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ABSTRACT

The Rate Training Manual is one of a series of training manuals prepared for enlisted personnel of the Navy and Naval Reserve studying for advancement in the Air Controlman (AC) rating to Air Controlman Third and Second Class. Chapter 1 discusses air controlman qualifications, the enlisted rating structure, the Air Controlman rating, references which will assist in working for advancement and in performing the duties of an Air Controlman, and information on how to make the best use of the Rate Training Manual. Chapters 2-14 cover the following topics: military aircraft designation and characteristics; Federal air regulations; basic air navigation; flight services; meteorological elements affecting aviation; aviation weather reports and advisories; aids to air navigation; control tower equipment; airport traffic control and airfield equipment; air traffic control communications; IFR/SVFR control procedures; radar and allied equipment and procedures; and publications, records, and security measures. Numerous illustrations, diagrams, and charts are interspersed throughout. The associated Nonresident Career Course (96 pages) for AC 3 and 2 is included. Supplementary material is appended. (BP)

AIR CONTROLMAN 3 & 2

NAVAL EDUCATION AND TRAINING COMMAND

RATE TRAINING MANUAL
AND NONRESIDENT CAREER COURSE

NAVEDTRA 10367-F

PREFACE

This Rate Training Manual is one of a series of training manuals prepared for enlisted personnel of the Navy and Naval Reserve who are studying for advancement in the Air Controlman (AC) rating. As indicated by the title, this manual is based upon the professional qualifications for the rates of AC3 and AC2, as set forth in the Manual of Qualifications for Advancement, NAVPERS 18068 (Series).

The associated Nonresident Career Course for AC 3 & 2 is included as the last section of this manual. Preceding the Nonresident Career Course is a listing of the occupational standards for AC3 and AC2, as set forth in the Manual of Qualifications for Advancement, which cross-references the occupational standards to the assignments in the Nonresident Career Course. Technical questions based upon each occupational standard are provided in the indicated assignment. The AC3 or AC2 will be greatly assisted in preparing for the advancement examination by making full use of these study aids. This manual and the attendant Nonresident Career Course are valuable aids as review sources for those men preparing for advancement. Their use for everyday on-the-job training is highly recommended.

This training manual was prepared by the Naval Education and Training Program Development Center, Pensacola, Florida, for the Chief of Naval Education and Training. Technical review of the manuscript was provided by personnel of the AC Schools, NATTC Memphis, Millington, Tennessee.

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THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

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CHAPTER 1

AIR CONTROLMAN RATING

This training manual is designed to help you meet the professional qualifications for advancement to Air Controlman Third Class and Air Controlman Second Class. The Air Controlman (AC) qualifications which are used as a guide in the preparation of this manual are found in the Manual of Qualifications for Advancement, NAVPERS 18068 (Series) and the Qualifications for Advancement at the end of this manual.

The remainder of this chapter deals with the enlisted rating structure, the Air Controlman rating, and references which will assist you in working for advancement and in performing your duties as an Air Controlman. This chapter also contains information on how to make the best use of Rate Training Manuals. Therefore, it is strongly recommended that you study this chapter carefully before beginning intensive study of the remainder of this training manual.

In studying this manual it should be kept in mind that all the qualifications for advancement are not necessarily completely covered in this training manual. Extensive use should be made of other publications referred to throughout this training manual.

Figures and tables are utilized in this manual to facilitate learning. The proper understanding of the various forms, recognition characteristics, and material discussed is made easier if each figure and table is studied carefully as it is referred to in the text.

This training manual contains training material only. It is not intended that any portion of this book supersede current instructions, manuals, or other technical publications in the performance of specific tasks.

The Nonresident Career Course for this Rate Training Manual has been included at the end of the text material. It is to assist you in the training required to fulfill your job requirements, and it will be of benefit to you when preparing for the Navy-wide Advancement Examinations. The answer sheets, referred to as IKOR (immediate knowledge of response) sheets, are a separate package and are not included with this Rate Training Manual. A separate errata sheet may be included with this training package if there are changes to the text material of the Rate Training Manual or to the Nonresident Career Course. Read the preliminary pages of the Nonresident Career Course thoroughly for complete instructions before you proceed with the course.

ENLISTED RATING STRUCTURE

The present enlisted rating structure consists of general ratings and service ratings.

General ratings identify broad occupational fields of related duties and functions. Some general ratings include service ratings; others do not. Both Regular Navy and Naval Reserve personnel may hold general ratings.

Service ratings identify subdivisions or specialties within a general rating which require related patterns of aptitudes and qualifications, and which provide paths of advancement for career development. The general rating provides the primary means of identifying billet requirements and personnel qualifications; it is established or disestablished by the Secretary of the Navy; and it is provided a distinctive rating badge. The term "rate" identifies personnel occupationally by pay grades. "Rating" refers to the occupational field. Service ratings can exist at any petty officer level, but they are most common at the PO3 and PO2 levels. Both Regular Navy and Naval Reserve personnel may hold service ratings.

AC RATING

The AC rating is a general rating and is included in Navy Occupational Group IX (Aviation). There are no AC service ratings.

Third and Second Class Air Controlmen perform air traffic control duties at naval Air Traffic Control (ATC) facilities; the complex of functions that comprise an ATC facility ashore includes the airport control tower, radar control facilities, and flight planning/approval branch.

The primary mission of ACs is the safe, orderly, and expeditious movement of air traffic under varying weather conditions; to aid in this direction, they employ such devices as radiotelephones, light signals and systems, surveillance and precision radars, and allied equipment.

The Air Controlman assists pilots in the preparation and processing of flight plans and clearances; maintaining current flight planning information is also a responsibility of the Air Controlman.

Air Controlmen Third and Second Class are also detailed to aircraft carriers where they perform duties in Carrier Air Traffic Control Centers (CATCCs).

ACs attached to CATCCs operate Carrier Controlled Approach (CCA) equipment and also provide many of the same services as those offered ashore.

The Air Controlman must be conscientious and highly motivated in order to effectively perform the duties of his rating. The importance of the Air Controlman rating in the overall mission of the Navy cannot be overemphasized.

As you advance to Air Controlman Third and Second Class, more and more of your worth to the Navy is judged on the basis of the amount of efficient work you are able to obtain from the men under your supervision. The Secretary of the Navy has outlined some of the most important aspects of naval leadership in General Order Number 21.

Naval leadership is the art of accomplishing the Navy's mission through people. It is the sum of those qualities of intellect, of human understanding, and of moral character that enables a man to inspire and to manage a group of people successfully. Effective leadership, therefore, is based on personal example, good management practices, and moral responsibility.

The naval leadership program is a continuing program to develop those qualities of leadership, to the greatest extent possible, in all people within the Naval Establishment.

To be considered for the Air Controlman rating, an applicant must pass a rigid medical examination. An applicant who meets the medical standards of FAR, Part 67, based on a medical examination and evaluation of the candidate's history and condition, is entitled to an appropriate medical certificate.

Medical certificates are designated as First, Second, and Third Class, with established medical standards for each class.

Air Controlmen are required to possess a Second Class medical certificate.

Medical examinations are given by an examiner designated by the FAA. The FAA has designated flight surgeons of the Armed Forces on specified military posts, stations, and facilities to give physical examinations to applicants for FAA medical certificates who are on active duty, or who are, under Department of Defense medical programs, eligible for FAA medical certification as civil airmen. In addition, such examiners may issue or deny, as appropriate, FAA medical certificates in accordance with the regulations of Part 67 and policies of the FAA.

ADVANCEMENT

Some of the rewards of advancement are easy to see. You get more pay. Your job assignments become more interesting and more challenging. You are regarded with greater respect by officers and enlisted personnel. You enjoy the satisfaction of getting ahead in your chosen Navy career.

The advantages of advancement are not yours alone. The Navy also profits. Highly trained personnel are essential to the functioning of the Navy. By advancement, you increase your value to the Navy in two ways: First, you become more valuable as a technical specialist in your own rating; and second, you become more valuable as a person who can train others and thus make far-reaching contributions to the entire Navy.

ADVANCEMENT TO WARRANT AND COMMISSIONED OFFICER

It has been demonstrated that the Navy has a need for warrant officers to serve as officer technical specialists, and limited duty officers to serve as officer technical managers.

On 5 December 1974, the Secretary of the Navy approved recommendations for improvement of the warrant officer and limited duty officer

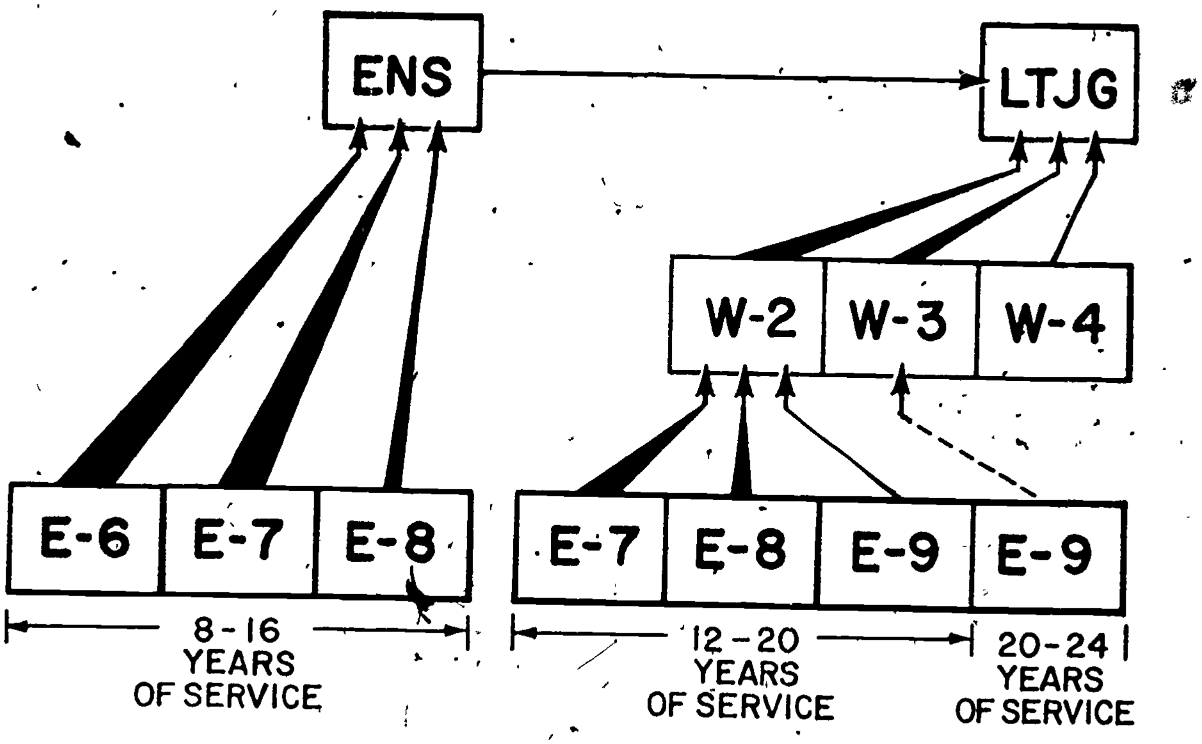

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Figure 1-1.—Path of advancement from enlisted to warrant officer and limited duty officer.

programs. The changes as set forth in BUPERS Notice 1120 of 24 January 1975 will be in effect until incorporated into the BUPERSMAN.

New paths from enlisted to warrant and LDO, and from warrant to LDO, are shown in figure 1-1. Application may be made for a grade indicated by an arrow. E-7s and E-8s with 12 to 16 years may not apply simultaneously for LDO ensign and W-2. Only two applications may be made while in any one pay grade.

Once appointed W-2, ex-enlisteds will continue progression to W-3, then W-4 as in the past, or after two years of warrant service may apply for LDO LTjg. Once appointed LDO ensign, ex-enlisted will progress through the LDO grades as in the past.

The dotted line from the second E-9 box at the extreme right of figure 1-2 means that E-9s with two years of performance equivalent to W-2 duties may be recommended by the procurement board for appointment as W-3 instead of W-2.

Enlisted personnel of the Regular Navy and Naval Reserve on active duty may seek appointment to warrant status via the Warrant Officer program or regular commissioned status via the Limited Duty Officer program.

Personnel seeking appointment under either of the programs should familiarize themselves with the laws and regulations governing appointment, retirement, reversions, and career matters as contained in the Career Planning Information Booklet NAVPERS 15176 for aviation personnel.

Eligible applicants for the Warrant Officer and Limited Duty Officer program will be considered by a selection board. The board will recommend those deemed best qualified for appointment within authorized quota limitations.

Competition in both of the programs has been and will continue to be particularly keen, and personnel should commence preparation early in their career. Increased knowledge by on-the-job training and specialized training through schools and correspondence courses should be sought by all potential candidates to better prepare for officer status.

E-4 time in service requirements changed by DOD effective 1 July 1975 for advancement to E-4 TIS requirements are increased from 21 months minimum to 2 years.

REQUIREMENTS *	E1 to E2	E2 to E3	# E3 to E4	#† E4 to E5	† E5 to E6	† E6 to E7	† E7 to E8	† E8 to E9
SERVICE	4 mos. service—or completion of Recruit Training.	8 mos. as E-2.	6 mos. as E-3.	12 mos. as E-4. 3 years time in service.	24 mos. as E-5. 6 years time in service.	36 mos. as E-6. 8 years time in service.	36 mos. as E-7. 8 of 11 years time in service must be enlisted.	24 mos. as E-8. 10 of 13 years time in service must be enlisted.
SCHOOL	Recruit Training. (C.O. may advance up to 10% of graduating class.)		Class A for PR3, DT3, PT3, AME 3, HM 3, PN 3, FTB 3, MT 3,			Class B for AGC, MUC, MNC.††		
PRACTICAL FACTORS	Locally prepared check-offs.	Record of Practical Factors, NavEdTra 1414/1, must be completed for E-3 and all PO advancements.						
PERFORMANCE TEST			Specified ratings must complete applicable performance tests before taking examinations.					
ENLISTED PERFORMANCE EVALUATION	As used by CO when approving advancement.		Counts toward performance factor credit in advancement multiple.					
EXAMINATIONS **	Locally prepared tests.	See below.	Navy-wide examinations required for all PO advancements.			Navy-wide selection board.		
RATE TRAINING MANUAL (INCLUDING MILITARY REQUIREMENTS)		Required for E-3 and all PO advancements unless waived because of school completion, but need not be repeated if identical course has already been completed. See NavEdTra 10052 (current edition).					Nonresident career courses and recommended reading. See NavEdTra 10052 (current edition).	
AUTHORIZATION	Commanding Officer		NAVEDTRAPRODEVCEN					

* All advancements require commanding officer's recommendation.
† 1 year obligated service required for E-5, and E-6; 2 years for E-7, E-8, and E-9.
\# Military leadership exam required for E-4 and E-5.
** For E-2 to E-3, NAVEDTRAPRODEVCEN exams or locally prepared tests may be used.
†† Waived for qualified EOD personnel.

Figure 1-2.—Active duty advancement requirements.

HOW TO QUALIFY FOR ADVANCEMENT

What must you do to qualify for advancement? The requirements may change from time to time, but usually you must:

1. Have a certain amount of time in your present grade.
2. Complete the required Rate Training Manuals by either demonstrating a knowledge of the material in the manual by passing a locally prepared and administered test, or by passing the Nonresident Career Course based on the Rate Training Manual.
3. Utilizing an appropriate Personnel Qualification Standard (when applicable) as a guideline, become qualified and demonstrate your ability to perform all the practical requirements for advancement by completing the Record of Practical Factors, NAVEDTRA 1414/1.
4. Be recommended by your commanding officer, after the petty officers and officers supervising your work have indicated that they consider you capable of performing the duties of the next higher rate.
5. Successfully complete the applicable military/leadership examination which is required prior to participating in the advancement (professional) examination.

Remember that the requirements for advancement can change. Check with your educational services office to be sure that you know the most recent requirements.

Advancement is not automatic. After you have met all the requirements, you are eligible for advancement. You will actually be advanced only if you meet all the requirements (including making a high enough score on the written examination) and if quotas permit. Figure 1-2 gives a more detailed view of the requirements for advancement of active duty personnel; figure 1-3 gives this information for inactive duty personnel.

HOW TO PREPARE FOR ADVANCEMENT

What must you do to prepare for advancement? You must study the qualifications for advancement, work on the personal qualification standard and practical factors, study the required Rate Training Manuals, and study other material that is required. You will need to be familiar with the following:

1. Manual of Qualifications for Advancement, NAVPERS 18068 (Series).
2. Personnel Qualification Standard for the equipment/system and rating assigned.
3. Record of Practical Factors, NAVEDTRA 1414/1.
4. Bibliography for Advancement Study, NAVEDTRA 10052 (Series).
5. Applicable Rate Training Manuals and their companion Nonresident Career Courses.
6. Examinations for advancement.

Collectively, these documents make up an integrated training package tied together by the qualifications. The following paragraphs describe these materials and give some information on how each one is related to the others.

"Quals" Manual

The Manual of Qualifications for Advancement, NAVPERS 18068 (Series), gives the minimum requirements for advancement. This manual is usually called the "Quals" Manual, and the qualifications themselves are often called "quals". The qualifications are of two general types: military requirements, and professional (or technical) qualifications.

Military requirements apply to all ratings rather than to any one particular rating. Military requirements for advancement to third class and second class petty officer rates deal with military conduct, naval organization, military justice, security, watch standing, and other subjects which are required of petty officers in all other ratings.

Professional qualifications are technical or professional requirements that are directly related to the work of each rating.

Both the military requirements and the professional qualifications are divided into subject matter groups. Practical factors are things you must be able to DO in order to perform the duties of your rate.

The qualifications for advancement and a bibliography of study materials are contained in the back of this rate training manual. Study these qualifications and the military requirements carefully. The written examination for advancement will contain questions relating to the knowledge factors and the knowledge aspects

REQUIREMENTS *	E1 to E2	E2 to E3	E3 to E4	E4 to E5	E5 to E6	E6 to E7	E8	E9
TOTAL TIME IN GRADE	4 mos.	8 mos.	6 mos.	12 mos.	24 mos.	36 mos. with total 8 yrs service	36 mos. with total 11 yrs service	24 mos. with total 13 yrs service
TOTAL TRAINING DUTY IN GRADE †	14 days	14 days	14 days	14 days	28 days	42 days	42 days	28 days
PERFORMANCE TESTS			Specified ratings must complete applicable performance tests before taking examination.					
DRILL PARTICIPATION	Satisfactory participation as a member of a drill unit in accordance with BUPERSINST 5400.42 series.							
PRACTICAL FACTORS (INCLUDING MILITARY REQUIREMENTS)	Record of Practical Factors, NavEdTra 1414/1, must be completed for all advancements.							
RATE TRAINING MANUAL (INCLUDING MILITARY REQUIREMENTS)	Completion of applicable course or courses must be entered in service record.							
EXAMINATION	Standard Exam		Standard Exam required for all PO advancements. Also pass Military Leadership Exam for E-4 and E-5.				Standard Exam, Selection Board.	
AUTHORIZATION	Commanding Officer		NAVEDTRAPRODEVCEN					

* Recommendation by commanding officer required for all advancements.
† Active duty periods may be substituted for training duty.

Figure 1-3.—Inactive duty advancement requirements.

of the practical factors of both the military requirements and the professional qualifications. If you are working for advancement to second class, remember that you may be examined on third class qualifications as well as on second class qualifications.

It is essential that the "quals" reflect current requirements of fleet and shore operations, and that new fleetwide technical, operational, and procedural developments be included. For these reasons, the qualifications are continually under evaluation. Although there is an established schedule for revisions to the "quals" for each rating, urgent changes to the "quals" may be made at any time. These revisions are issued in the form of changes to the "Quals" Manual. Therefore, never trust any set of "quals" until you have checked the change number against an up-to-date copy of the "Quals" Manual. Be sure you have the latest revision.

Personnel Qualification Standards

Personnel Qualification Standards (PQS) (OPNAV Instructions 3500.34) are presently being utilized to provide guidelines in preparing for advancement and qualification to operate specific equipment and systems. They are designed to support the advancement requirements as stated in the "Quals" Manual.

