centerline consists of a line of uniformly spaced stripes and gaps.

Runway Aiming Point Marking.

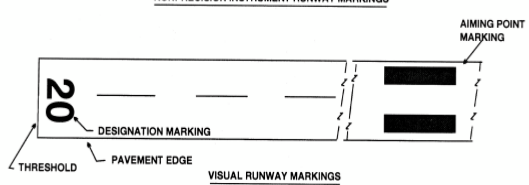
The aiming point marking serves as a visual aiming point for a landing aircraft. These two rectangular markings consist of a broad white stripe located on each side of the runway centerline and approximately 1,000 feet from the landing threshold, as shown in FIG 1, Precision Instrument Runway Markings.

Runway Touchdown Zone Markers.

The touchdown zone markings identify the touchdown zone for landing operations and are coded to provide distance information in 500 feet (150m) increments. These markings consist of groups of one, two, and three rectangular bars symmetrically arranged in pairs about the runway centerline, as shown in FIG1, Precision Instrument Runway Markings. For runways having touchdown zone markings on both ends, those pairs of markings which extend to within 900 feet (270m) of the midpoint between the thresholds are eliminated. Non-precision Instrument Runway and Visual Runway Markings



NONPRECISION INSTRUMENT RUNWAY MARKINGS



VISUAL RUNWAY MARKINGS

Runway Side Stripe Marking.

Runway side stripes delineate the edges of the runway. They provide a visual contrast between runway and the abutting terrain or shoulders. Side stripes consist of continuous white stripes located, on each side of the runway.

Runway Shoulder Markings.

Runway shoulder stripes may be used to supplement runway side stripes to identify pavement areas contiguous to the runway sides that are not intended for use by aircraft. Runway Shoulder stripes are Yellow.

Runway Threshold Markings.

Runway threshold markings come in two configurations. They either consist of eight longitudinal stripes of uniform dimensions disposed symmetrically about the runway centerline or the number of stripes is related to the runway. A threshold marking helps identify the beginning of the runway that is available for landing. In some instances the landing threshold may be relocated or displaced.

1. Relocation of a Threshold. Sometimes construction, maintenance, or other activities require the threshold to be relocated towards the rollout end of the runway. When a threshold is relocated, it closes not only a set portion of the approach end of a runway, but also shortens the length of the opposite direction runway. In these cases, a NOTAM should be issued by the airport operator identifying the portion of the runway that is closed, e.g., 10/28 W 900 CLSD. Because the duration of the relocation can vary from a few hours to several months, methods identifying the new threshold may vary. One common practice is to use a ten feet wide white threshold bar across the width of the runway. Although the runway lights in the area between the old threshold and new threshold will not be illuminated, the runway markings in this area may or may not be obliterated, removed, or covered.

2. Displaced Threshold. A displaced threshold is a threshold located at a point on the runway other than the designated beginning of the runway. Displacement of a threshold reduces the length of runway available for landings. The portion of runway behind a displaced threshold is available for takeoffs in either direction or landings from the opposite direction. A ten feet wide white threshold bar is located across the width of the runway at the displaced threshold. White arrows are located along the centerline in the area between the beginning of the runway and displaced threshold. White arrow heads are located across the width of the runway just prior to the threshold bar.

Demarcation Bar.

A demarcation bar delineates a runway with a displaced threshold from a blast pad, stopway or taxiway that precedes the runway. A demarcation bar is 3 feet (1m) wide and yellow, since it is not located on the runway. These markings are used to show pavement areas aligned with the runway that are unusable for landing, takeoff, and taxiing. Chevrons are yellow.

Runway Threshold Bar

A threshold bar delineates the beginning of the runway that is available for landing when the threshold has been relocated or displaced. A threshold bar is 10 feet (3m) in width and extends across the width of the runway.

Lights, General Requirements Aeronautical Ground Lights: Operation:

General

All aeronautical ground lights shall be operated:

a) continuously during the hours of darkness or during the time the centre of the sun's disc is more than 6 degrees below the horizon, whichever requires the longer period of operation, unless otherwise provided hereafter or otherwise required for the control of air traffic;

b) at any other time when their use, based on weather conditions, is considered desirable for the safety of air traffic.

6.1.2 Lights on and in the vicinity of aerodromes that are not intended for en-route navigation purposes may be turned off, subject to further provisions hereafter, if no likelihood of either regular or emergency operation exists, provided that they can be again brought into operation at least one hour before the expected arrival of an aircraft.

At aerodromes equipped with lights of variable intensity a table of intensity settings, based on conditions of visibility and ambient light, should be provided for the guidance of air traffic controllers in effecting adjustment of these lights to suit the prevailing conditions. When so requested by an aircraft, further adjustment of the intensity may be made whenever possible.

Approach lighting

In addition to 6.1.1 approach lighting shall also be operated:

a) by day when requested by an approaching aircraft;

b) when the associated runway lighting is operated.

The lights of a visual approach slope indicator system shall be operated during the hours of daylight as well as of darkness and irrespective of the visibility conditions when the associated runway is being used.

Runway lighting

Runway lighting shall not be operated if that runway is not in use for landing, take-off or taxiing purposes.

If runway lighting is not operated continuously, lighting following a take-off shall be provided as specified below:

a) at aerodromes where air traffic control service is provided and where lights are centrally controlled, the lights of one runway shall remain lighted after take-off as long as is considered necessary for the return of the aircraft due to an emergency occurring during or immediately after take-off;

b) at aerodromes without air traffic control service or without centrally controlled lights, the lights of one runway shall remain lighted until such time as would normally be required to reactivate the lights in the likelihood of the departing aircraft returning for an emergency landing, and in any case not less than fifteen minutes after take-off.

Stop way lighting

Stopway lights shall be operated whenever the associated runway lights are operated.

Taxiway lighting

Taxiway lighting shall be turned on in such order that a continuous indication of the taxi path is presented to taxiing aircraft. Taxiway lighting or any portion thereof may be turned off when no longer needed by the taxiing aircraft.

Stop bars

Stop bars shall be switched on to indicate that all traffic shall stop, and switched off to indicate that traffic may proceed.

Obstacle lighting

Obstacle lighting associated with the approach to or departure from a runway or channel, where the obstacle does not project through the inner horizontal surface, may be turned off and on simultaneously with the runway or channel lights.

Unserviceability lights may not be turned off while the aerodrome is open.

Monitoring of visual aids

Aerodrome controllers shall make use of automatic monitoring facilities, when provided, to ascertain whether the lighting is in good order and functioning according to selection.

In the absence of an automatic monitoring system or to supplement such a system, the aerodrome controller shall visually observe such lighting as can be seen from the aerodrome control tower and use information from other sources such as visual inspections or reports from aircraft to maintain awareness of the operational status of the visual aids.

On receipt of information indicating a lighting fault, the aerodrome controller shall take such action as is warranted to safeguard any affected aircraft or vehicles, and initiate action to have the fault rectified.

Aerodrome beacon

An aerodrome beacon or rotating beacon is a beacon installed at an airport or aerodrome to indicate its location to aircraft pilots at night.

An aerodrome beacon is mounted on top of a towering structure, often a control tower, above other buildings of the airport. It produces flashes not unlike that of a lighthouse.