The "Quals" and Record of Practical Factors are stated in broad terms. Each PQS is much more specific in its questions that lead to qualification. It provides an analysis of specific equipment and duties, assignments, or responsibilities which an individual or group of individuals (within the same rating) may be called upon to carry out. In other words, each PQS provides an analysis of the complete knowledge and skills required of that rating tied to a specific weapon system (aircraft and/or individual systems or components).

Each qualification standard has four main subdivisions in addition to an introduction and a glossary of PQS terms. They are as follows:

100 Series—Theory
200 Series—System
300 Series—Watchstations (duties, assignments, or responsibilities).
400 Series—Qualification cards.

The introduction explains the complete use of the qualification standard in terms of what it will mean to the user as well as how to use it.

The Theory (100 Series) section specifies the theory background required as a prerequisite to the commencement of study in the specific equipment or system for which the PQS was written. These fundamentals are normally taught in the formal schools (Preparatory, Fundamentals, and Class A) phase of an individual's training. However, if the individual has not been to school, the requirements are outlined and referenced to provide guidelines for a self-study program.

The Systems (200 Series) section breaks down the equipment or systems being studied into functional sections. PQS items are essentially questions asked in clear, concise statement (question) form and arranged in a standard format. The answers to the questions must be extracted from the various maintenance manuals covering the equipment or systems for which the PQS was written. This section asks the user to explain the function of the system, to draw a simplified version of the system from memory, and to use this drawn schematic or the schematic provided in the maintenance manual while studying the system or equipment. Emphasis is given to such areas as maintenance management procedures, components, component parts, principles of operation, system interrelations, numerical values considered necessary to operation and maintenance, and safety precautions.

The Watchstation (300 Series) section includes questions regarding the procedures the individual must know to operate and maintain the equipment or system. A study of the items in the 200 series section provides the individual with the required information concerning what the system or equipment does, how it does it, and other pertinent aspects of operation. In the 300 series section, the questions advance the qualification process by requiring answers or demonstrations of ability to put this knowledge to use or to cope with maintenance of the system or equipment. Areas covered include normal operation; abnormal or emergency operation; emergency procedures which could limit damage and/or casualties associated with a particular operation; operations that occur too infrequently to be considered mandatory performance items; and maintenance procedures/instructions such as checks, tests, repair, replacement, etc.

The 400 series section consists of the qualification cards. These cards are the accounting documents utilized to record the individual's satisfactory completion of items necessary for becoming qualified in duties assigned. Where the individual starts in completing a standard will depend on his assignment within an activity. The complete PQS is given to the individual being qualified so that he can utilize it at every opportunity to become fully qualified in all areas of his rating and the equipment or system for which the PQS was written. Upon transfer to a different activity, each individual must requalify. The answers to the questions asked in the qualification standards may be given orally or in writing to the supervisor, the branch or division officer, and maintenance officer as required to certify proper qualification. The completion of part or all of the PQS provides a basis for the supervising petty officer and officer to certify completion of Practical Factors for Advancement.

Record of Practical Factors

Before you can take the Navy-wide examination for advancement, there must be an entry in your service record to show that you have qualified in the practical factors of both the military requirements and the professional qualifications. A special form known as the Record of Practical Factors NAVEDTRA 1414/1 (plus the abbreviation of the appropriate rating), is used to keep a record of your practical factor qualifications. The form lists all practical factors, both military and professional. As you demonstrate your ability to perform each practical factor, appropriate entries are made in the DATE and INITIALS columns.

Changes are made periodically to the Manual of Qualifications for Advancement and revised forms of NAVEDTRA 1414/1 are provided when necessary. Extra space is allowed on the Record of Practical Factors for entering additional practical factors as they are published in changes. The Record of Practical Factors also provides space for recording demonstrated proficiency in skills which are within the general scope of the rate but which are not identified as minimum qualifications for advancement.

If you are transferred before you qualify in all practical factors, NAVEDTRA 1414/1 should be forwarded with your service record to your next duty station. You can save yourself a lot of trouble by making sure that this form is actually inserted in your service record before you are transferred. If the form is not in your service record, you will be required to start all over again and requalify in the practical factors which have already been checked off.

A second copy of the Record of Practical Factors should be made available to each man in pay grades E-2 through E-8 for his personal record and guidance.

The importance of NAVEDTRA 1414/1 cannot be overemphasized. It serves as a record to indicate to the petty officers and officers supervising your work that you have demonstrated proficiency in the performance of the indicated practical factors and is part of the criteria utilized by your commanding officer when he considers recommending you for advancement. In addition, the proficient demonstration of the applicable practical factors listed on this form can aid you in preparing for the examination for advancement. Remember that the knowledge aspects of the practical factors are covered in the examinations for advancement. Certain knowledge is required to demonstrate these practical factors and additional knowledge can be acquired during the demonstration. Knowledge factors pertain to that knowledge which is required to perform a certain job. In other words, the knowledge factors required for a certain rating depend upon the job (practical factors) that must be performed by personnel of that rating. Therefore, the knowledge required to proficiently demonstrate these practical factors will definitely aid you in preparing for the examination for advancement.

NAVEDTRA 10052

Bibliography for Advancement Study, NAVEDTRA 10052 (Series), is a very important publication for anyone preparing for advancement. This bibliography lists required and recommended Rate Training Manuals and other reference material to be used by personnel working for advancement. NAVEDTRA 10052 is revised and issued once each year by the Naval Education Training and Program Development Center. Each revised edition is identified by a letter following the NAVEDTRA number. When using this publication, be sure that you have the most recent edition.

If extensive changes in qualifications occur between the annual revisions of NAVEDTRA 10052, a supplementary list of study material may be issued in the form of a Notice. When you are preparing for advancement, check to see whether changes have been made in the qualifications.

If changes have been made, see if a Notice has been issued to supplement NAVEDTRA 10052.

The required and recommended references are listed by rate level in NAVEDTRA 10052. If you are working for advancement to third class, study the material that is listed for third class. If you are working for advancement to second class, study the material that is listed for second class. Remember that you are also responsible for the references listed at the third class level.

In using NAVEDTRA 10052, you will notice that some Rate Training Manuals are marked with an asterisk (*). Any manual marked in this way is MANDATORY—that is, it must be completed at the indicated rate level before you are eligible to take the Navy-wide examination for advancement. Each mandatory manual may be completed by passing the appropriate enlisted correspondence course that is based on the mandatory training manual; passing locally prepared tests based on the information given in the training manual, or in some cases, successfully completing an appropriate Class A School.

Do not overlook the section of NAVEDTRA 10052 which lists the required and recommended references relating to the military standards/requirements for advancement. For example, all personnel must complete the Rate Training Manual, Military Requirements for Petty Officer 3 & 2, NAVEDTRA 10056 (Series), for the appropriate rate level before they can be eligible to advance.

The references in NAVEDTRA 10052 which are recommended, but not mandatory, should also be studied carefully. All references listed in NAVEDTRA 10052 may be used as source material for the written examinations at the appropriate rate levels.

Rate Training Manuals

There are two general types of Rate Training Manuals. Rating manuals (such as this one) are prepared for most enlisted rates, giving information that is directly related to the professional qualifications. Basic manuals give information that applies to more than one rate and rating. Basic Electricity, NAVEDTRA 10086 (Series), is an example of a basic manual because many ratings use it for reference.

Rate Training Manuals are produced by field activities under the management control of the Naval Education and Training Command. Manuals are revised from time to time to keep them up to date technically. The numbering system is being changed from NAVTRA to NAVEDTRA. The revision of a Rate Training Manual is identified by a letter following the NAVTRA or NAVEDTRA number. You can tell whether any particular copy of a Rate Training Manual is the latest edition by checking the number in the most recent edition of List of Training Manuals and Correspondence Courses, NAVEDTRA 10061 (Series). NAVEDTRA 10061 is actually a catalog that lists training manuals and correspondence courses; you will find this catalog useful in planning your study program.

Rate Training Manuals are designed to help you prepare for advancement. The following suggestions may help you to make the best use of this manual and other Navy training publications when you are preparing for advancement.

1. Study the military requirements and the professional qualifications for your rate before you study the training manual, and refer to the "quals" frequently as you study. Remember, you are studying the training manual in order to meet these "quals."
2. Set up a regular study plan. If possible, schedule your studying for a time of day when you will not have too many interruptions or distractions.
3. Before you begin to study any part of the training manual intensively, become familiar with the entire manual. Read the preface and the table of contents. Check through the index. Look at the appendixes. Thumb through the manual without any particular plan, looking at the illustrations and reading bits here and there as you see things that interest you.
4. Look at the training manual in more detail, to see how it is organized. Look at the table of contents again. Then, chapter by chapter, read the introduction, the headings, and the subheadings. This will give you a clear picture of the scope and content of the manual. As you look through the manual in this way, ask yourself some questions: What do I need to learn about this? What do I already know about this? How is this information related to information given in other chapters? How is this information related to the qualifications for advancement?
5. When you have a general idea of what is in the training manual and how it is organized, fill in the details by intensive study. In each study period, try to cover a complete unit—it

may be a chapter, a section of a chapter, or a subsection. If you know the subject well, or if the material is easy, you can cover quite a lot at one time. Difficult or unfamiliar material will require more study time.

6. In studying any one unit—chapter, section, or subsection—write down the questions that occur to you. Many people find it helpful to make a written outline of the unit as they study, or at least to write down the most important ideas.

7. As you study, relate the information in the training manual to the knowledge you already have. When you read about a process, a skill, or a situation, try to see how this information ties in with your own past experience.

8. When you have finished studying a unit, take time out to see what you have learned. Look back over your notes and questions. Maybe some of your questions have been answered, but perhaps you still have some that are not answered. Without referring to the training manual, write down the main ideas that you have learned from studying this unit. Do not quote the manual. If you cannot give these ideas in your own words, the chances are that you have not really mastered the information.

9. Use Nonresident Career Courses whenever you can. Nonresident Career Courses are based on Rate Training Manuals or on other appropriate texts. As mentioned before, completion of a mandatory Rate Training Manual can be accomplished by passing the Nonresident Career Course based on the Rate Training Manual. You will probably find it helpful to take other career courses, as well as those based on mandatory training manuals. Taking a career course helps you to master the information given in the training manual and also helps you see how much you have learned.

10. Think of your future as you study Rate Training Manuals. You are working for advancement to third class or second class right now, but someday you will be working toward higher rates. Anything extra that you can learn now will help you.

SOURCES OF INFORMATION

One of the most useful things you can learn about a subject is how to find out more about it. No single publication can give you all the information you need to perform the duties of your rating. You should learn where to look for accurate, authoritative, up-to-date information on all subjects related to the military requirements for advancement and the professional qualifications of your rating.

Some of the publications described in this manual are subject to change or revision from time to time—some at regular intervals, others as the need arises. When using any publication that is subject to change or revision, be sure that you have the latest edition. When using any publication that is kept current by means of changes, be sure you have a copy in which all official changes have been made. Studying canceled or obsolete information will not help you perform efficiently or to advance; it is likely to be a waste of time and may even be seriously misleading.

Training films available to naval personnel are a valuable source of information on many technical subjects. Films that may be of interest are listed in the United States Navy Film Catalog, NAVAIR 10-1-777.

In addition to the sources of information previously listed and the Reading List, there are many helpful publications issued by various departments of the Navy, Air Force and Army, and the Federal Aviation Administration. Various lists of publications, divided by general subject matter, are available through the Government Printing Office. Chapter 14 of this manual, which includes a discussion of various publications applicable to the AC rating, is a good source of reference material. Additionally, publications appropriate to specific subject material are referenced throughout this training manual.

CHAPTER 2

MILITARY AIRCRAFT DESIGNATIONS AND CHARACTERISTICS

Aircraft performance differences have a direct effect on the airspace and visibility required to perform certain maneuvers, such as normal pattern entry; circling approaches, final alignment for landing; and missed approaches or waveoffs.

Specific categories of military aircraft are contained in the Flight Information Publication (FLIP) Planning Section 1.

Good landings are spawned in the approach to the runway; and although pilot technique is the major factor, correct and timely instructions and information issued by controllers will significantly assist pilots to obtain the desired results. When landings and takeoffs are smooth or normal, orderly movements of air traffic at the airport are enhanced.

Information concerning types of aircraft is received from various sources providing flight data on expected and actual aircraft movements. The AC must be able to mentally translate this information into a workable estimate of performance characteristics upon which air traffic control instructions and information are issued. This mental process must necessarily begin with familiarity with the DOD (Department of Defense) controlled aircraft designation system, and should mature with experience and association with the various aircraft the DOD operates.

MILITARY AIRCRAFT DESIGNATION

All aircraft used by DOD agencies have been assigned designations to conform to joint regulations. The system covers all current and newly designed military aircraft, rockets, and guided missiles, and applies to all elements of the military departments.

All military aircraft are assigned designations consisting of a combination of significant letters and numbers as described in the following paragraphs and tables.

STATUS PREFIX SYMBOLS

The status prefix symbol (letter) is never used without a basic or modified mission symbol, and indicates an aircraft is being used for special or permanent test, or is a prototype. The status letter is placed at the immediate left of the modified mission symbol, or the mission or type symbol if no modified mission symbol is applicable. An example of the use of a status prefix symbol and a modified mission symbol is the YAT-37D, which is an Air Force T-37 reworked and modified for evaluation as an attack aircraft. Status prefix symbols authorized for use are listed in table 2-1.

BASIC MISSION SYMBOLS

A basic mission symbol (letter) is used to denote the primary function or capability of an aircraft. Mission symbols denote the mission of the aircraft. Examples of the use of basic symbols for aircraft illustrated in figure 2-1 are: a P-3's mission is patrol; a T-2's mission is trainer; etc. The basic mission symbols authorized for use are listed in table 2-2.

MODIFIED MISSION SYMBOLS

The modified mission symbol consists of a prefix letter placed at the immediate left of the basic mission or type symbol. Each military department determines the need for the assignment of such symbols. Only one modified mission symbol is used in any one designation. An example of the use of the modified mission symbol is the RA-5C, which is the A-5 aircraft (fig. 2-1), modified as a reconnaissance aircraft, as indicated by the R. Modified mission symbols authorized for use are listed in table 2-2.

Table 2-1.—Status prefix symbols

Letter	Title	Description
J	Special test, temporary.	Aircraft on special test programs by authorized organizations on bailment contract having a special test configuration or whose installed property has been temporarily removed to accommodate the test. At completion of the test, the vehicle will be returned either to its original configuration or to standard operational configuration.
N	Special test, permanent.	Aircraft on special test programs by authorized organizations on bailment contract, whose configuration is so drastically changed that return of aircraft to its original configuration or conversion to standard operational configuration is beyond practicable or economical limits.
Y	Prototype.	Aircraft procured in limited quantities to develop the potentialities of the design.

TYPE SYMBOLS

Type symbols (letters) are always used with a modified mission symbol. Type symbols are placed immediately to the right of the basic mission symbol. An example of the use of a type symbol among the aircraft depicted in figure 2-1 is the UH-46. The H means helicopter, while the basic mission symbol U denotes utility. Type symbols authorized for use are listed in table 2-3.

DESIGN NUMBERS

Numbers are assigned consecutively for each basic mission or type. New design numbers are assigned when an existing aircraft is redesigned to an extent that it no longer reflects the original configuration or capability; for example, F-4, F-5, F-8, F-9, A-3, A-4, A-5, A-6, and A-7, with the numbers being the design numbers. The design number is that number assigned to a particular design; and since this joint DOD system is relatively new, it does not necessarily date aircraft presently in use. For instance, the F-4 has been in use much longer than the A-7.

SERIES SYMBOL

A letter is assigned to each series change of a specific basic design. In designating new aircraft, the series symbol is in consecutive order, starting with the letter A. The series symbol is placed immediately to the right of the design number in the aircraft designation. To avoid confusion, the letters I and O are not used as series symbols.

DESIGNATION

All aircraft designations consist of the following: Basic mission symbols and type symbols, if applicable, which denote the primary function or capability of the aircraft; a design number assigned in sequence to each aircraft intended to fulfill the mission; and a series symbol which identifies each change of a specific basic design. A hyphen (-) is always inserted between the basic mission symbol and the design number.

In the aircraft designation A-6A, for example, the A followed by a hyphen (-) indicates that the aircraft is designed for an attack mission, as shown in table 2-2. The number 6 has been assigned to this particular design for an attack mission. The letter A following the number 6 indicates that this is the first series of this design. The designation A-6B would identify the first series change of the basic design.

Aircraft designators may be expanded to indicate an added or restricted capability by the use of one of the modified mission symbols (table 2-2) preceding the basic mission symbol.

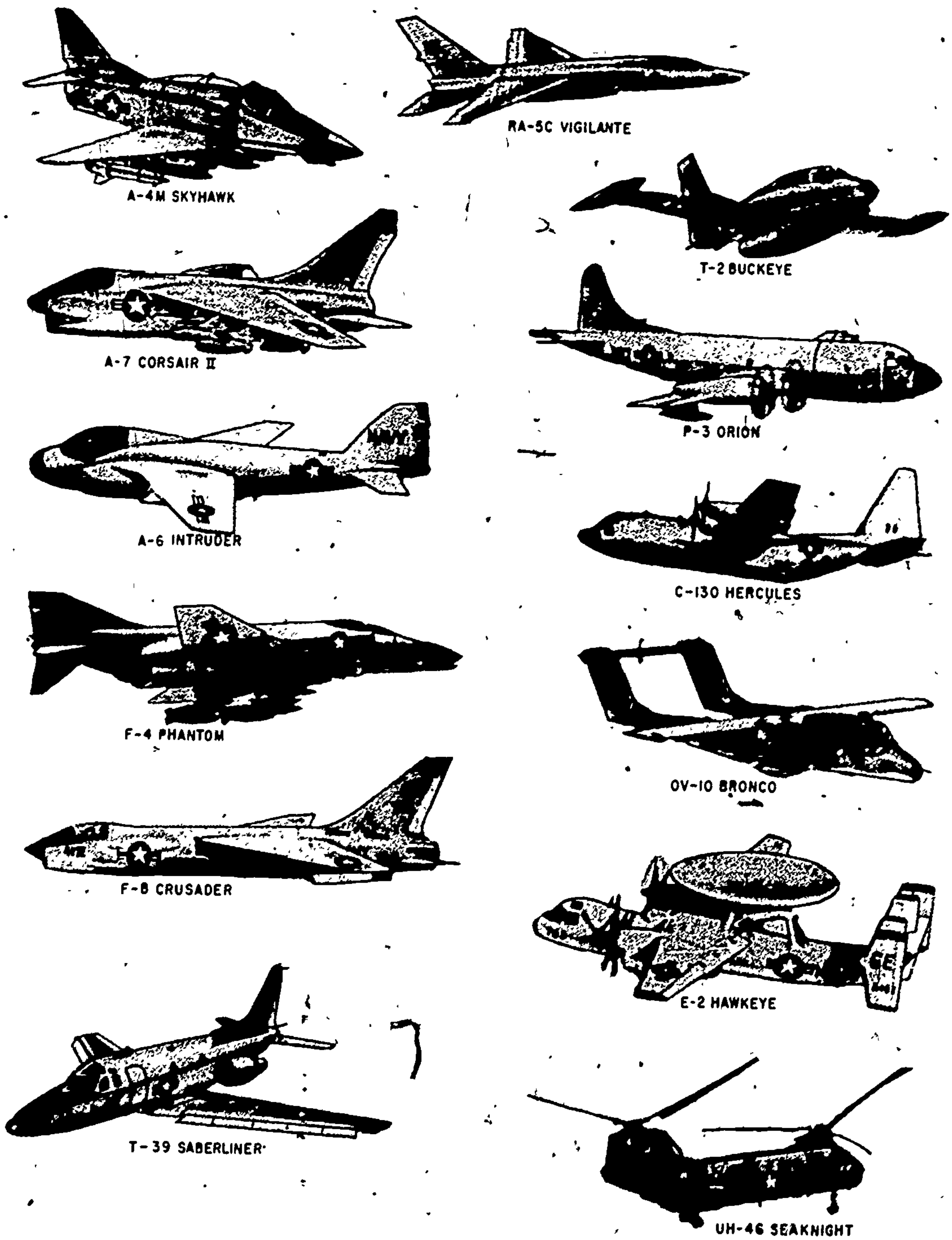

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Figure 2-1. — Military aircraft.