Airport and heliport beacons are designed in such a way to make them most effective from one to ten degrees above the horizon; however, they can be seen well above and below this peak spread. The beacon may be an omni-directional flashing xenon strobe, or it may rotate at a constant speed which produces the visual effect of flashes at regular intervals. Flashes may be of just a single color, or of two alternating colors.

In the United States, the Federal Aviation Administration (FAA) has established the following rules for airport beacons:

Flashing rates

1. 24 to 30 per minute for beacons marking airports, landmarks, and points on Federal airways
2. 30 to 45 per minute for beacons marking heliports

Color combinations

1. White and Green — lighted land airport
2. Green alone* — Lighted land airport
3. White and yellow — lighted water airport
4. Yellow alone* — Lighted water airport
5. Green, Yellow, and White — Lighted heliport
6. White, White, Green* — Military Airport
7. White, Green, Red — Hospital and/or Emergency Services Heliport

*Green alone or yellow alone is used only in connection with a white-and- green or white-and-yellow beacon display, respectively.

Military airport beacons flash alternately white and green, but are differentiated from civil beacons by two quick white flashes between the green flashes.

In Class B, Class C, Class D and Class E surface areas, operation of the airport beacon during the hours of daylight often indicates that the ground visibility is less than 3 miles and/or the ceiling is less than 1,000 feet. Regardless of the weather conditions, the FAA has no regulation that requires airports to turn the beacon on during the day.

At some locations with operating control towers, Air Traffic Control (ATC) personnel turn the beacon on or off with controls in the tower. At many airports the airport beacon is turned on by a photoelectric cell or time clocks, and ATC personnel cannot control them.

In Canadathe regulations are much simpler. Lighted aerodromes are equipped with white single flash beacons operating at a frequency of 20 to 30 flashes per minute. Heliports with beacons exhibit the Morse letter H (4 short flashes) at a rate of 3 to 4 groups per minute.

Identification Beacon

- An aeronautical radio beacon emitting coded signals that allow a particular point of reference to be identified.
- A light beacon emitting a two letter identification code in Morse code A green color is used for civil aerodromes, yellow for waterdromes, and red for military airfields. More often called an aeronautical light beacon.
- Aeronautical ground light that shows a coded signal to indicate a designated geographical location.

Simple approach lighting system and various lighting systems

An approach lighting system, or ALS, is a lighting system installed on the approach end of an airport runway and consisting of a series of lightbars, strobe lights, or a combination of the two that extends outward from the runway end. ALS usually serves a runway that has an instrument approach procedure (IAP) associated with it and allows the pilot to visually identify the runway environment and align the aircraft with the runway upon arriving at a prescribed point on an approach.

The first fixed runwaylighting possibly appeared in 1930 at Cleveland Municipal Airport (now known as Cleveland Hopkins International Airport) in Cleveland, Ohio. But it was suitable only clear night or days.

Modern approach lighting systems are highly complex in their design and significantly enhance the safety of aircraft operations, particularly in conditions of reduced visibility. The earliest approach lighting systems were far removed from the current sophisticated generation of ALS's and were developed before/during World War II.

They were commonly referred to as the Flare Path, the name being derived from the fact often flares were burned alongside the active runway to provide the pilot with an illuminated reference for approach and landing where an electrical system had not yet been installed. During the war the UK became a huge bomber base, and during England's famous fog a night a flare path was not enough even with a radar direct ground- controlled approach system that became available later in the war. The British were the most concerned because their night bombers were flying bombing missions every night year round, where the US day bombers operated when there was clear weather over the target. The British eventually developed a working system towards the end of the war that burned the fog off the area of the runway called FIDO that stood for Fog Investigation and Dispersal Operation. FIDO which worked and saved a lot of bomber crew lives, but due to its high cost (ie $4000 dollars a day) and inability during heavy rains was not suitable for civilian airline operation. After the war the US Navy and United Airlines worked together on various methods at the US Navy's Landing Aids Experimental Station located at the Arcata, Californian air base, to allow aircraft to land safely at night and under zero visibility weather, whether it was rain or heavy fog. The predecessor of today's modern ALS while crude had the basics: A 3,500 foot visual approach of 38 towers, with 17 on each side and atop each 75 foot high tower a 5000 watt natural gas light.

After the US Navy's development of the lighted towers it was not long before the natural gas lights, were soon replaced by more efficient and brighter strobe lights -- ie then called Stro beacon lights. The first large commercial airport to have installed a strobe light ASL visual approach path was New York cities New York International Airport. Soon other large airports had strobe light ASL systems installed.

The required minimum visibility for instrument approaches is influenced by the presence and type of approach lighting system. In the U.S., a CAT I ILS approach without approach lights will have a minimum required visibility of 3/4 mile, or 4000 foot runway visual range. With a 1400 foot or longer approach light system, the minimum potential visibility might be reduced to 1/2 mile (2400 runway visual range), and the presence of touchdown zone and centerline lights with a suitable approach light system might further reduce the visibility to 3/8 mile (1800 feet runway visual range).

The runway lighting is controlled by the air traffic control tower. At uncontrolled airports, Pilot Controlled Lighting may be installed which can be switched on by the pilot via radio. In both cases, the brightness of the lights can be adjusted for day and night operations. In the event of radio failure, the control tower can communicate with the aircraft via aviation light signals.

Depth perception is inoperative at the distances usually involved in flying aircraft, and so the position and distance of a runway with respect to an aircraft must be judged by a pilot using only two-dimensional cues such as perspective, as well as angular size and movement within the visual field. Approach lighting systems provide additional cues that bear a known relationship to the runway itself and help pilots to judge distance and alignment for landing.

Various Lighting Systems

Many airports have lighting that help guide planes using the runways and taxiways at night or in rain or fog.

On runways, green lights indicate the beginning of the runway for landing, while red lights indicate the end of the runway. Runway edge lighting consists of white lights spaced out on both sides of the runway, indicating the edge. Some airports have more complicated lighting on the runways including lights that run down the centerline of the runway and lights that help indicate the approach (an approach lighting system, or ALS). Low-traffic airports may use pilot controlled lighting to save electricity and staffing costs.

Along taxiways, blue lights indicate the taxiway's edge, and some airports have embedded green lights that indicate the centerline.

A particular runway may have some or all of the following.

- Runway End Identification Lights (REIL) – unidirectional (facing approach direction) or omnidirectional pair of synchronized flashing lights installed at the runway threshold, one on each side.

- Runway end lights – a pair of four lights on each side of the runway on precision instrument runways, these lights extend along the full width of the runway. These lights show green when viewed by approaching aircraft and red when seen from the runway.

- Runway edge lights – white elevated lights that run the length of the runway on either side. On precision instrument runways, the edge-lighting becomes yellow in the last 2,000 ft (610 m) of the runway, or last half of the runway, whichever is less. Taxiways are differentiated by being bordered by blue lights, or by having green centre lights, depending on the width of the taxiway, and the complexity of the taxi pattern.

- Runway Centerline Lighting System (RCLS[5]) – lights embedded into the surface of the runway at 50 ft (15 m) intervals along the runway centerline on some precision instrument runways. White except the last 3,000 ft (914 m), alternate white and red for next 2,000 ft (610 m) and red for last 1,000 ft (305 m).

- Touchdown Zone Lights (TDZL[5]) – rows of white light bars (with three in each row) at 100 ft (30 m) intervals on either side of the centerline over the first 3,000 ft (914 m) (or to the midpoint, whichever is less) of the runway.

- Taxiway Centerline Lead-Off Lights – installed along lead-off markings, alternate green and yellow lights embedded into the runway pavement. It starts with green light about runway centerline to the position of first centerline light beyond holding position on taxiway.

- Taxiway Centerline Lead-On Lights – installed the same way as taxiway centerline lead-off Lights.

- Land and Hold Short Lights – a row of white pulsating lights installed across the runway to indicate hold short position on some runways which are facilitating land and hold short operations (LAHSO).

- Approach Lighting System (ALS) – a lighting system installed on the approach end of an airport runway and consists of a series of light bars, strobe lights, or a combination of the two that extends outward from the runway end.

According to Transport Canada's regulations, the runway-edge lighting must be visible for at least 2 mi (3 km). Additionally, a new system of advisory lighting, Runway Status Lights, is currently being tested in the United States.

The edge lights must be arranged such that:

- the minimum distance between lines is 75 ft (23 m), and maximum is 200 ft (61 m);
- the maximum distance between lights within each line is 200 ft (61 m);
- the minimum length of parallel lines is 1,400 ft (427 m);
- the minimum number of lights in the line is 8.

Control of Lighting System Typically the lights are controlled by a control tower, a Flight Service Station or another designated authority. Some airports/airfields (particularly uncontrolled ones) are equipped with Pilot Controlled Lighting, so that pilots can temporarily turn on the lights when the relevant authority is not available. This avoids the need for automatic systems or staff to turn the lights on at night or in other low visibility situations. This also avoids the cost of having the lighting system on for extended periods. Smaller airports may not have lighted runways or runway markings. Particularly at private airfields for light planes, there may be nothing more than a windsock beside a landing strip.

VASI & PAPI

Visual approach slope indicator (VASI)

The visual approach slope indicator (VASI) is a system of lights on the side of an airport runway threshold that provides visual descent guidance information during the approach to a runway. These lights may be visible from up to eight kilometers (five miles) during the day and up to 32 kilometers (20 miles) or more at night.

Types

Standard VASI

Basic visual approach slope indicators consist of one set of lights set up some seven meters (twenty feet) from the start of the runway. Each light is designed so that the light appears as either white or red, depending on the angle at which the lights are viewed. When the pilot is approaching the lights at the proper angle, meaning the pilot is on the glide slope, the first set of lights appears white and the second set appears red. When both sets appear white, the pilot is flying too high, and when both appear red he or she is flying too low. This is the most common type of visual approach slope indicator system.

Precision approach path indicator

Precision Approach Path Indicator (PAPI) consist of four sets of lights in a line perpendicular to the runway, usually mounted to the left side of the runway. These have a similar purpose to basic visual approach slope indicators, but the additional lights serve to show the pilot how far off the glide slope the aircraft is. When the lights show White-White-Red-Red the aircraft is on the correct glide slope for landing, usually 3.0°. Three red lights (white–red–red– red) indicate that the aircraft is slightly below glide slope (2.8°), while four red lights (Red-Red-Red-Red) indicate that the aircraft is significantly below glide slope (<2.5°). Conversely, three white lights (white–white– white–red) indicate that the aircraft is slightly above glide slope (3.2°), and four white lights (White-White-White-White) indicated that the aircraft is significantly above glideslope (>3.5°). Most large airports utilize this system. Although most airports use a PAPI based on a 3.0° glide slope, some airports may use a glide slope as great as 5.0° in order to have proper obstruction clearance.

Pulsating visual approach slope indicator

Pulsating visual approach slope indicator (PVASI) is a single box found at non FAA Part 139 airports, heliports or airparks. The signal format is solid white when established on the proper descent profile, and solid red when below the proper descent profile. An active pulsing white light is seen when well above or pulsing red when well below. This allows the pilot to determine his position and rate of deviation or correction within the signal format and therefore determine the corrective action needed to return to the proper descent profile. Although PVASI is a single box system, its signal was evaluated by the U.S. Air Force and found to be much more accurate than VASI and equivalent to the four boxes PAPI.

Stabilized glide slope indicator (SGSI)

Tri-colored VASI

This is a single light that appears amber above the glide slope, green on the glide slope and red below it. It is has fallen out of widespread use, partly because pilots who are unfamiliar with them have been known to misinterpret the lights, causing them to 'correct' in the wrong direction. These errors are increased due to a major design shortcoming of the tri-colored VASI. While on approach, the color amber (above slope) can be seen at a very thin angle of approach between green (on slope) and red (below slope). Pilots not familiar with this shortcoming may see the amber light and think they are above glide slope, they would then descend rather than making the proper correction and ascending back to glide slope. Despite this shortcoming, it is (reportedly) in widespread use in EasternEuropean countries, especially Russia and Ukraine.

There is a stabilized version for use on moving landing platforms such as aircraft carriers. The SGSI projects a beam of light, with coloured sectors, from the aft face of the ship. This beam is stabilised to remove the effects of the ships' roll and pitch and provides the pilot with visual information relating to his approach angle. The coloured sector of the beam seen by the pilot will indicate to him if his approach is above, below or on the correct glide path. There are various beam configurations available, to suit different naval requirements.

Visual aids for navigation Wind direction indicator

Wind Direction Indicators
Application
Standard - An aerodrome shall be equipped with at least one wind direction indicator.

Location

Standard - A wind direction indicator shall be located so as to be visible from aircraft in flight or on the movement area and in such a way as to be free from the effects of air disturbances caused by nearby object. Recommendation - Aerodromes with runways greater than 1200 m should have a wind direction indicator located at each end of the runway at a point approximately 60 m outwards from the runway edge and approximately 150 m inwards from the approach end.

Recommendation - Aerodromes with runways 1200 m or less in length should have a wind direction indicator centrally located on the aerodrome except that at aerodromes with only one runway the wind direction indicator should be centrally located along the runway and approximately 60 m from the edge.

Characteristics

Standard - The height of wind direction indicators shall not exceed a height of 7.5 m when located in the runway strip.

Wind Direction Indicator

Recommendation - The wind direction indicator should be in the form of a truncated cone made of fabric and should have a length of not less than 3.6 m and a diameter, at the larger end, of not less than 0.9 m. It should be constructed so that it gives a clear indication of the direction of the surface wind and a general indication of the wind speed. The colour or colours should be so selected as to make the wind direction indicator clearly visible and understandable from a height of at least 300 m, having regard to background.

Where practicable, a single colour, preferably white or orange, should be used. Where a combination of two colours is required to give adequate conspicuity against changing backgrounds, they should preferably be orange and white, red and white, or black and white, and should be arranged in five alternate bands, the first and last bands being the darker colour.

Standard - Provision shall be made for illuminating at least one wind indicator at an aerodrome intended for use at night.

Objects To Be Marked and Lighter

Objects on Movement Areas

Standard - Vehicles and other mobile objects, excluding aircraft, on the manoeuvring area of obstacles and shall be marked and aerodrome are used at ons of low visibility, lighted.