Table 2-2.—Basic and/or modified mission symbols

LETTER	TITLE	DESCRIPTION
A	Attack.	Aircraft modified to search out, attack, and destroy enemy land or sea targets, using conventional or special weapons. This is also used for interdiction and close air support missions.
B	Bomber.	Aircraft designed for bombing enemy targets.
C	Cargo/Transport.	Aircraft modified for carrying cargo/passengers or medical patients.
D	Director.	Aircraft modified for controlling a drone aircraft or a missile.
E	Special Electronic Installation.	Aircraft modified with electronic devices for employment in one or more of the following missions: (1) Electronic countermeasures. (2) Airborne early warning radar. (3) Airborne command and control, including communications relay. (4) Tactical data communications link for all nonautonomous modes of flight.
F	Fighter.	Aircraft designed to intercept and destroy other aircraft and/or missiles *(includes multipurpose aircraft also designed for ground support missions)*. For example, interdiction and close air support.
H	Search/Rescue.	Aircraft modified and equipped for performance of search and rescue missions.
K	Tanker.	Aircraft modified and equipped to provide in-flight refueling of other aircraft.
L	Cold Weather.	Aircraft modified for operation in the arctic and antarctic regions; includes skis, special insulation, and other ancillary equipment required for extreme cold weather operations.
O	Observation.	Aircraft designed to observe *(through visual or other means)* and report tactical information concerning composition and disposition of enemy forces, troops, and supplies in an active combat area.
P	Patrol.	Long-range, all-weather, multiengine aircraft operating from land and/or water bases designed for independent accomplishment of the following functions: antisubmarine warfare; maritime reconnaissance; and mining.
Q	Drone.	Aircraft modified to be controlled from a point outside the aircraft.
R	Reconnaissance.	Aircraft modified and permanently equipped for photographic and/or electronic reconnaissance missions.
S	Antisubmarine.	Aircraft modified so that it can function to search out, identify, attack, and destroy enemy submarines.
T	Trainer.	Aircraft modified and equipped for training purposes.
U	Utility.	Aircraft, having small payload, modified to perform miscellaneous missions, such as carrying cargo or passengers, towing targets, etc.
V	Staff.	Aircraft modified to provide accommodations such as chairs, tables, lounge, berths, etc., for the transporation of staff personnel.
W	Weather.	Aircraft modified and equipped for meteorological missions.
X	Research.	Aircraft designed for testing configurations of a radical nature. These aircraft are not normally intended for use as tactical aircraft.

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Table 2-3.—Type symbols

Letter	Title	Description
H	Helicopter.	A rotary-wing aircraft designed with the capability of flight in any plane. For example, horizontal, vertical, or diagonal.
V	VTOL and STOL.	Aircraft designed for vertical takeoff or landing with no takeoff or landing roll, or aircraft capable of takeoff and landing in a minimum prescribed distance.

For example, the designation KA-6D indicates a basic A-6A model aircraft that has been modified to perform inflight refueling duties (tanker). The series symbol D denotes the design changes that have been incorporated in this particular model.

A status prefix symbol may be added to the designation to indicate aircraft being used for experimentation and for special or service testing. (See table 2-1.) The status letter, if used, is placed at the immediate left of the basic mission symbol or the modified mission symbol. The designation JA-6A would be identified as an aircraft with the same capabilities as the A-6A but temporarily configured for a special test program; at the completion of the test, the vehicle will be returned to the original configuration.

PERFORMANCE AND MANEUVERABILITY

In addition to being able to visually identify various types of aircraft, ACs must familiarize themselves with aircraft operating characteristics. New aircraft with increased speed and performance capabilities must operate within the same airspace as older, slower aircraft. This presents a problem in all aspects of air traffic control, not only from the standpoint of faster aircraft overtaking slower aircraft but also in regard to the maneuvering area, stalling speed, rate of climb, and other factors which should govern the AC's judgment under various conditions. Since the AC often gives instructions based on visual observations of air traffic in a particular area, it is evident that mistaken calculation of aircraft performance and maneuverability characteristics could lead to confusion for both pilots and controllers.

The control tower operator issues clearances that in his opinion can be safely followed without collision hazard if reasonable caution is exercised by the pilot. The clearance issued is permissive in nature and does not relieve the pilot of the responsibility for cautious handling of his aircraft. The information and clearances issued are intended to aid pilots to the fullest extent in avoiding collisions; this goal requires correct and concise instructions based on sound judgment for an effective flow of air traffic.

Normally, single-engine aircraft (as a class) are comparatively small and require less operating space around the airport than the large multiengine aircraft. However, some of the single-engine jet aircraft do require a rather wide approach due to their high landing speeds.

Multiengine aircraft (as a class) are normally larger than the single-engine types. They require approaches that are much wider and a final approach which is much longer. Each is a separate landing or takeoff problem as they rarely perform these functions in formation; whereas, in the case of the single-engine aircraft, many landings and takeoffs are completed in formation.

It is difficult to make generalizations concerning the performance and maneuverability of various aircraft, as each type has its own set of characteristics governing its performance both in the air and on the ground. Jet aircraft as a type require less warmup time than reciprocating engine types. The jets are extremely uneconomical to operate on the ground and at altitudes under those for which they were designed to operate. Their landing and takeoff speeds are universally higher, many requiring the use of drogue chutes for landing and afterburners for takeoff on most present-day airfields. Field elevations and runway temperatures are vital elements in control of jet aircraft and, to a somewhat lesser degree, in the control of reciprocating engine aircraft. As an example of what effect altitude has on even a light aircraft, it may be startling to learn that an aircraft of this type which has a rate of climb of 420 feet per minute at sea level has its rate of climb reduced to 225 feet per minute at 5,000 feet. Also, the distance needed for takeoff is doubled between these two altitudes. (See fig. 2-2.) Higher temperatures and higher humidity have similar effects on aircraft performance. A high-performance jet fighter quite possibly may not operate from an airfield with short runways on a day on which high runway temperatures prevail, even though the field elevation is only moderately high. Later in the afternoon, or at night, the same fighter may be able to effect a takeoff from the same field, because the atmosphere becomes more dense during night hours as a general rule. More lift is afforded the aircraft in dense air, be it a light aircraft or a high-performance jet.

An understanding of the large quantities of fuel consumed by our present-day jet-type aircraft is of great importance to the Air Controlman. Whether it be with respect to taxiing for departure, landing, or local flying, a working knowledge of the characteristics of the jet and its fuel problem will put the jet into the traffic picture without any special priority. A jet engine consumes 10 to 20 times as much fuel as the average reciprocating engine while operating on the ground. For example, a T-33 will consume 4 gallons of fuel per minute at idling speed while on the ground. At 40,000 feet, and using 100 percent power, it consumes 4 gallons per minute and travels 6 to 7 miles.

Cognizance of the hazards to aircraft on the ground and in the air, which are caused by wake turbulence from heavy aircraft, is of the utmost importance to the Air Controlman. Large aircraft can create wake turbulence severe enough to endanger light aircraft, particularly in light wind conditions, as this turbulence may remain in the approach and landing area for several

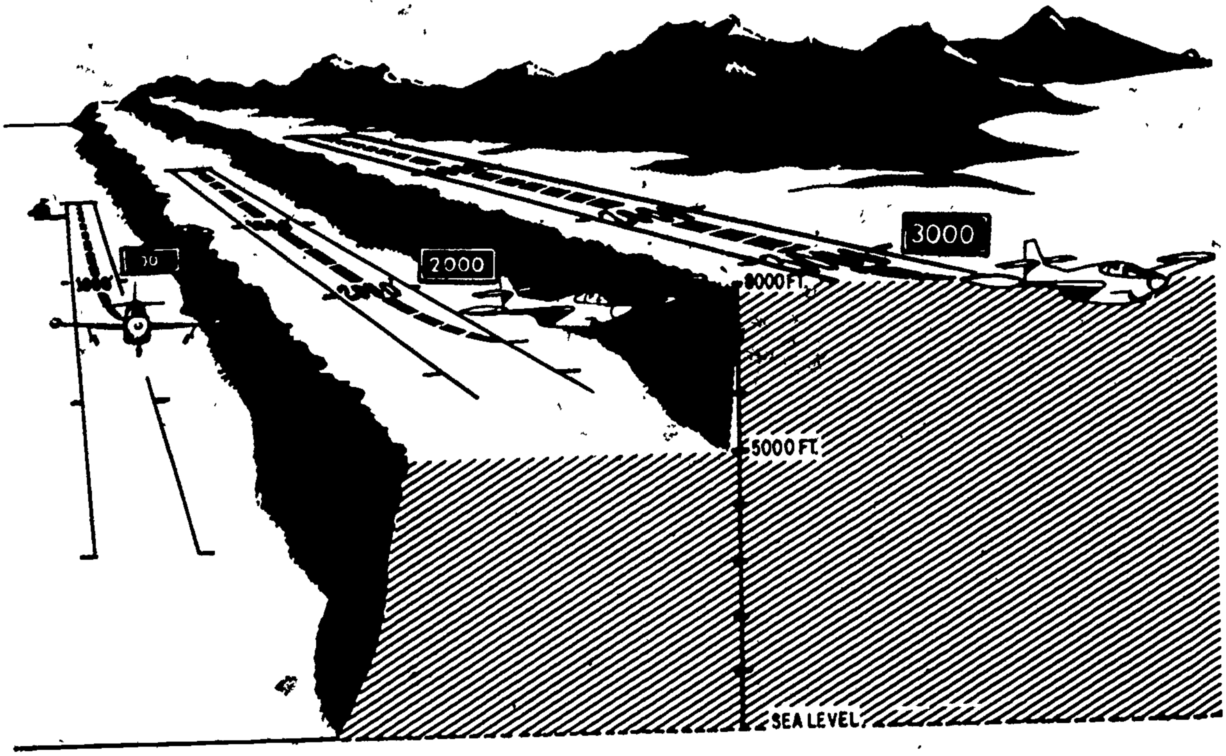

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Figure 2-2.—Comparison of takeoff distances with increased altitudes.

minutes. Turbulence may be encountered by lightweight and mediumweight aircraft when landing or crossing the wake of large aircraft. More detailed information concerning wake turbulence can be found in chapter 10 of this Rate Training Manual. The turbulence created by a jet aircraft without afterburner at 100 percent rpm may extend from 150 feet to 200 feet, while the same jet with afterburner may create turbulence from 300 feet to 400 feet. These areas may vary with atmospheric conditions. During ground operations, if the jet is moving, the area extends farther than if the jet is holding. The blast effect of a present-day large jet engine is extremely dangerous. For example, at a distance of 25 feet temperatures may reach 350 degrees with a velocity of 475 miles per hour, while at 100 feet the temperature may still be about 100 degrees with a velocity of 50 miles per hour.

The installation of high-speed or banked turnoffs is an important factor in the expeditious handling of arriving traffic. Pilots are able to clear the runway in use in a much shorter time than was possible with the earlier runway and taxiway configuration. This in turn is of tremendous assistance to the Air Controlman in expediting the flow of traffic. Taxiways at many airports are too narrow for use by our larger aircraft today. Consequently, remodeling and new construction are constantly being done to cope with the larger and heavier aircraft, as well as those planned for the future. The new taxiways have banked, high-speed turnoffs wide enough to accept aircraft at faster speeds. When installed and in use, high-speed turnoffs have been used at speeds up to 63 miles per hour.

The Air Controlman must remain alert to remember all of the performance and maneuverability characteristics needed to handle successfully all types of aircraft which may come under his control. As new types of aircraft are placed in service, he should immediately learn as much about them as possible.

When the pilot of a high-performance aircraft calls in for landing instructions, the Air Controlman must give the pilot a precise and correct set of instructions. These instructions should contain and be based on a great number of determinations made quickly by the Air Controlman. First of all, he has to recognize the aircraft and mentally review the performance characteristics associated with this aircraft. When the proper mental associations have been made, he is ready to give the pilot the necessary correct instructions. His mental review should be concerned with such considerations as the aircraft's landing speed, approach patterns, runway length requirements, barometric pressure, and many other factors connected with the safe approach and landing of this aircraft.

AIRCRAFT CHARACTERISTICS

The following paragraphs contain certain characteristics that should be known by individuals controlling aircraft, such as those illustrated in figure 2-1. Keep in mind that memorizing the exact figures is not important, but they are used in this text to show the type of comparison a controller would make when issuing instructions. If all aircraft in your landing pattern were high-performance aircraft, then spacing problems of one aircraft relative to another would be less than is the case when high-performance and cargo-type, for instance, are using the same runway.

The A-4 is considered a high-performance aircraft with a cruising speed in excess of 500 knots at altitude. One problem of particular importance is the effect of a crosswind on landing due to the configuration of the landing gear. Pilots of A-4s are listening intently for the wind direction and velocity since the gear is rather high and close together and presents a problem of stability after the aircraft has touched down on the runway under crosswind conditions.

The A-7 resembles the F-8 aircraft, is a high-performance type, and also cruises in excess of 500 knots at altitude. The A-7 lands rather fast with a final approach speed of approximately 120 knots.

The F-8 is a high-performance aircraft with the F-8H and J series capable of nearly Mach 2 (Mach 1 = speed of sound at sea level). Approach airspeed of these models is between 130 and 140 knots.

The A-6 has a cruising speed of about 420 knots but is an extremely stable aircraft at landing speed with a stall speed of about 70 knots, which is comparable to the E-2. This would allow the A-6 to mix with the slower

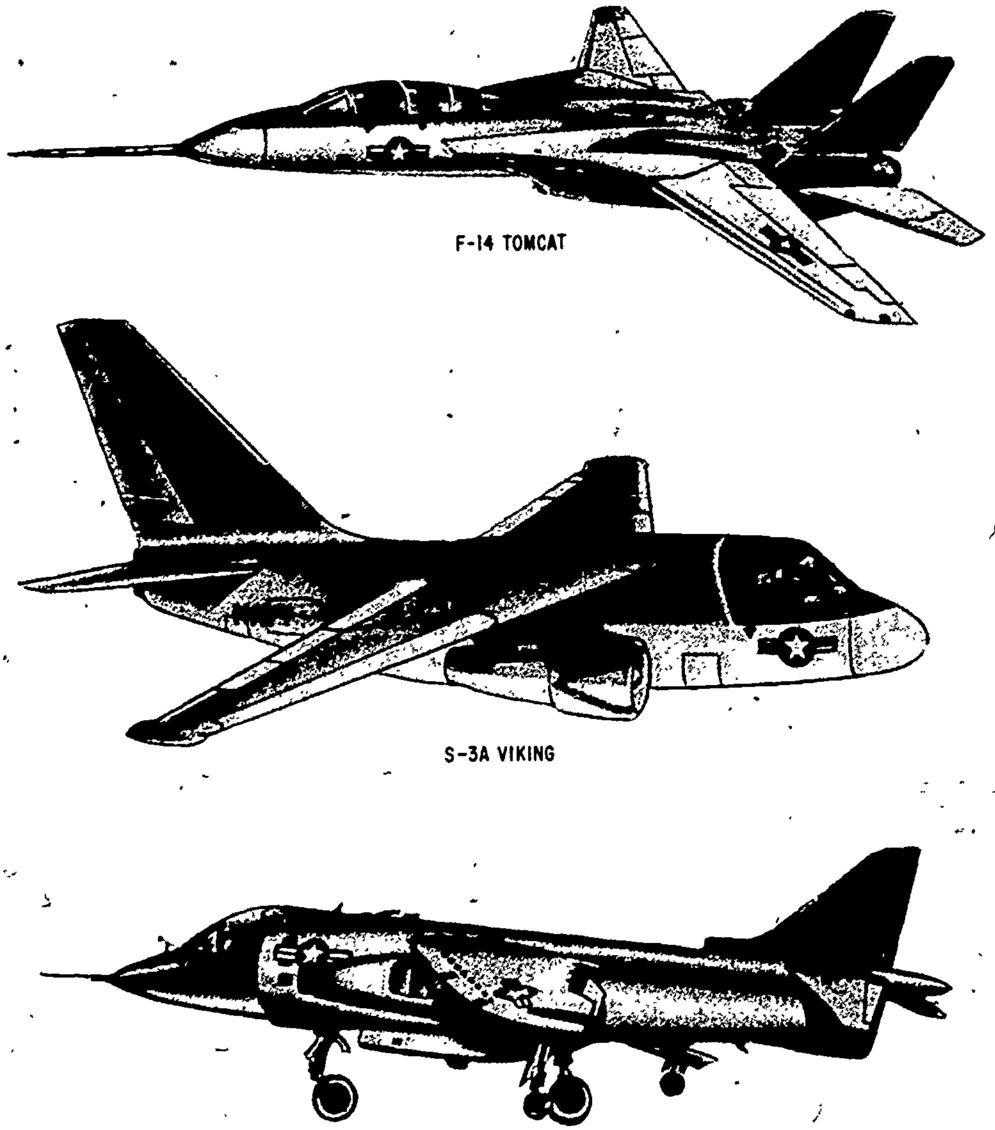

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Figure 2-3.—Advanced naval aircraft.

types of aircraft without too much concern about overtaking other traffic.

The F-4 is a high-performance aircraft with a maximum speed of over Mach 2. Its approach speed is between 130 and 140 knots, which is comparable to most jet fighter-type aircraft. Two engines with afterburners enable it to take off in about 5,000 feet, while it has good slow-down capability when back on the runway by being able to land in about 3,000 feet.

The P-3 has four turboprop engines and can take off in about 3,700 feet and climb at a rate of 1,500 feet per minute. It cruises at approximately 350 knots at altitude and has good endurance capability, being able to operate for 17 hours on two engines. It also has reversible pitch propellers which enable it to stop in a short distance after landing, for a quick turn off the duty runway.

The RA-5C is another high-performance aircraft with a maximum speed of over Mach 2. Its approach speed, takeoff, and landing characteristics are comparable to the F-4.

The T-2 is a jet trainer aircraft and is fairly fast with a cruising speed of over 450 knots, but with the straight wing design for more stable training operations and slower landing speeds.

The E-2 is a turboprop aircraft with a cruising speed of approximately 280 knots. It can slow down very effectively for the landing approach with a stall speed of approximately 70 knots.

The C-130 also has four turboprop engines and is a cargo-type aircraft with a cruising speed of approximately 350 knots. It lands a little faster than the E-2 with a stall speed of approximately 100 knots. It can take off in about 3,500 feet, and with the reversible pitch propellers can land and stop in about 2,200 feet. This enables it to clear the runway unusually fast for a large aircraft.

The T-39 Saberliner is a twin-jet aircraft which was originally designed to train radar intercept operators; it can fly at speeds in excess of 350 knots and has a landing speed of approximately 120 knots.

The OV-10 Bronco is a twin-turboprop, multipurpose aircraft which is designed for counterinsurgency operations; it can carry a crew of two, has a maximum speed of approximately 250 knots and a landing speed of 110 knots.

New aircraft are constantly undergoing test and evaluation for induction into the fleet. One of the newest of the Navy's aircraft is the S-3A Viking which was designed to replace the S-2 series for ASW purpose. The S-3A airframe, with modifications, can be utilized as COD (Carrier Onboard Delivery) aircraft. Another new aircraft, the F-14 Tomcat, is a fighter-bomber equipped with a variable position wing that is programed to replace the older F-4 Phantom. These aircraft are illustrated in figure 2-3.

Another of the Navy's latest aircraft is the AV-8A Harrier. This single seat, VTOL aircraft has been assigned to Marine aviation units. (See fig. 2-3.)

This unique attack aircraft has the capability to operate from unprepared fields and requires little takeoff and landing area due to its ability to land and take off vertically.

Maximum speed of the Harrier is listed at 625 knots with a range of 1,800 miles.

Air Controlmen should remain abreast of current and future developments relative to naval aircraft by referring to such periodicals as Naval Aviation News and other similar publications.

For more detailed information concerning specific flight characteristics of naval aircraft, the AC is urged to consult the appropriate NATOPS Flight Manual which is published for every aircraft in the Navy's inventory.