- Vehicles and other mobile g aircraft, used on an apron ed and, if the vehicle and ed at night or in conditions of ted.

ted aeronautical ground lights ent area shall be marked so as to be conspicuous by day.

Objects on Runway Strips

Standard - A fixed object located on a runway strip shall be marked and if the aerodrome is used at night, lighted, excluding visual aids that are by their nature visually conspicuous.
Other Objects

Recommendation - A fixed obstacle that extends above a take-off/approach surface within 3000 m of the inner edge should be marked and, if the runway is used at night, lighted except that:

1. Such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;

2. The marking may be omitted when the height of the obstacle above the level of the surrounding ground does not exceed 150 m and it is lighted by medium intensity obstacle light by day;
3. The marking may be omitted when the obstacle is lighted by high intensity obstacle lights by day and;
4. the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

Recommendation - A fixed object, other than an obstacle, adjacent to a take-off/approach surface should be marked and if the runway is used at night, lighted if such marking and lighting is considered necessary to ensure its avoidance except that the marking may be omitted when:

1. The height of the obstacle above the level of the surrounding ground does not exceed 150 m and it is lighted by medium intensity obstacle light by day; or
2. The object is lighted by high-intensity obstacle lights by day.

Recommendation - A fixed obstacle that extends above an outer surface should be marked and if the aerodrome is used at night lighted except that:

1. Such marking and lighting may be omitted when:

1. The obstacle is shielded by another fixed obstacle; or
2. For a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or
3. An aeronautical study shows the obstacle not to be of operational significance;

1. The marking may be omitted when the height of the obstacle above the level of the surrounding ground does not exceed 150 m and it is lighted by medium intensity obstacle light by day;
2. The marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and
3. The lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

Standard - A fixed object that extends above an obstacle protection surface shall be marked and, if the runway is used at night, lighted.

Standard - All elevated objects within the distance specified in Table3-1, column5 from the centre line of a taxiway or an apron taxiway shall be marked and, if the taxiway or apron taxiway is used at night, lighted.

Standard - All elevated objects within the distance specified in 3.6.6.1 from the centre line of an aircraft stand taxilane shall be marked and, if the aircraft stand taxilane is used at night, lighted.

Emergency and other services

Aircraft Emergencies

When an emergency experienced by an aircraft occurs in flight and radio communications still exist, the pilot-in-command of that aircraft is responsible for advising the appropriate Air Traffic Control (ATC) unit and for nominating the desired state of readiness / emergency response (See below) of the aerodrome and local emergency services. If communications between the aircraft and ATC are strained or non- existant, and a problem becomes known, the ATC unit will assess the situation and bring the aerodrome and local emergency services to the state of readiness considered appropriate.

Aerodrome Emergency Plan

The purpose of an aerodrome emergency plan is to prepare emergency services and aerodrome operators to cope with an emergency occurring on or in the vicinity of the aerodrome. The plan dictates and advises the procedures to be carried out for coordinating the response of different aerodrome services and those emergency services in the local area that could be of assistance in an emergency, such as the local Police, Fire, Coast Guard, Military and Ambulance etc.

Examples of the types of emergencies are:

- Aircraft defects / malfunctions serious enough possibly to impede safe flight;
- Sabotage of aviation related equipment;
- Bomb threats;
- Unlawfully seized aircraft;
- Dangerous goods incidents;
- building fires; and
- Natural disasters.

An aerodrome emergency plan exists at all aerodromes that have regular air transport services by aircraft with 30 or more passenger seats.

Activation of Aerodrome Emergency Services

The Air Traffic Service (Air Traffic Control) unit on the aerodrome has the responsiblity for alerting the emergency services, following a request from a pilot or when an aircraft is considered to be in such a danger as determined by the Air Traffic Controller on watch requiring any of the following emergency phases:

- Local Standby Phase: is defined when an aircraft is approaching an aerodrome in such a manner that there would not normally prevent it from making a safe landing, but has a defect of some kind. LOCAL STANDBY PHASE declaration will bring all aerodrome emergency services to a state of readiness. Local emergency services will be notified but remain at their respective bases on stand-by.1

- Full Emergency Phase: is defined when an aircraft is approaching an aerodrome in such a manner that there is a danger of an accident occuring.

FULL EMERGENCY PHASE declaration will bring all aerodrome and local emergency services (such as police, fire services, ambulance and medical) together at a common location on the airfield. Local hospitals will be alerted to prepare for casualties and the police will control traffic and roads in such a way as a clear path from the aerodrome to the hospital and other emergency services routes are clear enough to uninhibited access.

- Aircraft Accident Phase: is defined when an aircraft has had an accident on or in the vicinity of an aerodrome. When the AIRCRAFT ACCIDENT PHASE is declared, all available emergency services will be brought into action in accordance with the emergency plan.

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Questions	a	b	c	d	Answer
The air traffic services comprise of ______________ services	one	two	three	four	three
Aerodrome information to be provided for a certified aerodrome	Chart	Navigation aids	Visual aids	ATF	Chart
Aerodrome information to be provided for a certified aerodrome	Movement area	Administration	ATF	Speed	Administration
Aerodrome information to be not provided for a certified aerodrome	Chart	Administration	Location	Navigtion aids	Navigtion aids
Aeronautical marking and lighting system__________ aids	Navigation	Visual	Location	Ground service	Visual
Details of all navigation aids serving the _____________ will be provided	Aerodrome	Aerodrome area	ATF	Navigation aids	Aerodrome
The category of aerodrome-based ___________services will be provided	Rescue-fire fighting	Rescue	Fire fighting	ATF	Rescue-fire fighting
____________ is an acronym for radio detection and ranging	Ratio	Radar	Speed	Radio energy	Radar
The detection of the ___________ is accomplished by timing basis	Radio	Radar	Speed	Acronym	Acronym
Radar measurement of __________ is made possible of the properties of energy	Distance	Speed	Energy	Line	Distance
______________ waves are reflected if they meet an electrically leading surface	Straight line	Constant speed	Electromagnetic	Airplane	Electromagnetic
Electromagnetic energy travels through air at a __________	Straight line	Electromagnetic wave	Constant speed	Radar	Constant speed
The determination of the distance between the reflecting objects	Airplanes,ships,cars	speed,energy,line	Navigation aids	t, v, p	Airplanes,ships,cars
Airports Authority of India has adopted the ____________ methodology for using a code system	ICAO	ARP	ATF	RNP	ICAO
ICAO methodology for using a code system ,known as the ___________	Aerodrome reference point	Reflection of electromag	Aerodrome reference code	Aerodrome serial code	Aerodrome reference code
The code is composed of____________ elements	Five	Three	Six	Two	Two
An airport reference point is also called as ________________	Aerodrome reference point	Reflection of electromag	Aerodrome reference code	Aerodrome serial code	Aerodrome reference point
__________________ is the national centre point of an airport	AE	ARC	AR	ARP	ARP
It is generally indicated in _____________digit coordinates	Three	Two	One	Six	Six
The aerodrome elevation is prominently displayed at the _________________	Air traffic control	Approach charts	Geoid undulation	Air control device	Air traffic control
Airport elevation is also called as _______________	Approach charts	Control tower	Airfield elevation	Air control	Airfield elevation
Aerodrome elevation as it appears on ____________	Control tower	Approach charts	Aerodrome elevation	Airfield elevation	Approach charts
Aerodrome elevation is displayed at the ________________	Approach charts	Airfield elevation	Control tower	Aerodrome elevation	Control tower
An aerodrome reference temperature shall be determined for an aerodrome in _____________	Monthly mean	Geoid undulation	Aerodrome elevation	Degree Celsius	Degree Celsius
An aerodrome reference temperature shall be_______________of the daily maximum temperatures	Month of year	year only	Monthly mean	weekly once	Monthly mean
The actual runway length to be provided for a ____________	Secondary runway	Length	Primary runway	Speed	Primary runway
The surface surrounding the runway prepared_____________	RESA	RSA	ATF	RESA/RSA	RESA/RSA
_____________ is dependent on the normal prevalent visibility	Maneuvability	Stability of a/c	Runway controls	Width of runways	Width of runways
For precision approach runway ,the width should not be	>30m	=30m	<30m	>=30m	>=30m
Values of runway widths recommended by the ______________	FAR	ICAO	FAA	FAA/ICAO	FAA/ICAO
New construction which will not adversely affect the performance of_____________aids	Radio	Radar	Navigation	Visual	Visual
Basic terminology used in aerodrome design ___________	ARP	ARO	AIS	ARP, ARO, AIS	ARP, ARO, AIS
______________is a simultaneous approaches to parallel or near-parallel runways	Length runway	Runway strips	Instrument runway	mobile runway	Instrument runway
The runway length , when the actual runway length is corrected to the ____________ cases	6	2	5	3	3
Basic means to transition from instrument flight to visual flight for landing	VASI	PASI	ALS	RNAV	ALS
________________ are a set of regulations under which a pilot operates an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft	VFR	IFR	JFR	FAR	VFR
_______ flight depends upon flying by reference to instruments in the flight deck, and navigation is accomplished by reference to electronic signals.	VFR	IFR	JFR	FAR	IFR
__________ is a method of IFR navigation that allows an aircraft to choose any course within a network of navigation beacons	RNAV	RNP	IFR	VFR	RNAV
_____________also refers to the level of performance required for a specific procedure or a specific block of airspace.	RNAV	RNP	IFR	VFR	RNP
___________ is a service provided by ground-based controllers who direct aircraft on the ground and in the air.	ABS	ATC	AFR	ARR	ATC
The plane lifts off the ground and climbs to a cruising altitude.	Descent	Landing	Takeoff	Departure	Departure
Provide advice and information useful for the safe and efficient conduct of flights.	Aerodrome control service	Air traffic control servic	Flight information service	Alerting service	Flight information service
_____________ call signs are used as the contact between pilots and Air Traffic Control.	Radio-telephony	SOS	Signal	Messenger	Radio-telephony
Aircraft routing types used in flight planning are _____________.	Navi -aid	Direct	Navi -aid, Direct, Airway	Airway	Navi -aid, Direct, Airway
Vertically Short take off and landing is referred to _____________	UAV	Lighter aircraft	Helicopter	Space ship	Helicopter
Airports are divided into ___________ areas.	1	3	2	4	4
Loading of goods in airport at ___________.	terminal block	Cargo	Control block	Flight route	Cargo
Along taxiways, ________________ indicate the taxiway's edge.	green light	red light	blue lights	bright white light	blue lights
The location of Anna International Airport at ____________________	Bangalore	Chennai	Mumbai	Hyderabad	Chennai
Registration numbers of an aircraft appear on the ______________	rudder	aircraft belly	airfoil	fuselage	aircraft belly

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Subject Code	14BEAR7_ E10				
Questions	**a**	**b**	**c**	**d**	**Answer**
The height of the airplane above the earth is indicated by the ______________.	altimeter	stability meter	Compus	Sprit meter	altimeter
Maximum flying altitude for international air transportation is ________________.	25000	30000	35000	40000	35000
Aircraft operating under VFR and IFR is _____________.	Flight plans	Flight rules	Flight control	Flight route	Flight rules
_____________ is filed with the authority providing air-traffic control services.	FRC	Pilot license	DGCA Approval	Flight plans	DGCA Approval
The places were aircraft maintenance work is carried out.	Terminal block	Hangar	Parking	Shed room	Hangar
Preventing collisions is referred to as____________.	controlled airspace	Collision	Separation	Uncontrolled airspac	Separation
Private Helicopter is under control of ________________.	Defense	DGCA	Airforce	Airport	DGCA
Registration Alphabetic codes used for Indian Flights are __________________.	VHT	VT	VRT	VMR	VT
______ are documents filed by pilots with the local Civil Aviation Authority. ______ are documents filed by pilots with the local Civil Aviation Authority. ______ are documents filed by pilots with the local Civil Aviation Authority.	Flight Rules	Flight Path	Flight Plans	Flight Signal	Flight Plans
Flight plan format is specified in the ICAO Document.	1111	2222	4444	5555	4444
Preventing collisions is referred to as ________________.	safety	security	separation	control	safety
________ control include all areas accessible to aircraft, including runways, taxiways and ramps	Terminal	area	airport	Airside	airport
Controllers may use a radar system called__________ Surveillance Radar.	primary	Secondary	both a and b	ATC	both a and b
The areas of responsibility for ATCT controllers fall into ________ general operational discipline.	3	4	6	8	4
The primary responsibility of Clearance Delivery is to ensure that the aircraft have the_________.	proper route	slot time	both a and b	passenger list	both a and b
The maximum altitudes and airspace boundaries assigned to a ___________ control.	Surveillance	Radar	approach	Terminal	Radar
Radio navigation is under _______________.	VFR & IFR	RNR & RNAP	VOR & VHR	ARR &FAR	VFR & IFR
Focus light is mainly used for ________________.	clouds	Collision avoidance	runway	airspace	runway
Longitudinal separation can be based upon ___________as measure by DME.	time	distance	both a and b	speed	distance
Green colour lightings appear for __________________.	co-pilot sideco-pilot side	pilot side	ATC	Auto pilot	pilot side
Red colour lightings appear for __________________.	co-pilot sideco-pilot side	pilot side	ATC	Auto pilot	co-pilot sideco-pilot side
Logo lighting may appear on the ______________.	wings	rudder	airfoil	fuselage	rudder
Coast Guard Helicopter are used in______________.	airport	city	sea sore	border	sea sore
Registration Alphabetic codes used for Australian Flights are __________________.	VHT	VH	AVIT	VHRT	VH
The colors and flash intervals of lights became standardized under the _________ Organization	AAI	IAO	ICAO	AAA	ACAO
The speed of aircraft is measured by_________________ indicator.	air speed	pitot tube	sprit level	radio monitor	air speed
The location of Radar in airplane at _____________.	fuselage	wings	nose	rudder	nose
Information's send from ATC is received through _______________.	receiver	transmitter	Satellites	ATA	receiver
________________ are used to determine the wind direction for the aircraft in runway.	Air route	Wind shocks	Cock head	radio	Wind shocks
Contrary flag may appear on the ______________ and often on the wings.	wings	rudder	airfoil	fuselage	rudder
BSF Guard Helicopter is used in_____________.	airport	city	border	sea sore	border
The location of Indra Gandhi International Airport at ___________________	Bangalore	Delhi	Mumbai	Hyderabad	Delhi
A degree of conformance between the estimated or measured value and the true value	Accuracy	limits	mp	rotate	Accuracy
An_________is an aerodrome with extended facilities, mostly for commercial air transport.	airstop	airport	airforce	airstream	airport
An airport with a helipad for __________	jetcraft	glider	aircraft	rotorcraft	rotorcraft
An airport for use by seaplanes and amphibious aircraft is called a _________________.	helipad	seaplane base	air base	airport	seaplane base
Most of the world's airports are owned by___________bodies	govt /pvt	contract	government	Private	government
The earliest aircraft takeoff and landing sites were ______________.	runway	sea sore	high way	grassy fields	grassy fields
___________normally requires baggage checks, metal screenings of individual persons, and rules against any object that could be used as a weapon.	Airport security	BSF	ITBSP	CRPF	Airport security
__________ includes areas such as check-in, parking lots, public transportrailway stations and access roads.	beside	Airside	byside	Landside	Landside
Some airport names include the word ____________ to indicate their ability to handle international air traffic.	Domestic	International	cargo	aerodrome	International
___________airlines often have their own on-site and adjacent infrastructure to transfer parcels between ground and air.	Cargo	passenger	military	spacelines	Cargo
Many airports have _______________ that help guide planes using the runways and taxiways at night or in rain or fog.	Markings	lighting	lines	steps	lighting
_______________observations at the airport are crucial to safe takeoffs and landings.	refueling	fueling	parking	Weather	Weather
Many airports are built near ____________	city	open fields	village	sea sore	open fields
In India airport security is controlled by____________	CISF	CRPF	RAF	NSG	CISF
___________includes all areas accessible to aircraft, including runways, taxiways andapron/ramps.	landside	Airside	beside	byside	Airside
An airport with a helipad for rotorcraft but no runway is called a ____________.	heliport	airport	seaplane base	space base	heliport
Airports are divided into landside and ___________.	airside	byside	beside	riverside	airside