CHAPTER 3

FEDERAL AIR REGULATIONS

Pilots of naval aircraft must comply with Federal Air Regulations. Although the AC is not directly concerned with the physical operation of an aircraft, he must, nonetheless, have a knowledge of the regulations which govern such operations. Based on this knowledge, the AC is able to issue instructions and information which allow pilots to operate aircraft in conformance with both the ATC instructions and the FARs. Additionally, FARs contain the general operating rules for holders of control tower operator certificates and facility ratings.

The study of this chapter is intended to provide the Air Controlman with a knowledge of air traffic rules and regulations. Only those parts, subparts, or certain paragraphs of FAR which the Air Controlman needs to know in his work are reprinted in this chapter. Additions, deletions, and explanations to FAR within the text have been made for clarification only.

This chapter is NOT intended to replace, substitute for, or supersede official regulations or directives which should be consulted for latest changes and final authority.

NOTE: FAR, Part I definitions and abbreviations may be found in appendix III of this manual.

Rules of construction in this chapter, unless the context requires otherwise, shall be as follows:

1. Words importing the singular include the plural;

2. Words importing the plural include the singular;

3. Words importing the masculine gender include the feminine;

4. "Shall" is used in an imperative sense;

5. "May" is used in a permissive sense to state authority or permission to do the act prescribed, and the words "no person may ..." or "a person may not ..." mean that no person is required, authorized, or permitted to do the act prescribed; and

6. "Includes" means "includes but is not limited to".

FAR, PART 65—CERTIFICATION

This part prescribes the requirements for issuing air traffic control tower operators certificates and associated ratings and the general operating rules for the holders of such certificates and ratings.

65.11 APPLICATION AND ISSUE

(a) An application for a certificate and rating, or for an additional rating, under this Part is made on a form and in a manner prescribed by the Administrator.

(b) An applicant who meets the requirements of this Part is entitled to an appropriate certificate and rating.

(c) Unless authorized by the Administrator, a person whose air traffic control tower operator certificate is suspended may not apply for any rating to be added to that certificate during the period of suspension.

(d) Unless the order of revocation provides otherwise, a person whose air traffic control tower operator certificate is revoked may not apply for the same kind of certificate for 1 year after the date of revocation.

65.13 TEMPORARY CERTIFICATE

A certificate and rating effective for a period of not more than 90 days may be issued to a qualified applicant, pending review of his application and supplementary documents and the issue of the certificate and ratings for which he applied.

A temporary airman certificate is shown in figure 3-1.

65.15 DURATION OF CERTIFICATES

(a) An air traffic control tower operator certificate or rating issued under this Part is effective until it is surrendered, suspended, or revoked.

(b) The holder of any certificate issued under this Part that is suspended or revoked shall, upon the Administrator's request, return it to the Administrator.

65.16 CHANGE OF NAME: REPLACEMENT OF LOST OR DESTROYED CERTIFICATE

(a) An application for a change of name on a certificate issued under this Part must be accompanied by the applicant's current certificate and the marriage license, court order, or other document verifying the change. The documents are returned to the applicant after inspection.

(b) An application for a replacement of a lost or destroyed certificate is made by letter to the Department of Transportation, Federal Aviation Administration, Airman Certification Branch, P.O. Box 25082, Oklahoma City, Okla. 73125. The letter must:

(1) Contain any available information regarding the grade, number and date of issue of the certificate, the name in which it was issued, and the ratings on it; and

(2) Be accompanied by a check or money order for $2.00, payable to the FAA.

(c) An application for replacement of a lost or destroyed medical certificate is made by letter to the Department of Transportation, Federal Aviation Administration, Civil Aeromedical Institute, Aeromedical Certification Branch, P.O. Box 25082, Oklahoma City, Okla. 73125, accompanied by a check or money order for $2.00.

(d) A person whose certificate issued under this Part or medical certificate, or both, has been lost may obtain a telegram from the FAA confirming that it was issued. The telegram may be carried as a certificate for a period not to exceed 60 days pending his receiving a duplicate certificate under paragraph (b) or (c) of this section, unless he has been notified that the certificate has been suspended or revoked. The request for such a telegram may be made by prepaid telegram, stating the date upon which a duplicate certificate was requested, or including the request for a duplicate and a money order for the necessary amount. The request for a telegraphic certificate should be sent to the office prescribed in paragraph (b) or (c) of this section, as appropriate. However, a request for both at the same time should be sent to the office prescribed in paragraph (b) of this section.

65.17 TEST; GENERAL PROCEDURE

(a) Tests prescribed by or under this Part are given at times and places, and by persons, designated by the Administrator.

(b) The minimum passing grade for each test is 70 percent.

65.19 RETESTING AFTER FAILURE

An applicant who fails a written, oral, or practical test for a certificate and rating, or for an additional rating, under this Part may apply for retesting—

(a) After 30 days after the date he failed the test; or

(b) Upon presenting a statement from a certificated and appropriately rated ground instructor or air traffic control tower operator, certifying that he has given the applicant at least 5 hours of additional instruction in each of the subjects failed and now considers that the applicant is ready for retesting for the air traffic control tower operator certificate.

65.20 FRAUDULENT OR FALSE STATEMENTS OR RECORDS

(a) No person may make or cause to be made:

(1) Any fraudulent or intentionally false statement on any application for a certificate or rating under this Part;

(2) Any reproduction, for fraudulent purpose, or any certificate or rating under this Part; or

(3) Any alteration of any certificate or rating under this Part.

(b) The commission by any person of an act prohibited under paragraph (a) of this section is a basis for suspending or revoking any certificate or rating held by that person.

I. UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION—FEDERAL AVIATION ADMINISTRATION
II. TEMPORARY AIRMAN CERTIFICATE
III. CERTIFICATE NO PENDING

THIS CERTIFIES THAT IV. JOHN ROCHESTER DOE
V. 3421 SEVENTH STREET
OKLAHOMA CITY, OKLAHOMA 73101

DATE OF BIRTH	HEIGHT	WEIGHT	HAIR	EYES	SEX	NATIONALITY VI.
7/7/56	71 IN.	180	BROWN	BLUE	M	U. S. A.

IX. has been found to be properly qualified and is hereby authorized in accordance with the conditions of issuance on the reverse of this certificate to exercise the privileges of

Control Tower Operator

RATINGS AND LIMITATIONS
XII. TINKER TOWER, MIDWEST CITY, OKLAHOMA

XIII. PAR ONLY

THIS IS ☒ AN ORIGINAL ISSUANCE ☐ A REISSUANCE OF THIS GRADE OF CERTIFICATE
DATE OF SUPERSEDED AIRMAN CERTIFICATE

BY DIRECTION OF THE ADMINISTRATOR

X. DATE OF ISSUANCE 8/8/75
X. SIGNATURE OF EXAMINER OR INSPECTOR ROGER JONES
EXAMINER'S DESIGNATION NO. OR INSPECTOR'S REG. NO. 2-100
DATE DESIGNATION EXPIRES USAF

VII. AIRMAN'S SIGNATURE

FAA Form 8060-4 (1-67) FORMERLY FAA FORM 1719T

201.133

Figure 3-1.—Temporary airman certificate.

65.21 CHANGE OF ADDRESS

Within 30 days after any change in his permanent mailing address, the holder of a certificate issued under this Part shall notify the Department of Transportation, Federal Aviation Administration, Airman Certification Branch, P.O. Box 25082, Oklahoma City, Okla. 73125, in writing, of his new address.

65.31 REQUIRED CERTIFICATION AND RATING

No person may act as an air traffic control tower operator at an air traffic control tower in connection with civil aircraft unless he—

(a) Holds an air traffic control tower operator certificate issued to him under this subpart; and

(b) Holds a facility rating for that control tower issued to him under this subpart, or has qualified for the operating position at which he acts and is under the supervision of the holder of a facility rating for that control tower. For the purpose of this subpart, "operating position" means an air traffic control function performed within or directly associated with the control tower. Figure 3-2 is an example of a CTO and Facility Rating.

NOTE: OPNAV Instruction 3721.1 (Series) promulgates the applicability of these regulations to Navy Air Controlmen.

65.33 ELIGIBILITY REQUIREMENTS

To be eligible for an air traffic control tower operator certificate a person must—

(a) Be at least 18 years of age;

(b) Be of good moral character;

(c) Be able to read, write, and understand the English language and speak it without accent or impediment of speech that would interfere with two-way radio conversation;

(d) Hold at least a second-class medical certificate issued under Part 67 of this chapter within the 12 months before the date he applies; and

(e) Comply with section 65.35.

65.35 KNOWLEDGE REQUIREMENTS

Each applicant for an air traffic control tower operator certificate must pass a written test on—

(a) The flight rules in Part 91 of this chapter;

(b) Airport traffic control procedures, and this subpart;

(c) En route traffic control procedures;

(d) Communications operating procedures;

(e) Flight assistance service;

(f) Air navigation, and aids to air navigation; and

(g) Aviation weather.

65.37 SKILL REQUIREMENTS: OPERATING POSITIONS

No person may act as an air traffic control tower operator at any operating position unless he has passed a practical test on—

(a) Control tower equipment and its use;

(b) Weather reporting procedures and use of reports;

(c) Notices to Airmen, and use of the Airman's Information Manual;

(d) Use of operational forms;

(e) Performance of noncontrol operational duties; and

(f) Each of the following procedures that is applicable to that operating position and is required by the person examining him:

(1) The airport, including rules, equipment, runways, taxiways, and obstructions.

I. UNITED STATES OF AMERICA XI.
DEPARTMENT OF TRANSPORTATION-FEDERAL AVIATION ADMINISTRATION
FEDERAL AVIATION ADMINISTRATION

THIS CERTIFIES THAT IV. THURMAN MARK HITCHCOCK
V. 303 EDGEWOOD AVENUE
MCMINNVILLE TENN 37110

DATE OF BIRTH	HEIGHT	WEIGHT	HAIR	EYES	SEX	NATIONALITY
12-27-52	72 IN	165	BLOND	BROWN	M	USA VI.

IX. HAS BEEN FOUND TO BE PROPERLY QUALIFIED TO EXERCISE THE PRIVILEGES OF

II. CONTROL TOWER OPERATOR III. CERT. NO. 2057357

RATINGS AND LIMITATIONS

XII. NAVAL AIR STATION TOWER MEMPHIS, TENN

XIII.
VII. T Mark Hitchcock X. N C. Bayer
SIGNATURE OF HOLDER ADMINISTRATOR

X. DATE OF ISSUE. 12-18-75 VIII.

AC FORM 8060-1 113691 SUPERSEDES PREVIOUS EDITION

Figure 3-2.—CTO and Facility Rating. 201.134

(2) The control zone, including terrain features, visual checkpoints, and obstructions.

(3) Traffic patterns and associated procedures for use of preferential runways and noise abatement.

(4) Operational agreements.

(5) The center, alternate airports, and those airways, routes, reporting points, and air navigation aids used for terminal air traffic control.

(6) Search and rescue procedures.

(7) Terminal air traffic control procedures and phraseology.

(8) Holding procedures, prescribed instrument approach, and departure procedures.

(9) Radar alignment and technical operation.

(10) The application of the prescribed radar and nonradar separation standard, as appropriate.

65.39 PRACTICAL EXPERIENCE REQUIREMENTS: FACILITY RATING

Each applicant for a facility rating at any air traffic control tower must have satisfactorily served—

(a) As an air traffic control tower operator at that control tower without a facility rating for at least 6 months; or

(b) As an air traffic control tower operator with a facility rating at a different control tower for at least 6 months before the date he applies for the rating.

A member of the Armed Forces of the United States meets the requirements of this section if he has satisfactorily served as an air traffic control tower operator for at least 6 months.

65.41 SKILL REQUIREMENTS: FACILITY RATING

Each applicant for a facility rating at an air traffic control tower must have passed a practical test on each item listed in section 65.37 of this part that is applicable to each operating position at the control tower at which the rating is sought.

65.45 PERFORMANCE OF DUTIES

(a) An air traffic control tower operator shall perform his duties in accordance with the limitations on his certificate and the procedures and practices prescribed in air traffic control manuals of the FAA, to provide for the safe, orderly, and expeditious flow of air traffic.

(b) An operator with a facility rating may control traffic at any operating position at the control tower at which he holds a facility rating. However, he may not issue air traffic clearance for IFR flight without authorization from the appropriate facility exercising air traffic control at that location.

(c) An operator who does not hold a facility rating for a particular control tower may act at each operating position for which he has qualified, under the supervision of an operator holding a facility rating for that control tower.

65.47 MAXIMUM HOURS

Except in an emergency, a certificated air traffic control tower operator must be relieved of all duties for at least 24 consecutive hours at least once during each 7 consecutive days. Such an operator may not serve or be required to serve—

(a) For more than 10 consecutive hours; or

(b) For more than 10 hours during a period of 24 consecutive hours, unless he has had a rest period of at least 8 hours at or before the end of the 10 hours of duty.

65.49 GENERAL OPERATING RULES

(a) No person may act as an air traffic control tower operator under a certificate issued to him under this part unless he has in his personal possession an appropriate current medical certificate issued under Part 67 of this chapter.

(b) Each person holding an air traffic control tower operator certificate shall keep it readily available when performing duties in an air traffic control tower, and shall present that certificate or his medical certificate or both for inspection upon the request of the Administrator or an authorized representative of the National Transportation Safety Board, or of any Federal, State, or local law enforcement officer.

(c) A certificated air traffic control tower operator who does not hold a facility rating for a particular control tower may not act at any operating position at the control tower concerned unless there is maintained at that control tower, readily available to persons named in paragraph (b), a current record of the operating positions at which he has qualified.

(d) An air traffic control tower operator may not perform duties under his certificate during any period of known physical deficiency that would make him unable to meet the physical requirements for his current medical certificate. However, if the deficiency is temporary, he may perform duties that are not affected by it whenever another certificated and qualified operator is present and on duty.

(e) A certificated air traffic control tower operator may not control air traffic with equipment that the Administrator has found to be inadequate.

(f) The holder of an air traffic control tower operator certificate, or an applicant for one, shall, upon the reasonable request of the Administrator, cooperate fully in any test that is made of him.

65.50 CURRENCY REQUIREMENTS

The holder of an air traffic control tower operator certificate may not perform any duties under that certificate unless—

(a) He has served for at least 3 of the preceding 6 months as an air traffic control tower operator at the control tower to which his facility rating applies, or at the operating positions for which he has qualified; or

(b) He has shown that he meets the requirements for his certificate and facility rating at the control tower concerned, or for operating at positions for which he has previously qualified.

FAR, PART 71—DESIGNATION OF

71.3 FEDERAL AIRWAYS

Federal airways are classified as follows:

(a) Colored Federal airways—

(1) Green Federal airways.
(2) Amber Federal airways.
(3) Red Federal airways.
(4) Blue Federal airways.

(b) VOR Federal airways.

Each Federal airway is based on a centerline that extends from one navigation aid or intersection to another navigation aid (or through several navigation aids or intersections) specified for that airway.

Unless otherwise specified, each Federal airway includes the airspace within parallel boundary lines 4 nautical miles each side of the centerline. Where an airway changes direction, it includes the airspace that is enclosed by extending the boundary lines of the airway segments until they meet.

Unless otherwise specified, each Federal airway includes the airspace that extends upward from 1,200 feet above the surface of the earth to, but not including, 18,000 feet MSL, except that Federal airways for Hawaii have no upper limits. Variations of the lower limits of an airway are expressed in hundreds of feet above the surface (AGL) or mean sea level (MSL) and, unless otherwise specified, apply to the segment of an airway between adjoining navigational aids or intersections.

The airspace of a Federal airway within the lateral limits of a transition area has a floor coincident with that of the transition area.

One or more alternate airways may be designated between specified navigational aids or intersections along each VOR Federal airway. Unless otherwise specified, the centerline of an alternate VOR Federal airway and the centerline of the main VOR Federal airway are separated by 15°.

A Federal airway does not include the airspace of a prohibited area.

71.7 CONTROL AREAS

Control areas consist of Federal airways, additional control areas, and control area extensions, but do not include the continental control area. Unless otherwise designated, control areas include the airspace between a segment of a main VOR Federal airway and its associated alternate segments with the vertical extent of the area corresponding to the vertical extent of the related segment of the airway.

71.9 CONTINENTAL CONTROL AREA

The continental control area consists of the airspace of the 48 contiguous states, the District of Columbia, and Alaska excluding the Alaska peninsula west of longitude 160 degrees west, at and above 14,500 MSL, but does not include—

(a) The airspace less than 1,500 feet above the surface of the earth; or

(b) Prohibited and restricted areas, other than restricted area military climb corridors and the restricted areas listed in 71.151. Part 71.151 is not printed in this training manual.

71.11 CONTROL ZONES

Control zones consist of controlled airspace which extends upwards from the surface of the earth and terminates at the base of the continental control area. Control zones that do not underlie the continental control area have no upper limit. A control zone is normally a circular area with a radius of 5 miles and any extensions necessary to include instrument approach and departure paths.

71.12 TERMINAL CONTROL AREAS

A terminal control area (TCA) consists of controlled airspace extending upward from the surface or higher to specified altitudes, within which all aircraft are subject to operating rules and pilot and equipment requirements specified in Part 91 of the FARs. Each such location is designated as a Group I, II, or III terminal control area, and includes at least one primary airport around which the TCA is located.

TCAs are assigned to a particular group commensurate with the volume of traffic and passengers carried.

71.13 TRANSITION AREAS

Transition areas consist of controlled airspace extending upward from 700 feet or more above the surface of the earth when designated in conjunction with an airport for which an approved instrument approach procedure has been prescribed; or from 1,200 feet or more above the surface of the earth when designated in conjunction with airway route structures or segments. Unless otherwise specified, transition areas terminate at the base of the overlying controlled airspace.

71.17 REPORTING POINTS

Reporting points consist of geographic locations, in relation to which the position of an aircraft must be reported in accordance with 91.125.

FAR, PART 73—SPECIAL USE AIRSPACE

73.3 DEFINITIONS OF SPECIAL USE AIRSPACE

(a) Special use airspace consists of airspace of defined dimensions identified by an area on the surface of the earth wherein activities must be confined because of their nature, or wherein limitations are imposed upon aircraft operations that are not a part of those activities, or both.

(b) The vertical limits of special use airspace are measured by designated altitude floors and ceilings expressed as flight levels or as feet above mean sea level.

(c) The horizontal limits of special use airspace are measured by boundaries described by geographic coordinates or other appropriate references that clearly define their perimeter.

(d) The period of time during which a designation of special use airspace is in effect is stated in the designation.

(e) Special use airspace includes the following types of areas and restrictions, which are published on aeronautical charts and in aeronautical publications:

(1) Prohibited area—Flights are prohibited except by special permission.

(2) Restricted area—Flights are prohibited between the designated altitudes and during the time of designation, unless prior permission is obtained from the "using agency," or the "controlling agency."

(3) Warning area—Flights are not restricted, but avoidance is advised during periods of special use.

(4) Alert area—Flights are not restricted, but pilots should be aware that a high volume of pilot training and/or unusual type of aerial activity takes place in this area.

(5) Also included under the general heading of special use airspace are Intensive Student Jet Training Areas (ISJTA) and military training routes.

NOTE: A tabulation of these areas is contained in FLIP Planning, AP/1A.

73.15 USING AGENCY

(a) For the purposes of this Part, the following are using agencies:

(1) The agency, organization, or military command whose activity within a restricted area necessitated the area being so designated.

(2) In the case of a Restricted Area/Military Climb Corridor that does not have a designated controlling agency, the Military Air Traffic Control facility may be contacted for permission for transit through the climb corridor.

(b) Upon the request of the FAA, the using agency shall execute a letter establishing procedures for joint use of a restricted area by the using agency and the controlling agency, under which the using agency would notify the controlling agency whenever the controlling agency may grant permission for transit through the restricted area in accordance with the terms of the letter.

(c) The using agency shall—

(1) Schedule activities within the restricted area;

(2) Authorize transit through, or flight within, the restricted area as feasible; and

(3) Contain within the restricted area all activities conducted therein in accordance with the purpose for which it was designated.

73.17 CONTROLLING AGENCY

For the purposes of this Part, the controlling agency is the FAA facility that may authorize transit through or flight within a restricted area in accordance with a joint-use letter issued under 73.15.

FAR, PART 75—JET ROUTES

75.1 APPLICABILITY

Routes between high altitude navigational aids or intersections of their signals are designated as jet routes along which aircraft may be operated between 18,000 feet MSL and flight level 450. Certain areas are designated as jet advisory areas along specified jet route segments, VOR/VORTAC radials, bearings from L/MF navigational facilities, direct courses between high altitude navigational facilities, centerlines of control areas, or in the vicinity of specific geographical locations.

75.11 JET ROUTES

Each jet route consists of a direct course for navigating aircraft between 18,000 feet MSL and flight level 450, inclusive, between the navigational aids and intersections specified for that route.

75.15 JET ADVISORY AREAS

(a) Jet advisory areas consist of airspace as designated, within the continental control area.

(b) En route radar jet advisory areas consist of areas within which jet advisory service is provided by using radar. Unless otherwise designated, each of them includes the area within 14 miles on each side of the jet route segment from flight level 240 through flight level 410, inclusive.

(c) Terminal radar jet advisory areas consist of areas in which jet advisory service is provided by using radar. Unless otherwise designated, each of them includes the area within 14 miles on each side of the VOR/VORTAC radials, bearings from L/MF navigational facilities, direct courses between navigational facilities, or centerlines of control areas from flight level 240 through flight level 410, inclusive.

(d) Nonradar jet advisory areas consist of areas within which jet advisory service is provided on a procedural basis without the use of radar. Unless otherwise designated, each of them includes the area within 14 miles on each side of the jet route segment from flight level 270 through flight level 310, inclusive, and from flight level 370 through flight level 410, inclusive.

(e) Jet advisory areas do not include the airspace within positive control areas, prohibited areas, or restricted areas except restricted area military climb corridors and other restricted areas so specified.

(f) Jet advisory areas that are based on jet routes are identified by the associated jet route number. Those based on VOR/VORTAC radials, bearings from L/MF navigational facilities, direct courses between navigational facilities, or centerlines of control areas and those in the vicinity of geographical locations, are identified by geographical names.

FAR, PART 91—GENERAL OPERATING AND FLIGHT RULES

GENERAL

91.1 Applicability.

(a) Except as provided in paragraph (b) of this section, this Part prescribes rules governing the operation of aircraft (other than moored balloons, kites, unmanned rockets, and unmanned free balloons) within the United States.

(b) Each person operating an aircraft of U.S. registry in air commerce over the high seas shall comply with Annex 2 (Rules of the Air) to the convention on International Civil Aviation.

91.3 Responsibility and authority of the pilot in command.

(a) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft.

(b) In an emergency requiring immediate action, the pilot in command may deviate from any rule of this subpart or of Subpart B to the extent required to meet that emergency.

(c) Each pilot in command who deviates from a rule under paragraph (b) of this section shall, upon the request of the Administrator, send a written report of that deviation to the Administrator.

91.5 Preflight action.

Each pilot in command shall, before beginning a flight, familiarize himself with all available information concerning that flight. This information must include:

(a) For a flight under IFR or a flight not in the vicinity of an airport, weather reports and forecasts, fuel requirements, alternatives available if the planned flight cannot be completed, and any known traffic delays of which he has been advised by ATC.

(b) For any flight, runway lengths at airports of intended use.

91.7 Flight crewmembers at stations.

During takeoff and landing, and while en route, each required flight crewmember shall—

(a) Be at his station unless his absence is necessary in the performance of his duties in connection with the operation of the aircraft or in connection with his physiological needs; and

(b) Keep his seat belt fastened while at his station.

91.8 Prohibition against interference with crewmembers.

(a) No person may assault, threaten intimidate, or interfere with a crewmember in the performance of his duties aboard an aircraft being operated in air commerce.

(b) No person may attempt to cause or cause the flight crew of an aircraft being operated in air commerce to divert its flight from its intended course, or destination.

FLIGHT RULES

91.61 Applicability.

This subpart prescribes flight rules governing the operation of aircraft within the United States.

91.63 Waivers.

(a) The Administrator may issue a certificate of waiver authorizing the operation of aircraft in deviation of any rule of this subpart if he finds that the proposed operation can be safely conducted under the terms of that certificate of waiver.

(b) An application for a certificate of waiver under this section is made on a form and in a manner prescribed by the Administrator and may be submitted to any FAA office.

(c) A certificate of waiver is effective as specified in that certificate.

91.65 Operating near other aircraft.

(a) No person may operate an aircraft so close to another aircraft as to create a collision hazard.

(b) No person may operate an aircraft in formation flight except by arrangement with the pilot in command of each aircraft in the formation.

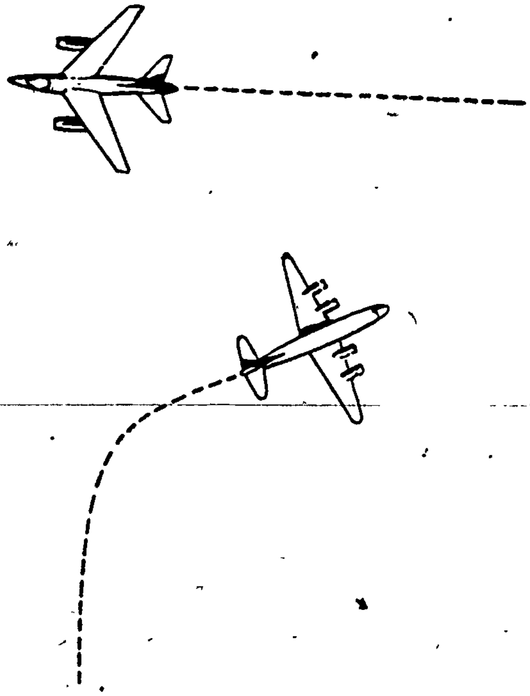
(c) No person may operate an aircraft, carrying passengers for hire, in formation flight.

(d) Unless otherwise authorized by ATC, no person operating an aircraft may operate his aircraft in accordance with any clearance or instruction that has been issued to the pilot of another aircraft for radar air traffic control purposes.

91.67 Right-of-way rules; except water operations.

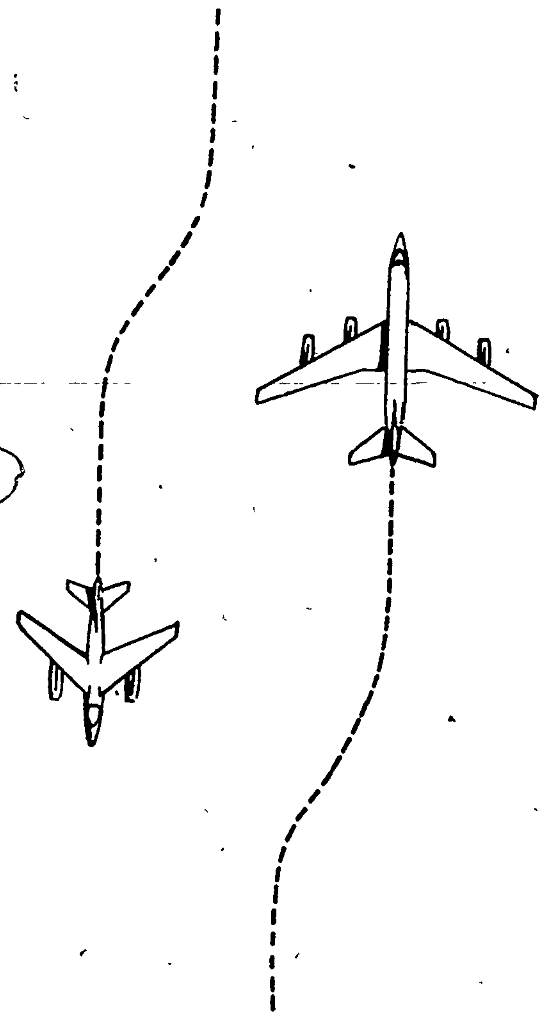
(a) General. When weather conditions permit, regardless of whether an operation is conducted under IFR or VFR, vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft in compliance with this section. When a rule of this section gives another aircraft the right of way, he shall give way to that aircraft and may not pass over, under, or ahead of it, unless well clear.

(b) In distress. An aircraft in distress has the right of way over all other air traffic.



201.121

Figure 3-3.—Converging aircraft.



201.122

Figure 3-4.—Aircraft approaching head-on.

(c) Converging. When aircraft of the same category are converging at approximately the same altitude (except head-on, or nearly so) the aircraft to the other's right has the right of way. (See figure 3-3.) If the aircraft are of different categories—

(1) A balloon has the right of way over any other category of aircraft;

(2) A glider has the right of way over an airship, airplane or rotorcraft; and

(3) An airship has the right of way over an airplane or rotorcraft.

However, an aircraft towing or refueling other aircraft has the right of way over all other engine-driven aircraft.

(d) Approaching head-on. When aircraft are approaching each other head-on, or nearly so, each pilot of each aircraft shall alter course to the right. (See fig. 3-4.)

(e) Overtaking. Each aircraft that is being overtaken has the right of way and each pilot of an overtaking aircraft shall alter course to the right to pass well clear. (See fig. 3-5.)

NOTE: Passing an overtaken aircraft on the right is required because the pilot in side-by-side, dual-control aircraft is seated on the left and has a better view on that side. Further, in narrow traffic lanes, passing on the left of an overtaken aircraft would place the overtaking aircraft in the path of oncoming traffic.

(f) Landing. Aircraft, while on final approach to land, or while landing, have the right of way over other aircraft in flight or operating on the surface. When two or more aircraft are approaching an airport for the purpose of landing, the aircraft at the lower altitude has the right of way, but it shall not take advantage of this rule to cut in front of another which is on final approach to land, or to overtake that aircraft.

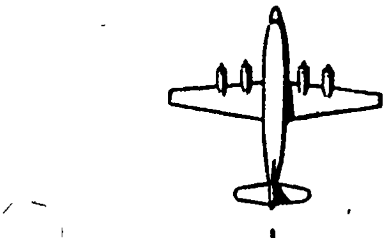
(g) Inapplicability. This section does not apply to the operation of an aircraft on water.

91.70 Aircraft speed.

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

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

(1) In the case of reciprocating engine aircraft, 156 knots (180 mph).



201.123

Figure 3-5.—Aircraft overtaking another.

(2) In the case of turbine-powered aircraft, 200 knots (230 mph).

(c) No person may operate aircraft in the airspace beneath the lateral limits of any terminal control area at an indicated airspeed of more than 200 knots (230 mph).

However, if the minimum safe airspeed for any particular operation is greater than the maximum speed prescribed in this section, the aircraft may be operated at that minimum speed.

91.71 Acrobatic flight.

No person may operate an aircraft in acrobatic flight—

(a) Over any congested area of a city, town or settlement;

(b) Over an open air assembly of persons;

(c) Within a control zone or Federal airway;

(d) Below an altitude of 1,500 feet above the surface; or

(e) When flight visibility is less than 3 miles.

For the purpose of this paragraph, acrobatic flight means an intentional maneuver involving an abrupt change in an aircraft's attitude, an abnormal attitude, or an abnormal acceleration, not necessary for normal flight.

91.73 Aircraft lights.

No person may, during the period from sunset to sunrise (or, in Alaska, during the period a prominent unlighted object cannot be seen from a distance of 3 statute miles or the sun is more than 6 degrees below the horizon)—

(a) Operate an aircraft unless it has lighted position lights;

(b) Park or move an aircraft in, or in dangerous proximity to, a night flight operations area of an airport unless the aircraft—

(1) Is clearly illuminated;

(2) Has lighted position lights; or

(3) Is in an area which is marked by obstruction lights; or

(c) Anchor an aircraft unless the aircraft—

(1) Has lighted anchor lights; or

(2) Is in an area where anchor lights are not required on vessels.

91.75 Compliance with ATC clearances and instructions.

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

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

(c) Each pilot in command who deviates, in an emergency, from an ATC clearance or instruction shall notify ATC of that deviation as soon as possible.

(d) Each pilot in command who (though not deviating from a rule of this subpart) is given priority by ATC in an emergency, shall, if requested by ATC, submit to the chief of that ATC facility a detailed report of that emergency within 48 hours.

91.77 ATC light signals.

NOTE: ATC light signals have the meaning shown in table 11-1 of this manual.

91.79 Minimum safe altitudes; general.

Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:

(a) Anywhere. An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface. (See fig. 3-6.)

(b) Over congested areas. Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft. (See fig. 3-7.)

(c) Over other than congested areas. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In that case the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure. (See fig. 3-8.)

(d) Helicopters. Helicopters may be operated at less than the minimums prescribed in paragraphs (b) or (c) of this section if the operation

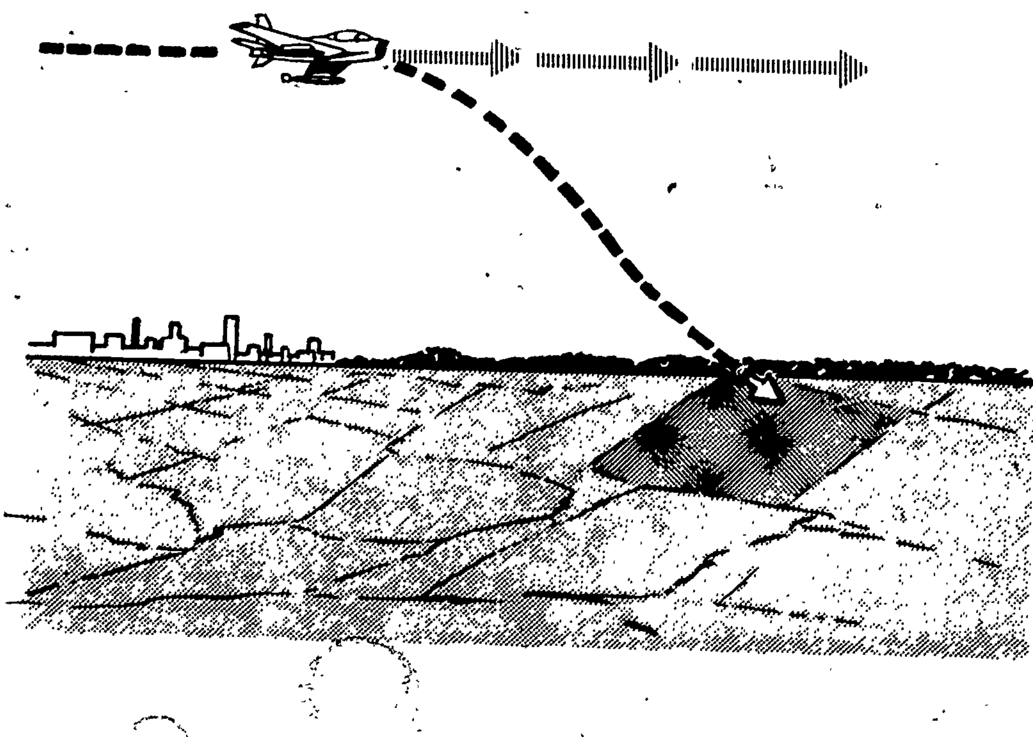
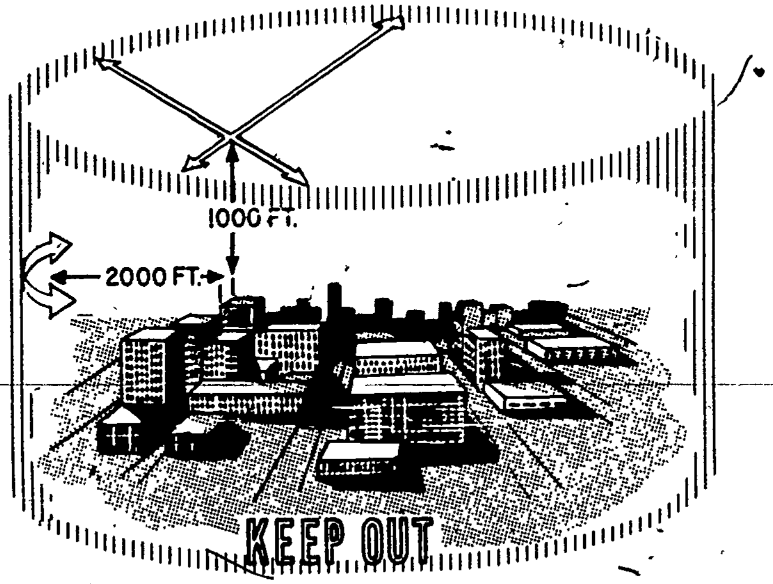


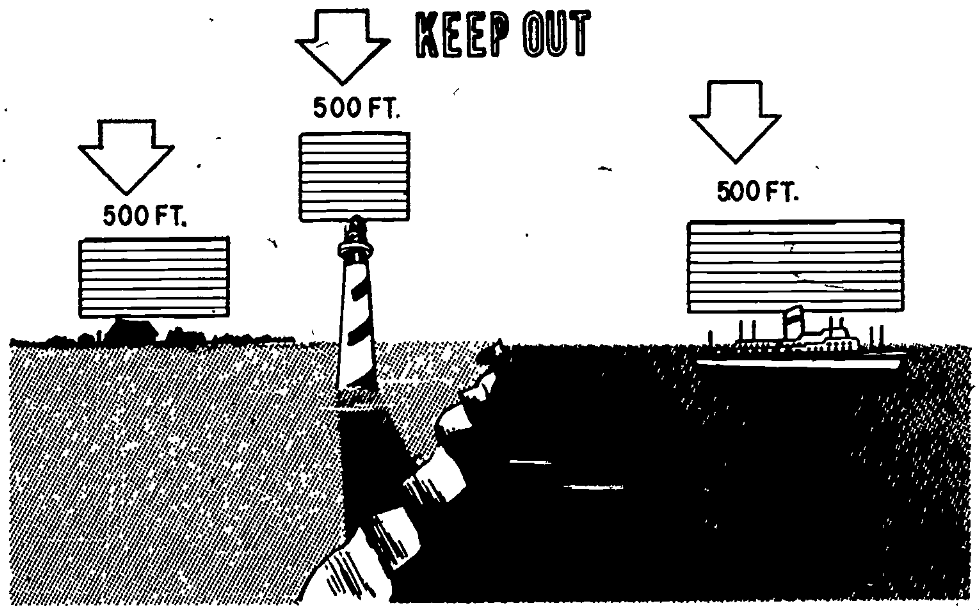
Figure 3-6.—Minimum safe altitudes-anywhere.

201.124



201.125

Figure 3-7.—Minimum safe altitude over congested areas.



201.126

Figure 3-8.—Minimum safe altitude over other than congested areas.

is conducted without hazard to persons or property on the surface. In addition, each person operating a helicopter shall comply with routes or altitudes specifically prescribed for helicopters by the Administrator.

91.81 Altimeter settings.

(a) Each person operating an aircraft shall maintain that aircraft's cruising altitude or flight level, as the case may be, by reference to an altimeter that is set, when operating—

(1) Below 18,000 feet MSL, to—

(i) The current reported altimeter setting of a station along the route and within 100 nautical miles of the aircraft;

(ii) If there is no station within the area prescribed in subdivision (i) of this subparagraph, the current reported altimeter setting of an appropriate available station; or

(iii) In the case of an aircraft not equipped with a radio, the elevation of the departure airport or an appropriate altimeter setting available before departure; or

(2) At or above 18,000 feet MSL, to 29.92" Hg.

(b) The lowest usable flight level is determined by the atmospheric pressure in the area of operation, as shown in the following listing:

Altimeter setting (Current reported)	Lowest usable flight level
29.92 or higher	180
29.91 to 29.42	185
29.41 to 28.92	190
28.91 to 28.42	195
28.41 to 27.92	200
27.91 to 27.42	205
27.41 to 26.92	210

(c) To convert minimum safe altitude to minimum flight level, the pilot should add the appropriate number of feet specified below, according to the current altimeter setting, to the flight level equivalent of the minimum safe altitude.