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Questions	a	b	c	d	Answer
An air base is an ___________ with significant facilities to support for reserved military bases.	aerodrome	airport	airspace	airstrip	aerodrome
______________International Airport is the first green field airport in India	Coimbatore	Chennai	Kochi	Cochin	Cochin
A _______________is an airport serving traffic within a relatively small or lightly populated geographical area.	domestic airport	regional airport	International airport	Sea base	regional airport
A ___________ terminal is a building detached from other airport buildings, so that aircraft can park around its entire circumference.	area	aerodrome	satellite	airport	satellite
A ____________movement radar was installed for effective monitoring of flights in the runway and parking bays.	ATC	terminal	airspace	surface	surface
________________ academy provides education for avation science.	Engineering	aviation	merain	management	aviation
The air ambulance service is exclusive for ______________	passenger	military	business	medical	medical
______________ are personnel responsible for the safe, orderly, and expeditious flow of air traffic	ATC	ATAD	ARR	FAR	ATC
A ____________ is a defined rectangular area on a land aerodrome prepared for the landing and takeoffof aircraft.	High way	rail way	runway	sea way	runway
The runway ________ are markings across the runway that denote the beginning and end of the designated	Blast pads	Overrun	center line	thresholds	thresholds
_____________ runways are used at small airstrips	Optimal	Visual	airbase	airfield	Visual
If you are landing on runway 270 degree, which direction are you heading?	East	West	North	South	South
Intrumental landing system is used in _____________	VFR	IFR	VOR	RNP	IFR
________________ is documents are required for flying in inter states	passport	visa	ticket	MC	ticket
The ___________develops engineering, design, and construction standards for civil airports, heliports, and seaplane bases.	SETCE	DGCA	ARR	FAA	FAA
Fit to fly certificate is referes to ____________ of an aircraft	FC	Airworthiness	Repair	overhauling	Airworthiness
Red colour light indicate in aircraft is _______	Port side	starboard side	front side	rear side	Port side
Aerodrome is also called as _________	airbone	airport	airdrome	aeroport	airdrome
_____________ a document that allows entry to a country	Passport	Travel visa	Airticket	MC	Travel visa
__________systems used in the provision of air traffic services	hydralic	pneumatic	electronic	Radar	Radar
Radar measurement of range ismade possible because of the properties ofradiated __________energy.	magnatic	electromagnetic	kinamatic	heat	electromagnetic
Federal Aviation Regulations defines _________	IFR	VFR	IFR & VFR	RNA	IFR & VFR
SOS code is tyed for ____________	emergency landing	taxing	takeoff	crusing	emergency landing
The human activity that surrounds aircraft is called ______________.	aviation	aeronautical	aerospace	nautical science	aviation
Recording and transmission of information on the progress of flights is ________	FIS	FMS	FMC	FAR	FIS
A __________ is a travel document, usually issued by a country's government, that certifies the identity and nationality of its holder	visa	passport	MC	Air ticket	passport
Port side indicate in aircraft is _______	Pilot	co-pilot	air crew	passenger	Pilot
The National Aviation Day is celebrated on ______________	4-Oct	12-Aug	19-Aug	1-May	19-Aug
An airport is an aerodrome certificated for ___________ flights.	commercial	fighter	rocket	spaceshuttle	commercial
Satellites are used in ____________	Global positioning system	Global point system	Global plane system	Galaxy l positioning system	Global positioning system
Vertical axis in aircraft through the top and bottom of the fuselage refers to________________	pitching	yawing	rolling	climbing	yawing
Navigation system is used to ____________	Traffic control	Communication	Weather detection	Find position and direction	Find position and direction
During the First World War __________ technology is used for communication.	wireless	Dopple	Radio	RADAR	wireless
DME stands for _________	Distance measuring equipment	Distance monitoring equipment	Direct measuring equipment	Doppler monitoring equipment	Distance measuring equipment
Starboard side indicate in aircraft is _______	Pilot	co-pilot	air crew	passenger	co-pilot
Wing span = ______________	wing tip to wing tip	wing root to wing root	nose to enpanage	rudder to elevator	wing tip to wing tip
___________indicates the direction of aircraft	red	yellow	green	white	white
Lateral axis in aircraft refers to________________	fuselage	wings	nose	rudder	wings
Rules of the air state with ________	IFR & VFR	IFR	VFR	CCR	IFR & VFR
________ are under which a pilot operates an aircraft clear enough to allow the pilot to see where the aircraft is going.	VFR	IFR	RNAV	RNP	VFR
Airspace Class A type aircrafts fly above ___________ altitude.	18,000	10,000	25,000	35,000	18,000
An international airport is an airport that offers customs and __________	customs	terminal path	airboom	immigration	immigration
John F. Kennedy International Airport is located at ____________	New York City	New Delhi	New Jersey	New Sweden	New York City
A water aerodrome is an area of open water used regularly by ___________	gliders	seaplanes	fighter jets	rotocraft	seaplanes
Airoprt is also called as _________	airbone	airport	aerodrome	aeroport	aerodrome
International Civil Aviation Day is celebrated on _________________	7-Dec	7-Nov	9-Mar	4-Dec	7-Dec
Longitudinal axis in aircraft refers to________________	fuselage	wings	nose	rudder	fuselage
Green colour light indicate in aircraft is _______	Port side	starboard side	front side	rear side	starboard side
A ______________ is an airport that handles only domestic flights—flights within the same country.	domestic airport	International airport	Aerodrome	Sea Base	domestic airport
Cochin International Airport became the world's first fully ______________ airport	Thermal Powered	Nuclera powered	Hydro powered	solar powered	solar powered