29.92 (or higher)	None
29.91 to 29.42	500 feet
29.41 to 28.92	1,000 feet
28.91 to 28.42	1,500 feet
28.41 to 27.92	2,000 feet
27.91 to 27.42	2,500 feet
27.41 to 26.92	3,000 feet

91.85 Operating on or in the vicinity of an airport; general rules.

(a) Unless otherwise required by Part 93 (Special air traffic rules and airport traffic patterns), each person operating an aircraft on or in the vicinity of an airport shall comply with the requirements of this section and of 91.87 and 91.89.

(b) Unless otherwise authorized or required by ATC, no person may operate an aircraft within an airport traffic area except for the purpose of landing at, or taking off from, an airport within that area. ATC authorizations may be given as individual approval of specific operations or may be contained in written agreements between airport users and the tower concerned.

91.87 Operation at airports with operating control towers.

(a) General. Unless otherwise authorized or required by ATC, each person operating an aircraft to, from, or on an airport with an operating control tower shall comply with the applicable provisions of this section.

(b) Communications with control towers operated by the United States. No person may, within an airport traffic area, operate an aircraft to, from, or on an airport having a control tower operated by the United States unless two-way radio communications are maintained between that aircraft and the control tower. However, if the aircraft radio fails in flight, he may operate that aircraft and land if weather conditions are at or above basic VFR weather minimums, he maintains visual contact with the tower, and he receives a clearance to land. If the aircraft radio fails while in flight under IFR, he must comply with 91.127.

(c) Communications with other control towers. No person may, within an airport traffic area operate an aircraft to, from, or on an airport having a control tower that is operated by any person other than the United States unless—

(1) If that aircraft's radio equipment so allows, two-way radio communications are maintained between the aircraft and the tower; or

(2) If that aircraft's radio equipment allows only reception from the tower, the pilot has the tower's frequency monitored.

(d) Minimum altitudes. When operating to an airport with an operating control tower, each pilot of—

(1) A turbine-powered airplane or a large airplane shall, unless otherwise required by the applicable distance from cloud criteria, enter the airport traffic area at an altitude of at least 1,500 feet above the surface of the airport and maintain at least 1,500 feet within the airport traffic area, including the traffic pattern, until further descent is required for a safe landing;

(2) A turbine-powered airplane or a large airplane approaching to land on a runway being served by an ILS, shall, if the airplane is ILS-equipped, fly that airplane at an altitude at or above the glide slope between the outer marker (or the point of interception with the glide slope, if compliance with applicable distance from clouds criteria requires interception closer in) and the middle marker; and

(3) An airplane approaching to land on a runway served by a visual approach slope indicator, shall maintain an altitude at or above the glide slope until a lower altitude is necessary for a safe landing.

However, subparagraphs (2) and (3) of this paragraph do not prohibit normal bracketing maneuvers above or below the glide slope that are conducted for the purpose of remaining on the glide slope.

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

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

(2) A helicopter, shall avoid the flow of fixed-wing aircraft.

(f) Departures. No person may operate an aircraft taking off from an airport with an operating control tower except in compliance with the following:

(1) Each pilot shall comply with any departure procedures established for that airport by the FAA.

(2) Unless otherwise required by the departure procedures or applicable distance from clouds criteria, each pilot of a large or turbine-powered airplane shall climb to an altitude of 1,500 feet above the surface as rapidly as practicable.

(g) Noise abatement runway system. When landing or taking off from an airport with an operating control tower, and for which a formal runway use program has been established by the FAA, each pilot of a turbine-powered airplane and each pilot of a large airplane, assigned a noise abatement runway by ATC, shall use that runway. However, each pilot has final authority and responsibility for the safe operation of his airplane and if he determines in the interest of safety that another runway should be used, ATC will assign that runway (air traffic and other conditions permitting).

(h) Clearances required. No pilot may, at an airport with an operating control tower, taxi an aircraft on a runway, or take off or land an aircraft on a movement area, unless he has received an appropriate clearance from ATC. A clearance to "taxi to" the runway is a clearance to cross all intersecting runways but is not a clearance to "taxi on" the assigned runway.

91.89 Operation at airports without control towers.

Each person operating an aircraft to or from an airport without an operating control tower shall—

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

(b) In the case of a helicopter approaching to land, avoid the flow of fixed-wing aircraft; and

(c) In the case of an aircraft departing the airport, comply with any FAA traffic pattern for that airport.

91.90 Flight in terminal control areas; operating rules and pilot and equipment requirements.

(a) Group I terminal control areas.

(1) Operating rules. No person may operate an aircraft within a Group I terminal control area designated in Part 71 of this chapter except in compliance with the following rules:

(i) No person may operate an aircraft within a Group I terminal control area unless he has received an appropriate authorization from ATC prior to the operation of that aircraft in that area.

(ii) Unless otherwise authorized by ATC, each person operating a large turbine engine powered airplane to or from a primary airport shall operate at or above the designated floors while within the lateral limits of the terminal control area.

(2) Pilot requirements. The pilot in command of a civil aircraft may not land or take off that aircraft from an airport within a Group I terminal control area unless he holds at least a private pilot certificate.

(3) Equipment requirements. Unless otherwise authorized by ATC in the case of inflight failure, no person may operate an aircraft within a Group I terminal control area unless that aircraft is equipped with—

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

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

(iii) An operable radar beacon transponder having at least a Mode A/3 64-code capability, replying to A/3 interrogation with the code specified by ATC. This requirement is not applicable to helicopters operating within the terminal control area, or to IFR flights to or from an airport other than the primary airport.

(b) Group II terminal control areas.

(1) Operating rules. No person may operate an aircraft within a Group II terminal control area designated in Part 71 of this chapter except in compliance with the following rules:

(i) No person may operate an aircraft within a Group II terminal control area unless he has received an appropriate authorization from ATC prior to the operation of that aircraft in that area.

(c) Group III terminal control areas. After July 1, 1975 no person may operate an aircraft within a Group III terminal control area designated in Part 71 unless the applicable provisions of 91.24(b) are complied with, except that such compliance is not required if two-way radio communications are maintained, within the TCA, between the aircraft and the ATC facility, and the pilot provides position, altitude, and proposed flight path prior to entry.

91.91 Temporary flight restrictions.

(a) Whenever the Administrator determines it to be necessary in order to prevent an unsafe congestion of sight-seeing aircraft above an incident or event which may generate a high degree of public interest, or to provide a safe environment for the operation of disaster relief aircraft, a Notice to Airmen will be issued designating an area within which temporary flight restrictions apply.

(b) When a Notice to Airmen has been issued under this section, no person may operate an aircraft within the designated area unless—

(1) That aircraft is participating in disaster relief activities and is being operated under the direction of the agency responsible for relief activities;

(2) That aircraft is being operated to or from an airport within the area and is operated so as not to hamper or endanger relief activities;

(3) That operation is specifically authorized under an IFR ATC clearance;

(4) VFR flight around or above the area is impracticable due to weather, terrain, or other considerations, prior notice is given to the Air Traffic Service facility specified in the Notice to Airmen, and en route operation through the area is conducted so as not to hamper or endanger relief activities; or

(5) That aircraft is carrying properly accredited news representatives, or persons on official business concerning the incident or event which generated the issuance of the Notice to Airmen; the operation is conducted in accordance with section 91.79 of this chapter; the operation is conducted above the altitudes being used by relief aircraft unless otherwise authorized by the agency responsible for relief activities; and further, in connection with this type of operation, prior to entering the area the operator has filed with the Air Traffic Service facility specified in the Notice to Airmen a flight plan that includes the following information:

(i) Aircraft identification, type and color.

(ii) Radio communications frequencies to be used.

(iii) Proposed times of entry and exit of the designated area.

(iv) Name of news media or purpose of flight.

(v) Any other information deemed necessary by ATC.

91.93 Flight test areas.

(a) No person may flight test an aircraft except over open water or sparsely populated areas having light air traffic.

91.95 Restricted and prohibited areas.

(a) No person may operate an aircraft within a restricted area (designated in Part 73) contrary to the restrictions imposed, or within a prohibited area, unless he has the permission of the using or controlling agency, as appropriate.

(b) Each person conducting, within a restricted area, an aircraft operation (approved by the using agency) that creates the same hazards as the operations for which the restricted area was designated, may deviate from the rules of this subpart that are not compatible with his operation of the aircraft.

91.97 Positive control areas.

(a) Except as provided in paragraph (b) of this section, no person may operate an aircraft within a positive control area designated in Part 71 unless that aircraft is—

(1) Operated under IFR at a specific altitude assigned by ATC;

(2) Equipped with instruments and equipment required for IFR operations and is flown by a pilot rated for instrument flight; and

(3) Equipped with—

(i) A coded radar beacon transponder, having a Mode A (military Mode 3) 64 code capability, replying to Mode 3/A interrogation with the code specified by ATC; and

(ii) A radio providing direct pilot/controller communication on the frequency specified by ATC for the area concerned.

(b) ATC may authorize deviations from the requirements of paragraph (a) of this section for operation in a positive control area. In the case of an inoperative transponder, ATC may immediately approve an operation allowing flight to continue to the ultimate destination, including any intermediate stops, or to proceed to a place where suitable repairs can be made, or both. A request for authorization to deviate from a requirement of this section must be submitted at least four days before the proposed operation, in writing, to the ATC center having jurisdiction over the positive control area concerned. ATC may authorize deviations on a continuing basis or for an individual flight, as appropriate.

91.99 Jet advisory areas.

(a) No person may operate an aircraft within a radar jet advisory area designated in Part 75 unless—

(1) That aircraft is operated under IFR at a specific altitude assigned by ATC; or

(2) If the aircraft is not so operated and—

(i) That aircraft is equipped with a functioning coded radar beacon transponder having a Mode A (military Mode 3) 64 code capability, that transponder is operated to reply to Mode 3/A interrogation with the code specified by ATC;

(ii) If that aircraft is not so equipped, it is operated under specific authorization from ATC; or

(iii) If radio failure prevents the receiving of that authorization, he maintains an appropriate VFR cruising flight level.

(b) No person may pilot an aircraft within a nonradar jet advisory area designated in Part 75 unless that aircraft is operated under—

(1) IFR at a specific altitude assigned by ATC; or

(2) Specific authorization from ATC.

91.102 Flight limitation in the proximity of space flight recovery operations.

No person may operate any aircraft of United States registry, or pilot any aircraft under the authority of an airman certificate issued by the FAA within areas designated in a NOTAM for space flight recovery operations except when authorized by ATC, or operated under the control of the DOD Manager for Manned Space Flight Support Operations.

91.104 Flight limitations in proximity of the Presidential Party.

No person may operate an aircraft, over or in the vicinity of areas to be visited or traveled by the President, the Vice President, or other public figures, contrary to the restrictions established by the Administrator and published in a Notice to Airman (NOTAM).

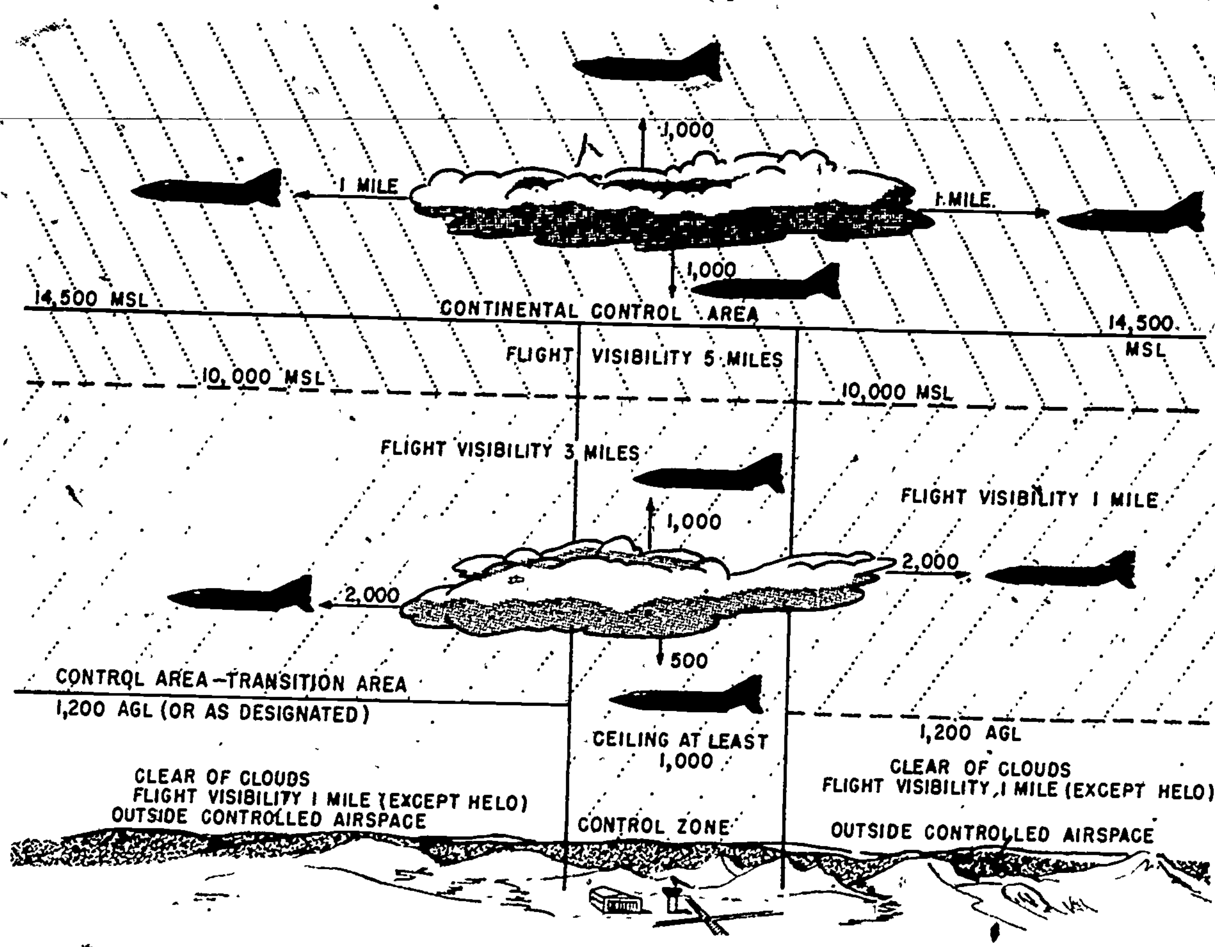


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Figure 3-9.—Basic VFR weather minimums.

VISUAL FLIGHT RULES

91.105 Basic VFR weather minimums.
(See fig. 3-9 and table 3-1.)

(a) Except as provided in 91.107, no person may operate an aircraft under VFR when the flight visibility is less, or at a distance from clouds that is less, than that prescribed for the corresponding altitude in table 3-1.

(b) When the visibility is less than 1 mile, a helicopter may be operated outside controlled airspace at 1,200 feet or less above the surface is operated at a speed that allows the pilot adequate opportunity to see any air traffic or other obstruction in time to avoid a collision.

(c) Except as provided in 91.107, no person may operate an aircraft, under VFR, within a control zone beneath the ceiling when the ceiling is less than 1,000 feet.

(d) Except as provided in 91.107, no person may takeoff or land an aircraft, or enter the traffic pattern of an airport under VFR within a control zone—

(1) Unless ground visibility at that airport is at least 3 statute miles; or

(2) If ground visibility is not reported at that airport, unless flight visibility during landing or takeoff, or while operating in the traffic pattern, is at least 3 statute miles.

(e) For the purpose of this section, an aircraft operating at the base altitude of a transition area or control area is considered to be within the airspace directly below that area.

91.107 Special VFR weather minimums.

(a) Except as provided in FAR 93.113 (Control zones within which special VFR weather minimums are not authorized), when a person has received an appropriate ATC clearance, the special weather minimums of this section instead of those contained in 91.105 apply to the operation of an aircraft by that person in a control zone under VFR.

(b) No person may operate an aircraft in a control zone under VFR except clear of clouds.

(c) No person may operate an aircraft (other than a helicopter) in a control zone under VFR unless flight visibility is at least 1 statute mile.

(d) No person may takeoff or land an aircraft (other than a helicopter) at any airport in a control zone under VFR—

(1) Unless ground visibility at that airport is at least 1 statute mile; or

(2) If ground visibility is not reported at that airport, unless the flight visibility during landing or takeoff is at least 1 statute mile.

91.109 VFR cruising altitude or flight level.

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

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

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

(2) On a magnetic course of 180 degrees through 359 degrees, any even thousand foot MSL altitude +500 feet (such as 4,500, 6,500, or 8,500).

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

Table 3-1.—Basic VFR weather minimums

Altitude	Flight visibility	Distance from clouds
1,200 feet or less above the surface (regardless of MSL altitude)—		
Within controlled airspace	3 statute miles	500 feet below. 1,000 feet above. 2,000 feet horizontal.
Outside controlled airspace	1 statute mile (except as in 91.105(B))	Clear of clouds.
More than 1,200 feet above the surface but less than 10,000 feet MSL—		
Within controlled airspace	3 statute miles	500 feet below. 1,000 feet above. 2,000 feet horizontal.
Outside controlled airspace	1 statute mile	500 feet below. 1,000 feet above. 2,000 feet horizontal.
More than 1,200 feet above the surface and at or above 10,000 feet MSL	5 statute miles	1,000 feet below. 1,000 feet above. 1 mile horizontal.

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

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

(c) When operating above flight level 290 and—

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

(2) On a magnetic course of 180 degrees through 359 degrees, any flight level at 4,000-foot intervals, beginning at and including flight level 320 (such as flight level 320, 360, or 400). (See fig. 3-10.)

INSTRUMENT FLIGHT RULES

91.115 ATC clearance and flight plan required.

No person may operate an aircraft in controlled airspace under IFR unless—

(a) He has filed an IFR flight plan; and

(b) He has received an appropriate ATC clearance.

91.116 Takeoff and landing under IFR: general.

(a) Instrument approaches to civil airports. Unless otherwise authorized by the Administrator (including ATC), each person operating an aircraft shall, when an instrument letdown to an airport is necessary, use a standard instrument approach procedure prescribed for that airport in Part 97.

(b) Landing minimums. Unless otherwise authorized by the Administrator, no person operating an aircraft (except a military aircraft of the United States) may land that aircraft using a standard instrument approach procedure prescribed in FAR Part 97 unless the visibility is at or above the landing minimum prescribed in FAR 97 for the procedure used. If the landing minimum in a standard instrument approach procedure (prescribed in FAR 97) is stated in terms of ceiling and visibility, the visibility minimum applies. However, the ceiling minimum shall be added to the field elevation and that value observed as the MDA or DH, as appropriate to the procedure being executed.

(c) Military airports. Unless otherwise prescribed by the Administrator, each person operating a civil aircraft under IFR into, or out of a military airport shall comply with the instrument approach procedure and the takeoff and landing minimums prescribed by the military authority having jurisdiction on that airport.

(d) Comparable values of RVR and ground visibility. If RVR minimums for takeoff or landing are prescribed in an instrument approach procedure, but RVR is not reported for the runway of intended operation, the RVR minimum shall be converted to ground visibility in accordance with the following comparable values and observed as the applicable visibility minimum for takeoff or landing on that runway:

RVR	Visibility (statute miles)
1,600 feet	1/4 mile
2,400 feet	1/2 mile
3,200 feet	5/8 mile
4,000 feet	3/4 mile
4,500 feet	7/8 mile
5,000 feet	1 mile
6,000 feet	1 1/4 mile

(e) Use of radar in instrument approach procedure. When radar is approved at certain locations for ATC purposes, it may be used not only for surveillance and precision radar approaches, as applicable, but also may be used in conjunction with instrument approach procedures predicated on other types of radio navigation aids. Radar vectors may be authorized to provide course guidance through the segments of an approach procedure to final approach fix or position. Upon reaching the final approach fix or position, the pilot will either complete his instrument approach in accordance with the procedure approved for the facility, or will continue a surveillance or precision radar approach to a landing.

(f) Limitations on procedure turns. In the case of a radar initial approach to a final approach fix or position, or a timed approach from a holding fix, or where the procedure specifies "NOPT" or "FINAL," no pilot may make a procedure turn unless, when he receives his final approach clearance, he so advises ATC.

91.117 Limitations on the use of instrument approach procedures.

(a) Unless otherwise authorized by the Administrator, each person operating an aircraft

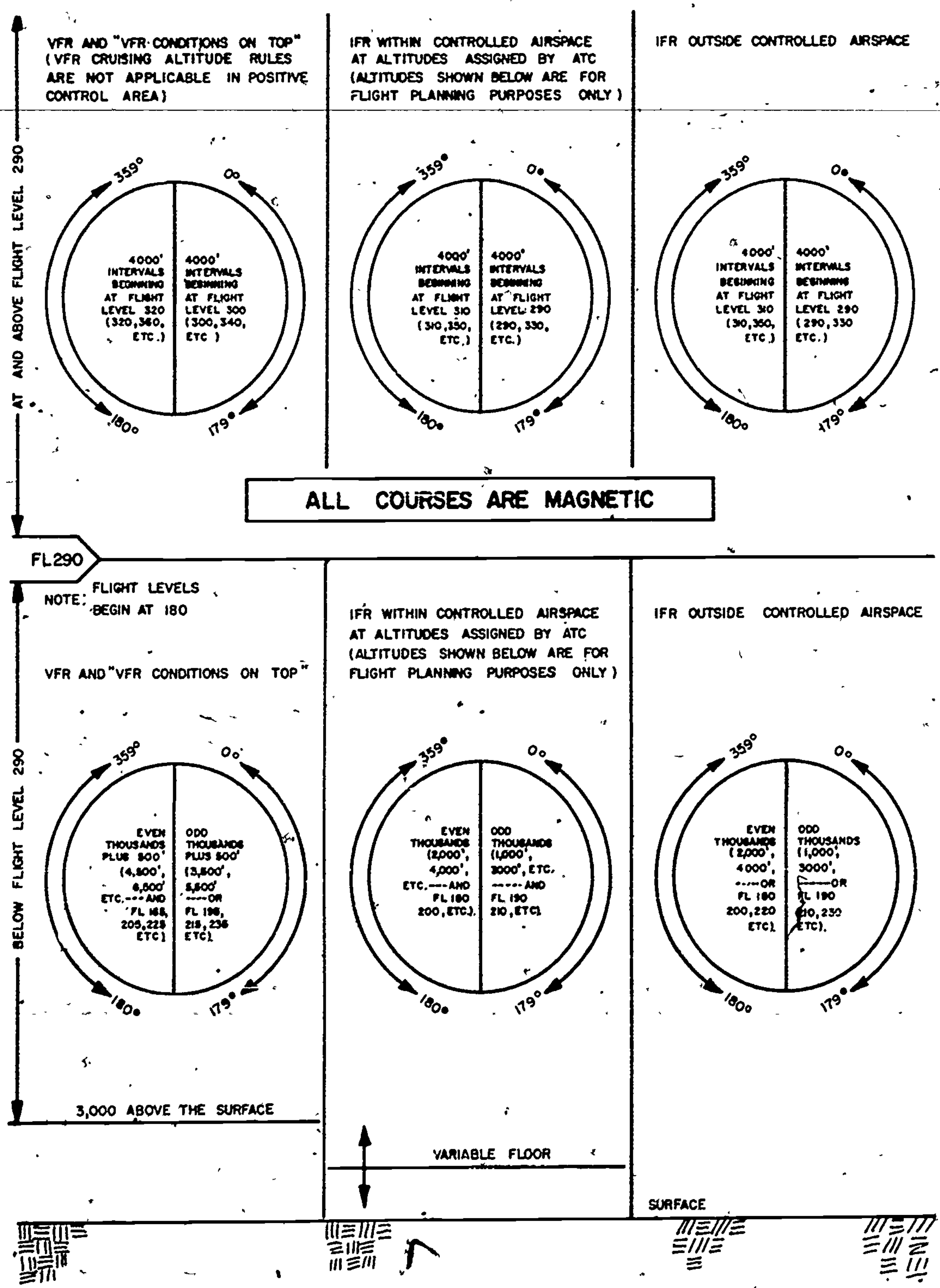

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Figure 3-10.—Cruising altitudes.

using an instrument approach procedure prescribed in FAR 97 shall comply with the requirements of this section. This section does not apply to the use of Category II approach procedures.

(b) Descent below MDA or DH. No person may operate an aircraft below the prescribed minimum descent altitude or continue an approach below the decision height unless—

(1) The aircraft is in a position from which a normal approach to the runway of intended landing can be made; and

(2) The approach threshold of that runway, or approach lights or other markings identifiable with the approach end of that runway, are clearly visible to the pilot. If, upon arrival at the missed approach point or decision height, or at any time thereafter, any of the above requirements are not met, the pilot shall immediately execute the appropriate missed approach procedure.

91.119 Minimum altitudes for IFR operations.

(a) Except when necessary for takeoff or landing, or unless otherwise authorized by the Administrator, no person may operate an aircraft under IFR below—

(1) The applicable minimum altitudes prescribed in Parts 95 and 97; or

(2) If no applicable minimum altitude is prescribed in those Parts—

(i) In the case of operations over an area designated as a mountainous area in Part 95, an altitude of 2,000 feet above the highest obstacle within a horizontal distance of 5 statute miles from the course to be flown; or

(ii) In any other case, an altitude of 1,000 feet above the highest obstacle within a horizontal distance of 5 statute miles from the course to be flown. However, if both a MEA and a MOCA are prescribed for a particular route or route segment, a person may operate an aircraft below the MEA down to, but not below, the MOCA, when within 25 statute miles of the VOR concerned (based on the pilot's reasonable estimate of that distance).

(b) Climb. Climb to a higher minimum IFR altitude shall begin immediately after passing the point beyond which that minimum altitude applies, except that, when ground obstructions intervene the point beyond which the higher minimum altitude applies shall be crossed at or above the applicable MCA.

91.121 IFR cruising altitude or flight level

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

(b) In uncontrolled airspace. Except while holding in a holding pattern of 2 minutes or less, or while turning, each person operating an aircraft under IFR in level cruising flight, in uncontrolled airspace, shall maintain an appropriate altitude as follows:

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

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

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

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

(i) On a magnetic course of zero degrees through 179 degrees, any odd flight level (such as 190, 210, or 230); or

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

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

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

(ii) On a magnetic course of 180 degrees through 359 degrees, any flight level, at 4,000-foot intervals, beginning at and including flight level 310 (such as flight level 310, 350, or 390). (See fig. 3-10.)

91.123 Course to be flown.

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

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

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

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

91.125 IFR, radio communications.

The pilot in command of each aircraft operated under IFR in controlled airspace shall have a continuous watch maintained on the appropriate frequency and shall report by radio as soon as possible—

(a) The time and altitude of passing each designated reporting point, or the reporting points specified by ATC, except that while the aircraft is under radar control, only the passing of those reporting points specifically requested by ATC need be reported;

(b) Any unforecast weather conditions encountered; and

(c) Any other information relating to the safety of flight.

91.127 IFR operations; two-way radio communications failure.

(a) General. Unless otherwise authorized by ATC, each pilot who has two-way radio communications failure when operating under IFR shall comply with the rules of this section.

(b) VFR Conditions. If the failure occurs in VFR conditions, or if VFR conditions are encountered after the failure, each pilot shall continue the flight under VFR and land as soon as practicable.

(c) IFR Conditions. If the failure occurs in IFR conditions, or if paragraph (b) of this section cannot be complied with, each pilot shall continue the flight according to the following:

(1) Route.

(i) By the route assigned in the last ATC clearance received;

(ii) If being radar vectored by the direct route from the point of radio failure to the fix, route, or airway, specified in the vector clearance;

(iii) In the absence of an assigned route, by the route that ATC has advised may be expected in a further clearance; or

(iv) In the absence of an assigned route or a route that ATC has advised may be expected in a further clearance, by the route filed in the flight plan.

(2) Altitude. At the highest of the following altitudes or flight levels for the route segment being flown:

(i) The altitude or flight level assigned in the last ATC clearance received;

(ii) The minimum altitude (converted, if appropriate, to minimum flight level as prescribed in 91.81 (c)) for IFR operations; or

(iii) The altitude or flight level ATC has advised may be expected in a further clearance.

(3) Leave holding fix. If holding instructions have been received, leave the holding fix at the expect-further-clearance time received, or, if an expected approach clearance time has been received, leave the holding fix in order to arrive over the fix from which the approach begins as close as possible to the expected approach clearance time.

(4) Descent for approach. Begin descent from the en route altitude or flight level upon reaching the fix from which the approach begins, but not before—

(i) The expect-approach-clearance time (if received); or

(ii) If no expect-approach-clearance time has been received, at the estimated time of arrival, shown on the flight plan, as amended with ATC.

91.129 Operation under IFR in controlled airspace; malfunction reports.

(a) The pilot in command of each aircraft operated in controlled airspace under IFR, shall report immediately to ATC any of the following malfunctions of equipment occurring in flight:

(1) Loss of VOR, TACAN, ADF, or low frequency navigation receiver capability.

(2) Complete or partial loss of ILS receiver capability.

(3) Impairment of air/ground communications capability.

(b) In each report required by paragraph (a) of this section, the pilot in command shall include the —

(1) Aircraft identification;

(2) Equipment affected;

(3) Degree to which the capability of the pilot to operate under IFR in the ATC system is impaired; and

(4) Nature and extent of assistance he desires from ATC.

FAR, PART 95—IFR ALTITUDES

Terms used in IFR altitudes are as follows:

(a) This part prescribes altitudes governing the operation of aircraft under IFR on Federal airways, jet routes, or other direct routes for which an MEA is designated in this part. In addition, it designates mountainous areas and changeover points (not included in this training manual).

(b) The MAA is the highest altitude on a Federal airway, jet route, or other direct route for which an MEA is designated in this part at which adequate reception of navigation aid signals is assured.

(c) The MCA applies to the operation of an aircraft proceeding to a higher minimum en route altitude when crossing specified radio fixes.

(d) The MEA prescribed for a Federal airway or segment thereof, applies to the entire width of that airway or segment between the radio fixes defining that airway or segment. An MEA prescribed for an off-airway route or route segment applies to the airspace 5 statute miles on each side of a direct course between radio fixes defining that route or route segment. The MEA in effect between fixes assures navigation signal reception and obstruction clearance between those fixes.

(e) The MOCA applies to the operation of an aircraft within 25 statute miles of the VOR station concerned. The MOCA assures obstruction clearance between the fixes specified but adequate reception of navigational signals is assured only within 25 miles of the VOR station concerned.

(f) The MRA applies to the operation of an aircraft over an intersection used in the navigation of that aircraft. The MRA is the lowest altitude at which the intersection can be determined.

(g) The COP (changeover point) applies to operation of an aircraft along a Federal airway, jet route, or other direct route for which an MEA is designated in this part. It is the most appropriate point for transfer of the airborne navigation reference between the facility abaft the aircraft and the next appropriate facility along the Federal airway, jet route, or other direct route that provides:

(1) Continuous reception between facilities; and

(2) A common source of azimuth guidance for all aircraft operating along the same segment of the Federal airway, jet route, or direct route. Unless otherwise specified, the COP is midway between the navigation facilities for straight route segments, or at the intersection of radials forming a dogleg in the case of dogleg route segments.

FAR, PART 99—SECURITY CONTROL OF AIR TRAFFIC

99.1 APPLICABILITY

(a) This subpart prescribes rules for operating civil aircraft in a defense area, or into, within, or out of the United States through an Air Defense Identification Zone (ADIZ).

(b) Except for 99.7, this subpart does not apply to the operation of an aircraft—

(1) In a Coastal or Domestic ADIZ north of 25 degrees north latitude or west of 85 degrees west longitude at a true airspeed of less than 180 knots;

(2) In the Alaskan DEWIZ at a true airspeed of less than 180 knots while the pilot maintains a continuous listening watch on the appropriate frequency;

(3) From any point in the 48 contiguous States on an outbound track through the Southern Border ADIZ that does not penetrate a Coastal ADIZ;

(4) Within the 48 contiguous States and the District of Columbia, or within the State of Alaska, which remains within 10 nautical miles of the point of departure; or

(5) Over any island, or within three nautical miles of the coastline of any island, in the Hawaiian ADIZ.

(c) Except as provided in 99.7, the radio and position reporting requirements of this subpart do not apply to the operation of an aircraft within the 48 contiguous States and the District of Columbia, or within the State of Alaska, if that aircraft does not have two-way radio and is operated in accordance with a filed DVFR flight plan containing the time and point of Domestic or Coastal ADIZ penetration and that aircraft departs within 5 minutes of the estimated departure time contained in the flight plan.

(d) An FAA ATC center may exempt the following operations from this subpart (except 99.7), on a local basis only, with the concurrence of the military commanders concerned:

(1) Aircraft operations that are conducted wholly within the boundaries of an ADIZ and are not currently significant to the air defense system.

(2) Aircraft operations conducted in accordance with special procedures prescribed by the military authorities concerned.

99.3 GENERAL

(a) Air defense identification zones (ADIZs) are areas of airspace over land or water in which the ready identification, location, and control of civil aircraft is required in the interest of national security. (See fig. 3-11.) They are classified as—

(1) Coastal air defense identification zones (Coastal ADIZs);

(2) Domestic air defense identification zones (Domestic ADIZs); and

(3) Distant early warning identification zones (DEWIZs).

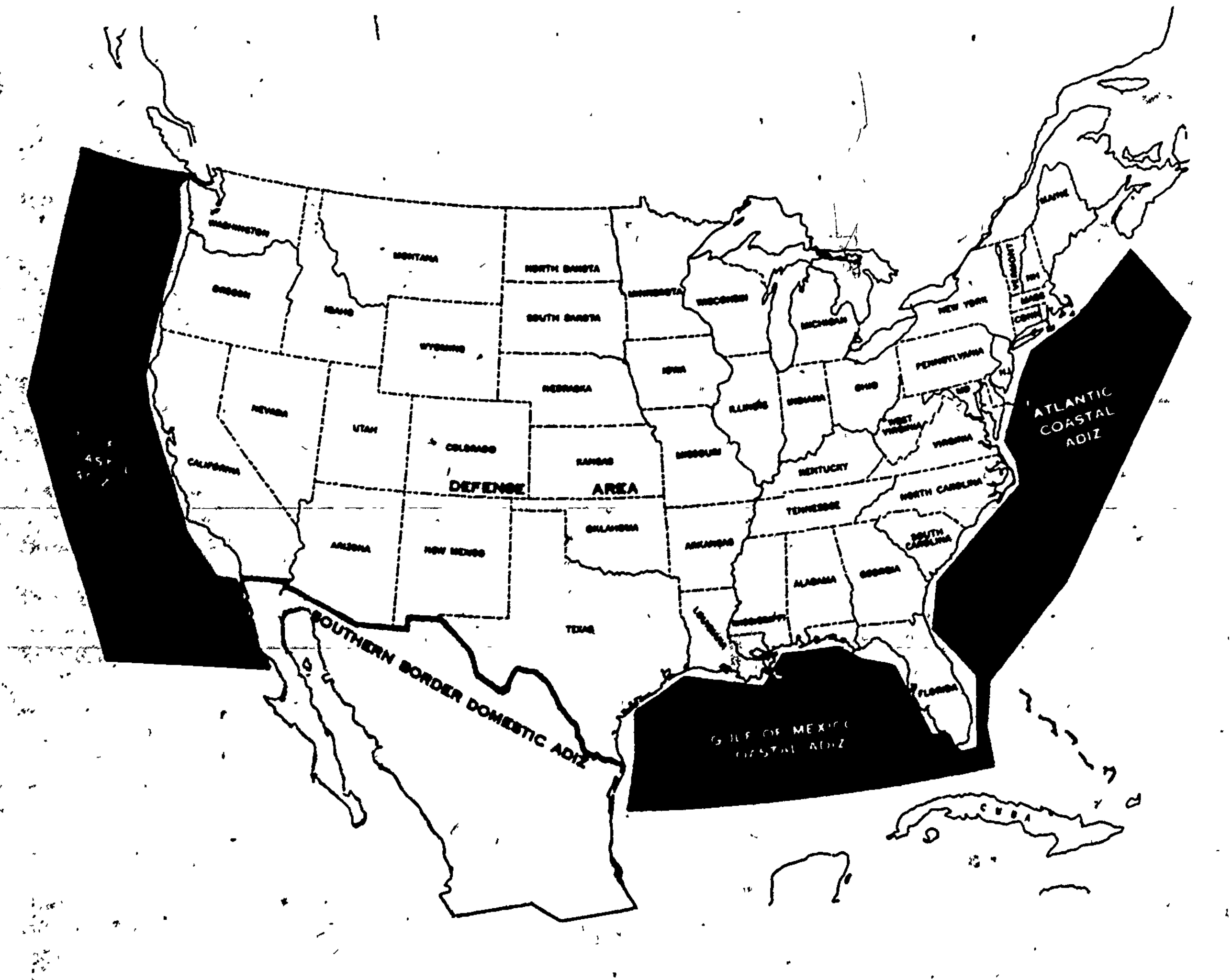

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Figure 3-11.—ADIZs and defense area.

(b) Unless designated as an ADIZ, a Defense Area is any airspace of the United States in which the control of aircraft is required for national security.

(c) For the purposes of this Part, a Defense Visual Flight Rules (DVFR) ~~flight~~ is a flight within an ADIZ conducted under the visual flight rules in Part 91.

99.5 EMERGENCY SITUATIONS

In an emergency that requires immediate decision and action for the safety of the flight, the pilot in command of an aircraft may deviate from the rules in this Part to the extent required by that emergency. He shall report the reasons for the deviation to the communications facility where flight plans or position reports are normally filed (referred to in this Part as "an appropriate aeronautical facility") as soon as possible.

99.7 SPECIAL SECURITY INSTRUCTIONS

Each person operating an aircraft in an ADIZ or Defense Area shall, in addition to the applicable operating rules of this Part, comply with special security instructions issued by the Administrator in the interest of national security and that are consistent with appropriate agreements between the FAA and Department of Defense.

99.9 RADIO REQUIREMENTS

No person may operate an aircraft in an ADIZ unless the aircraft has a functioning two-way radio.

99.11 FLIGHT PLAN REQUIREMENTS
ADIZ

(a) No person may operate an aircraft in or penetrating a Coastal or Domestic ADIZ unless he has filed a flight plan with an appropriate aeronautical facility.

(b) Unless ATC authorizes an abbreviated flight plan—

(1) A flight plan for IFR flight must contain the information specified in 91.83; and

(2) A flight plan for VFR flight must contain the information specified in 91.83 (a) (1) through (7).

(c) The pilot shall designate a flight plan for VFR flight as a DVFR flight plan.

DEWIZ

(a) No person may operate an aircraft in or penetrating a DEWIZ unless he has filed a flight plan before takeoff with an appropriate aeronautical facility. If there is no facility for filing a DVFR flight plan, the pilot must comply with 99.25 (a) (2) and proceed according to the instructions issued by the appropriate aeronautical facility. These instructions normally require the flight to proceed to a specific area for visual identification or to land at a stated location.

(b) Unless ATC authorizes an abbreviated flight plan—

(1) A flight plan for IFR flight must contain the information specified in 91.83 and the estimated time and point of DEWIZ penetration (ETDP); and

(2) A flight plan for VFR flight must contain the information in 91.83 (a) (1) through (7) and the estimated time and point of DEWIZ penetration (ETDP).

(c) The pilot shall designate a flight plan for VFR flight as a DVFR flight plan.

99.17 POSITION REPORTS

The pilot of an aircraft operating in or penetrating a Domestic ADIZ under IFR—

(a) In controlled airspace, shall make the position reports required in 91.125; and

(b) In uncontrolled airspace, shall make the position reports required in 99.19.

99.19 Position Reports; Aircraft Operating in or Penetrating a Domestic ADIZ; DVFR.

No pilot may penetrate a Domestic ADIZ under DVFR unless—

(a) He reports to an appropriate aeronautical facility before penetration. The time, position, and altitude at which the aircraft passed the last reporting point before penetration and the estimated time of arrival over the next appropriate reporting point along the flight route;

(b) If there is no appropriate reporting point along the flight route, he reports at least 15 minutes before penetration; the estimated time, position, and altitude at which he will penetrate; or

(c) If the airport of departure is so close to the Domestic ADIZ boundary that it prevents his complying with paragraphs (a) or (b) of this section, he has reported immediately after taking off: The time of departure, altitude, and estimated time of arrival over the first reporting point along the flight route.