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Subject Code	14BEAR7_ E10

Questions	a	b	c	d	Answer
Avionics is the combination of ____________	Airline and Electronics	Aviation and Electronics	Aircraft and Electrical	Aviation and Electrical	Aviation and Electronics
Navigation system is used to ____________	Traffic control	Communication	Weather detection	Find position and direction	Find position and direction
During the First World War __________ technology is used for communication.	wireless	Dopple	Radio	RADAR	wireless
DME stands for _________	Distance measuring equipment	Distance monitoring equipment	Direct measuring equipmen	Doppler monitoring equipment	Distance measuring equipment
Following one is the type of navigation system	Medium frequency	pilotage	High frequency	Low frequency	pilotage
Electronic Warfare is mainly used to search the ___________	Communication signals	Ultrasonic waves	Sound waves	Radio frequency band	Radio frequency band
In communication system __________ is used as a transmitter links.	fiber	iron	mica	Silver	fiber
__________ memory is require a power to maintain the stored information.	Non volatile	virtual	protected	volatile	volatile
In communication system _______ is used to convert the natural signal into an electrical signal.	antenna	compressor	Transducer	generator	Transducer
Fly-By-Wire system sends the information in the form of ____________	Electrical signals	Analog signals	Radio signals	Sky waves	Electrical signals
VOR stands for____________	Very High Frequency Omni ran	Very High distance Omni range	Very High signal Omni ran	Very low FrequencyOmni range	Very High Frequency Omni range
ADF is used in ____________	Communication system	Navigation system	ILS	GPS	Navigation system
Doppler RADAR uses the _____________	Microwave signal	Digital signal	Direct signal	Pulse signal	Microwave signal
Critical frequency is the ____________ frequency of the radio wave.	minimum	maximum	Maximum usable	medium	maximum
RADAR stands for ____________	Radio organization	Radio detection and ranging	Radio development organiz	Radio communication	Radio detection and ranging
Another name for primary surveillance RADAR is _______________	Mirror image radar	Low frequency radar	Skin paint radar	INR	Skin paint radar
ADF is used in _______________	Communication system	Navigation system	ILS	GPS	Navigation system
In communication system receiver contains ______________	IN	Doppler	Sensitive amplifier	Loud speaker	Sensitive amplifier
INS system contains ______________	Gyros and sensitive acceleromet	Doopler radar	Primary surveillance radar	holes	Gyros and sensitive accelerometer
FBW system first introduced in ________Aircraft	YF-16	cessna	Sukai	vikas	YF-16
Primary memory stored in secondary memory is called _____________	ROM	PROM	Virtual memory	Flash memory	Virtual memory
Instrument Landing System consist of_____________	localizer	slope	Doppler	Gyros	localizer
AIRCOM stands for	Air computers	Airbone communication	Air communication services	Air computation	Air communication services
Satellite navigation is using a ____________ for its operation.	GPS	pilotage	frequency	Doppler	GPS
Materials like GaAs, GaAsP are used in _________	LED	LCD	CRT	EL	LED
LCD stands for __________	Light Crystal Display	Liquid Crystal Display	Light Copper Display	Liquid Crystal Display	Liquid Crystal Display
Single LED is used as _________	Indicator lights	Induction lights	Indicator switch	Induction switch	Indicator lights
The light of an LED comes when the diode is __________	Forward biased	Backward biased	unbiased	over biased	Forward biased
Pilotage is used to find the direction with the help of ____________	Land marks	Radio signals	radar	maps	Land marks
RLG stands for __________	Real Laser Gyro	Ring Laser Gas	Ring Laser Gyro	Ring large Gyro	Ring Laser Gyro
EL stands for_____________	Electro Luminescence	Electro Light	Electro Laser	Electronic Laser	Electro Luminescence
Following one is the principle of touch screen________	Scanning infrared	radar	Radio	Digital display	Scanning infrared
LED has_________ Junction	p-n	n-p	r-p	s-p	p-n
CRT is coated inside with ___________	phosphorous	neutron	electron	polymer	phosphorous
SELCAL is the _____________	Separate calling	Selective calling	Selective calculation	Sensor calling	Selective calling
MLS stands for_______________	Microwave Landing Syste	Microcontrol Landing System	Micronics Landing S	Microwave Lane System	Microwave Landing System
No. of cycles per seconds is known as _____________	Wave length	frequency	Sound	Light	frequency
_________is generated during radio transmission	Electromagnetic waves	Magnetic flux	Electric field	Magnitude	Electromagnetic waves
___________ of an aircraft to twist vertically around its body, the right wing sliding upward and the left wir	Roll	Pitch	Yaw	Hover	Roll
UAS technologies are used worldwide as aerial ______________ and LiDAR platforms.	Surveillance	payload Carrying	photogrammetry	Product Delivery	photogrammetry
Journalists are interested in using drones for ____________	newsgathering	Live telecast	Photography	payload distribution	newsgathering
____________ departments in India have procured drones for law and order and aerial surveillance.	Civil	Judiciary	police	Hospitals	police
UAVs are especially useful in accessing areas that are too ________ for manned aircraft.	Easy	Critical	dangerous	Sub-Critical	dangerous
___________ UAVs were used to monitor rhinos, tigers and elephants and deter poachers	Tactical	Poaching	Firing	Anti-poaching	Anti-poaching
AGL is stands for __________	Above Ground Level	Above Gate level	Against Ground Level	Anti Ground Level	Above Ground Level
Remotely piloted aircraft operate on the same rules of engagement as _________ aircraft.	Commercial	Fighter	Unmanned	manned	manned
The only armed UAV used by a handful of systems are capable of carrying____________	Payload	Camera	Sensor	weapons	weapons
____________is defined as an aircraft that does not carry a human operator, or non-lethal payload.	UAP	SAV	DAV	UAV	UAV
___________ Forward force on an aircraft provided by the aircraft's power system.	Lift	Thrust	Drag	Weight	Thrust
__________ is defined as a system, whose components include the unmanned aircraft and all equipment, n	UAS	UAV	HALE	MALE	UAS
________________ is flown remotely by a pilot, is normally recoverable, and can carry a lethal or nonletha	Remotely Controlled Aircraft	A Transmitter	Remotely Piloted Aircraft	Data Transmitter	Remotely Piloted Aircraft
_____________ system is one that, in response to inputs from one or more sensors.	automated	Programmed	Controlled	Piloted	automated
____________ system is capable of understanding higher level intent and direction.	non-autonomous	Programmed	Controlled	autonomous	autonomous

The classification of UAV system has been proposed and endorsed by ______________	NATO’s	GATO’s	QATO’s	OATO’s	NATO’s

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Question	option A	option B	option C	option D	Answer
______ are documents filed by pilots or a Flight Dispatcher with the local Civil Aviation Authority.	Flight Rules	Flight Plans	Flight Signal	Flight path	flight rules
2. Flight plan format is specified in the ICAO Document.	1111	2222	3333	4444	3333
Preventing collisions is referred to as __________________.	safety	security	separation	searching	safety
_________ include all areas accessible to aircraft, including runways, taxiways and ramps._________ include all areas accessible to airc	Terminal control	area control	airport control	Airside control	terminal control
Controllers may use a radar system called__________ Surveillance Radar.	primary	Secondary	both	none of the given	secondary
The areas of responsibility for ATCT controllers fall into ________ general operational discipline.	2	3	4	5	4
_______________ is the position that is responsible for ensuring that both controllers and pilot have the most current information.	flight registration	flight idntification	Flight Data	Flight plans	flight plans
Clearance Delivery is the position that issues _____________ to aircraft, typically before they commence taxiing.	bird clerance	weather clerance	routed	birds flying clearence	weather clerance
The primary responsibility of Clearance Delivery is to ensure that the aircraft have the_________.	proper route	slot time	both a and b	none of the given	both a and b
10. The maximum altitudes and airspace boundaries assigned to a _______________.	Surveillance Control	Radar Control	Terminal Radar Approach Control	non radar control	radar control
Radar control is referred to as_____________.	hanger control	control for airport	ATC control	terminal control	ATC control
Lateral separation minima are usually based upon the position of the aircraft is derived visually, from_______________.	dead reckoning	internal navigation sources	radio navigation aids	all navigation aids	all navigation aids
Radio navigation is under _______________.	VHR&IFR	RNR & RNAP	VOR & VHAR	VHR	ENR &RNAP
Focus light is mainly used for ________________.	focusing air space	collision avoidance	fousing runway	uncontrolled air space	collision avoided
Longitudinal separation can be based upon ___________as measure by DME.	time	distance	both a and b	none of the given	both a and b
Red colour lightings appear for __________________.	co pilot side	pilot side	air traffic control system	auto pilot system	pilot side
____________ will come under area control.	Aerodrome Control Service	Approach Control Service	Area Control Service	all ATS Services	area control service
Logo lighting may appear on the _____________.	wing	rudder	airfoil	fuselage	rudder
Coastal Guard Helicopter are used in______________.	airport surveillance	city surveillance	sea sore surveillance	border Surveillance	sea source survilence
Registration Alphabetic codes used for Australian Flights are ___________________.	VHT	AUS	VIT	VHRT	AUS
The height of the airplane above the earth is indicated by the _____________.	Radar altimeter	Flight stability meter	Direction indicator	Sprit level indicator	radar altimeter
__________ is under the Divisions of ATS.	Area control service	Approach control service	Aerodrome control service	ATCS	aero drome conrol service
_____________ is a non-power-driven, unmanned, lighter than air aircraft in free flight.	Unmanned free balloon	UAV	Mono plan	Tri-cycle	UAV
Maximum flying altitude for international air transportation is________.	25,000ft to 30,000ft	40,000ft to 45,000ft	30,000ft to 35,000ft	20,000ft to 25,000ft	25000ft to 30000 ft
A Pilot to able to see outside the cockpit, to control the aircraft altitude,navigation and avoid obstacles.	IFR	RNP	RNAP	VFR	RNP
Aircraft operating under VFR and IFR is__________.	flight plane	flight rules	flight control	fligh route	flight rules
____________ is filed with the authority providing air-traffic control service.	Flight registration	Pilot license	DGCA approval	Flight plans	flight regitration
Two-way ___________communications between civil pilots and air-traffic Controllers are conducted in the very high frequency (VHF)	ATC to terminal	Runway-to-ATC	Air-to-ground communication	Satellites link	ATC control
__________ are used to determine the plan position of the aircraft in coordinates referenced either to the navigation aid or to the Ear	Air route navigation	Wind shocks navigation	Cock head direction navigation	Radio navigation aids	wind shocks navigation
Air-traffic controllers use radar to monitor the position of aircraft and to monitor Areas of air routes to prevent accidents is __________	Surveillance Systems	Wind blow direction	Airport security	Passenger arrival	airport security
___________are installed in aircraft to provide ground-independent protection From midair collisions , as a backup to the conventiona	Air-to-ground communications system	Flight Management computer syst	Airborne collision avoidance systems	Surveillance systems	air- to groung communication system
___________ are installed in aircraft for the purpose of guiding the aircraft along its Planned route of flight while minimizing operatin	Radio navigation system	Airborne collision avoidance syster	Surveillance systems	Flight management computer systen	flight management computer system
The place were aircraft maintenance work is carried out.	Terminal block	Hangar	Parking	Shed room	hanger
Preventing collision is referred to as____________.	Controlled airspace	Collision avoidance	Separation and collision avoidance syst	Uncontrolled airspace	collision avoidence
___________ is a term used to prevent aircraft from coming too close to each other by use of lateral and longitudinal separation	Horizontal separation	Vertical separation	Lateral separation	Longitudinal separation	lateral sepration
Many aircraft now have __________ installed to act as a backup to ATC Observation and instructions.	Collision avoidance systems	speed governing system	Cock pit Surveillance system	Auto pilot system	auto pilot system
ATC operations are conducted either in the _________ communication.	Native language	Numbering code	identification marks	English	native language
The cross sectional shape obtained by the inter-section of the wing with Perpendicular plane is called as_________.	Air service controller	Aerodrome or Towers	Radar controller	Surveillance controller	radar controller
____________controllers are responsible for the separation and efficient Movement of aircraft and vehicles operating on the taxiways	Radar and virtual Towers	Remote and Vertical Tower	Radar and Vertical Tower	Remote and Virtual Tower	Radar and vertical tower
_____________ is a system based on Air Traffic Controllers being located somewhere other than at the local airport tower and still able	Remote and Vertical Tower	Radar and Vertical Tower	d. Remote and Virtual Tower	non radar control	non radar control
Raising the aircraft from ground for maintenance is termed as ____.	Jacking	Leveling	Mooring	Lifting	jacking
_________is used for cutting sheet metal of various thickness and shapes.	Hammer	Hacksaw	Chisels	Snips	Hacksaw
Leveling is mainly done to _________	Fire extinguisher	Lifting the aircraft	Fixing the aircraft using anchors/ropes	Defueling the aircraft	liffting the aircraft
Aircraft Jacking is a maintenance procedure for	craining	Lifting	rope tieing	covering	Lifting
The Agent which should not be used in fire extinguishers used in aircraft	spanners	hammers	punches	hack shaw	hack shaw
Special wrenches include	to reduce weight of aircraft	for maintenance	both a & b	for overhauiling	for maintanence
Defueling in aircraft is done	paramerter	temprary	drillingd	reaming	reaming
A bolt is tightened or released by giving torque to	nut	head	both a & b	screw	screw
The process of creating an accurate sized hole is called	drafting	reaming	riverting	shaping	reaming
Small holes may be punched in sheet metal using	drafter	reamer	chassis punch	riverting	chassis punch
Heat treatment is a necessary process in order to achieve materials _________ properties	physical	mechanical	chemical	kinatic	chemical