The pilot of an aircraft entering the United States through a Coastal ADIZ shall make the reports required in 99.17 or 99.19 to an appropriate aeronautical facility.

In addition to such other reports as ATC may require, no pilot in command of a foreign civil aircraft may enter the United States through a Coastal ADIZ unless he makes the reports required in 99.17 or 99.19 or reports the position of the aircraft when it is not less than 1 hour and not more than 2 hours average direct cruising distance from the United States.

99.25 Position Reports, Aircraft Entering the United States Through a DEWIZ.

(a) The pilot of an aircraft entering the United States through a DEWIZ—

(1) If under IFR, shall report his position as required by 91.125; or

(2) If under DVFR, shall report when within radio range of an appropriate aeronautical facility but before penetration: The time, altitude, and position at which he passed the last reporting point and the estimated time, altitude and point of penetration.

(b) If requested, the pilot of an aircraft entering the United States through a DEWIZ shall advise an appropriate aeronautical facility of the difference between the actual time and point of penetration and the same data recorded in the original ground filed flight plan.

99.27 DEVIATION FROM FLIGHT PLANS AND ATC CLEARANCES

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

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

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

99.29 RADIO FAILURE

If the pilot operating an aircraft under DVFR in an ADIZ cannot maintain two-way radio communications, he may proceed in accordance with his original DVFR flight plan or land as soon as practicable. The pilot shall report the radio failure to an appropriate aeronautical facility as soon as possible.

If a pilot operating an aircraft under IFR in an ADIZ cannot maintain two-way radio communications, he shall proceed in accordance with 91.127 of this chapter.

CHAPTER 4

BASIC AIR NAVIGATION

Air navigation has borrowed and adapted many of the instruments, practices, and procedures of marine navigation; thus, fundamental knowledge and skills are the same for marine and air navigation. It will be necessary for the Air Controlman to understand some of the problems encountered by pilots in planning and completing a successful flight. Also, a sound understanding of the basic theories of navigation is of importance to the Air Controlman to give him the required know-how in the daily application of his duties.

This chapter is intended to familiarize the AC with the fundamentals of air navigation and should give him the confidence necessary when called on to render assistance to pilots.

BASIC CONCEPTS OF AIR NAVIGATION

Any purposeful movement in the universe ultimately involves an intention to proceed to a definite point, and navigation is the business of proceeding in such a manner as to arrive at that point. Air navigation is defined, formally, as the process of directing the movement of an aircraft from one point to another. The function of air navigation is primarily to determine the direction necessary to accomplish the intended flight, locate positions, and measure distance and time as means to that end.

Position is a point defined by stated or implied coordinates. This term is frequently qualified by such adjectives as estimated, dead reckoning, no wind, etc., whose meanings will be explained later in this chapter. But however qualified, the word position always refers to some place that can be identified. One of the basic problems of the navigator is that of fixing his position; unless he knows where he is, he cannot know how to direct the movement of the aircraft to its intended destination.

Direction is the position of one point in space relative to another without reference to the distance between them. Direction may be either 3-dimensional or 2-dimensional, the horizontal being the usual plane of 2-dimensional direction. For example, the direction of San Francisco from New York is approximately west (2-dimensional); while the direction of an aircraft from an observer on the ground may be west and 20 degrees above the horizontal (3-dimensional). Direction is not itself an angle (that is, the direction east) but it is often measured in terms of its angular distance from a reference direction.

Distance is the spatial separation between two points and is measured by the length of a line joining them. This seems understandable enough. Suppose, however, that the two points are on opposite sides of a baseball. How is the line to be drawn? Does it run through the center of the ball, or around the surface? If around the ball, what path does it follow? The term distance as used in navigation must be qualified to indicate how the distance is to be measured. The shortest distance on the earth's surface from San Diego to Sydney, Australia, is 6,530 miles, but via Honolulu and Guam, a frequently used route, it is 8,602 miles. And, furthermore, the length of the chosen line could be expressed in various units, as miles, kilometers, or yards.

Time has many definitions, but those used in navigation consist mainly of two: the hour of the day, and an elapsed interval. The first is used to designate a definite instant, as takeoff time is 0215. The second definition is used to indicate an interval, as time of flight, 2 hours 15 minutes.

A map or a chart of the earth's surface is the primary instrument used in air navigation. Without a chart it would be impossible to navigate. Therefore, it is important to understand certain known facts indicated on these charts about the earth's surface. Some of these will be familiar; others may not. To ensure that all are known, let us start from the very beginning and review the pertinent facts.

The earth resembles a spinning ball. The imaginary line about which the earth rotates is called the axis of the earth. The ends of the axis are called the North Geographic Pole and the South Geographic Pole.

Although most people think of it as such, the earth is not a true sphere. A sphere is a body whose surface is equidistant from a point within, known as the center. Any line which passes from one side of a sphere through the center to the other side is a diameter of the sphere. Obviously, one diameter is equal to every other diameter.

The earth is slightly flattened at the poles. This causes its axis to be about 26 miles shorter than its greatest diameter. This difference, however, is only about 0.3 percent of the diameter. Therefore, for the purposes of navigation, the earth may be considered a true sphere.

POSITION

It is necessary to have a system for designating any position on the surface of the earth. Sometimes we may simply say that the aircraft is 10 miles south of San Diego or that its destination is the municipal airport. Such designations may be clear and simple enough, but they would be useless in designating the aircraft's position while crossing the Atlantic Ocean. It would not be sufficient to say that the aircraft was in the middle of the Atlantic or 3 miles south of an iceberg. What is needed is a universal method of expressing position without regard to nearby geographic features.

To tell a stranger the location of a restaurant in Chicago, one might say that it is at the corner of 2nd Street and 3rd Avenue. This definitely tells him the location, as there is only one place in all the city at which 2nd Street and 3rd Avenue cross. You might also tell him that the restaurant is 2 blocks north of Main Street and 3 blocks east of Broadway. This is just as definite. Quantities which give position with respect to two reference lines are called coordinates. Thus, "2 blocks north" and "3 blocks east" are the coordinates of the restaurant relative to Main Street and Broadway.

Positions on the earth may be given by a similar system of coordinates. However, since there are no natural lines on the earth to serve as reference lines, it is necessary to use imaginary lines.

Straight lines are usually the most convenient with which to work. However, straight lines cannot be drawn on a curved surface. On a sphere, the most convenient reference line is a circle.

Circles on a Sphere

If a sphere is cut straight through the center, the resulting cut edges are circles. Thus, the intersection of a plane with a sphere forms a circle. If the plane passes through the center of the sphere, dividing it in half, the circle formed is a great circle. (See fig. 4-1.) A great circle is the largest circle which can be drawn on a given sphere. Any circle other than a great

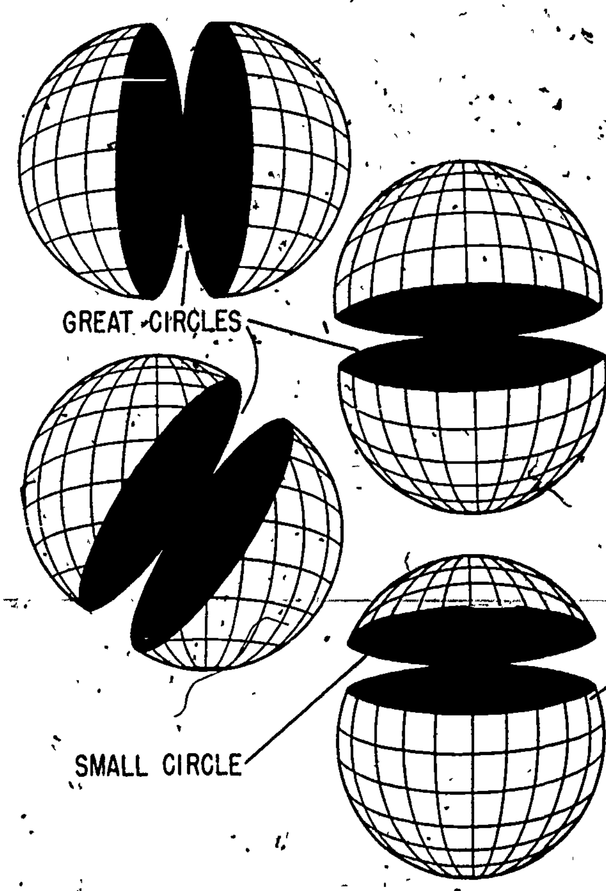

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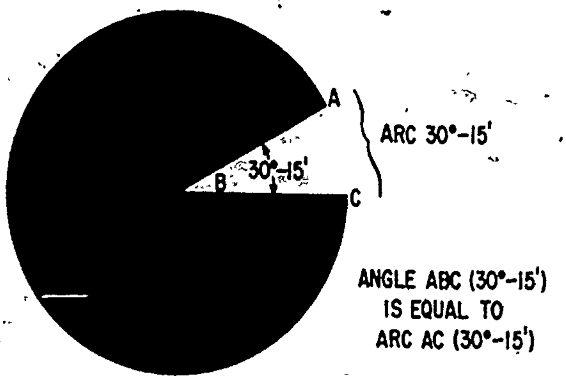
Figure 4-1. — Circles on a sphere.



201.72
Figure 4-2.—The angle at the center is equal to the arc.

circle, no matter how large, is called a small circle. (See fig. 4-1.) The plane of a small circle, of course, does not pass through the center of the sphere, and hence does not divide it into halves.

Segments of circles or arcs are measured in degrees, minutes, and seconds. A circle contains 360° of arc. Each degree (°) is 1/360 of the circumference of a circle. Thus, if any circle is divided into 360 equal arcs, each arc is 1° in length, regardless of the size of the circle. A minute (') is 1/60 of 1°—a second ('') is 1/60 of 1'.

Notice in figure 4-2 that if a straight line is drawn from each end of an arc to the center of the circle, the two lines meet to form an angle at the center. This angle is subtended by the arc. Angles, like arcs, are measured in degrees, minutes, and seconds. The angle at the center of a circle (fig. 4-2) always contains the same number of degrees, minutes, and seconds as the arc which subtends it.

Reference Lines on the Earth

As stated earlier in this chapter, circles make the best reference lines for designating position on a sphere. The question is where to draw the circles. A sphere is a continuous surface without beginning or end, and on the earth the only distinctive natural geometric line is its axis, which is different from every other diameter, by about 26 miles, as previously stated. Thus, the geographic poles are distinctive points on the earth. The geographic poles are used as the central points for one set of reference circles. The most important circle of this set is the Equator.

The Equator is the great circle halfway between the poles. Since the poles are 180°, or half a circle apart, every point on the Equator is 90° from each pole. The plane of the Equator is perpendicular to the earth's axis. The Equator divides the earth into a northern and southern hemisphere, and it is important to remember that the Equator serves as a reference line for denoting north and south latitude.

Any small circle on the earth whose plane is parallel with the plane of the Equator is called a parallel of latitude, or simply a parallel. Each parallel is everywhere equidistant from the poles, from the Equator, and from every other parallel. Thus, the parallels and the Equator are concentric about the polar axis. (See fig. 4-3.)

Every point on the earth has a parallel passing through it. However, only a few of these parallels are shown on the globe; the globe would be solid black if they were all shown. Each parallel is designated by its angular distance north or south of the Equator—that is, toward the North or South Pole, as the case may be.

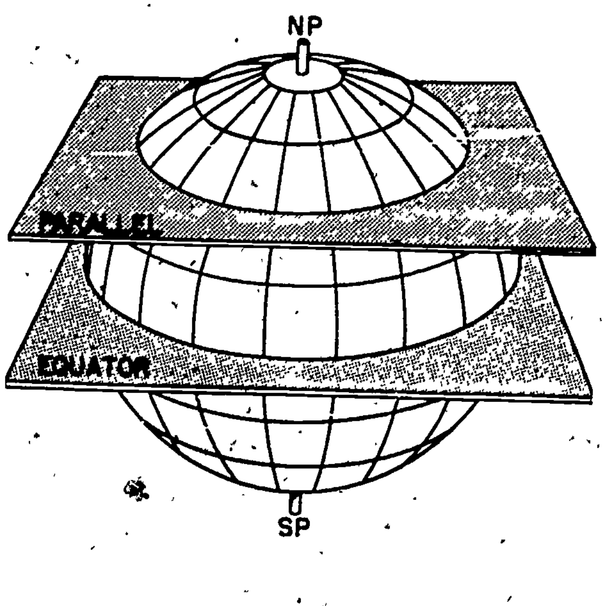


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Figure 4-3.—Parallels of latitude.

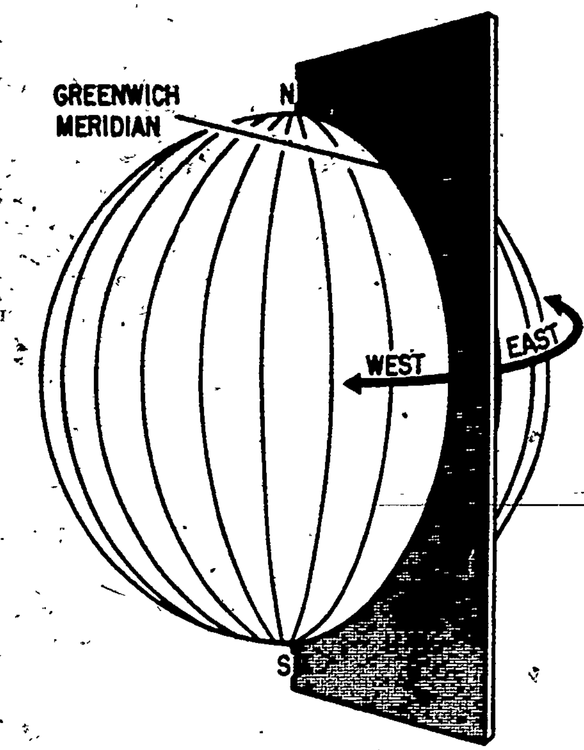

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Figure 4-4.—Meridians of longitude.

Points east or west on the earth are located by reference to a meridian of longitude, or simply a meridian. (See fig. 4-4.) Instead of using small circles as in the case with latitude, the longitude system is based on great circles passing through the poles. These great circles are divided in half by the poles, and are farthest apart at the Equator. Each half of the circle is assigned a value east or west.

The prime meridian is the meridian whose plane passes through the Observatory at Greenwich, England, which has been adopted as an origin for the measurement of longitude. This meridian is also referred to as Greenwich meridian, and serves as our second reference line. (See fig. 4-4.)

Latitude and Longitude

The parallels and meridians intersect at right angles to form a grid system comparable to the intersecting streets of a city. You can designate any position in a city by naming the streets which pass through it. Likewise, you can designate any point on the earth by naming the parallel and meridian which pass through it. Thus, the 29°59'N parallel and the 95°21'W meridian together designate Houston, Texas. (See fig. 4-5.) Any point on the earth can be designated by giving its coordinates relative to the Equator and Greenwich meridian. These coordinates are called latitude and longitude.

The latitude of a point is its angular distance north or south of the Equator, measured in the plane of the meridian. It is measured from 0° at the Equator, north to 90° at the North Pole, and south to 90° at the South Pole.

The longitude of a point is its angular distance east or west of the prime meridian, measured in the plane of the Equator or of a parallel. Longitude is measured from 0° to 180° east and from 0° to 180° west from the prime meridian. In giving the coordinates of a place, give latitude first, then longitude; i.e., 29°59'N, 95°21'W. Note again in figure 4-5 how this was illustrated.

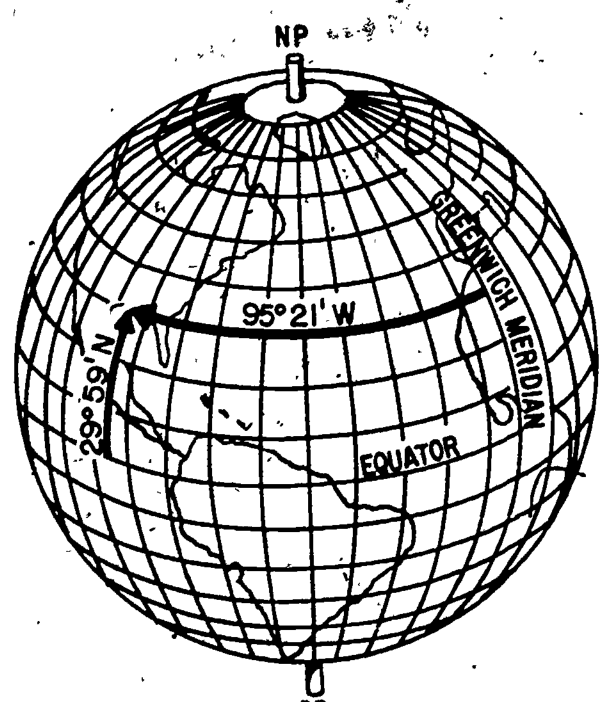

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Figure 4-5.—Position designated by coordinates.

Each parallel and meridian is named according to its angular distance from the Equator or the prime meridian. Keep in mind, however, that a meridian of longitude is a line; whereas longitude is an angle. Likewise, a parallel of latitude is a line; whereas latitude is an angle.

DL and DLo

The difference of latitude (DL) between two points is the angular distance between the parallels which pass through these points. Thus, it is the arc of any meridian between these parallels. (See fig. 4-6.) If both points are on the same side of the Equator, the smaller latitude is subtracted from the larger. Therefore, the DL between 20°N at point A and 40°N at point B is 20°. If the two points are on opposite sides of the Equator, the two latitudes are added. In figure 4-6, the latitude at A is 20°N. If the latitude at C is 15°S, the difference of latitude between A and C is 35°.

Similarly, the difference of longitude (DLo) between any two points is the angular distance between their meridians. (See fig. 4-7.) If both points are in east longitude or if both are in

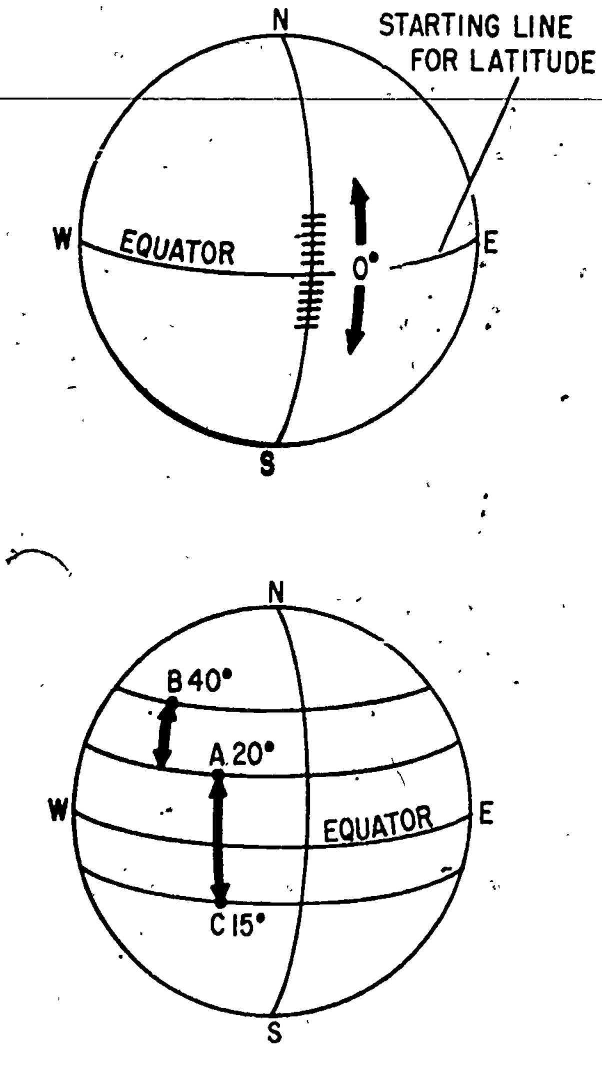

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Figure 4-6.—Difference of latitude.

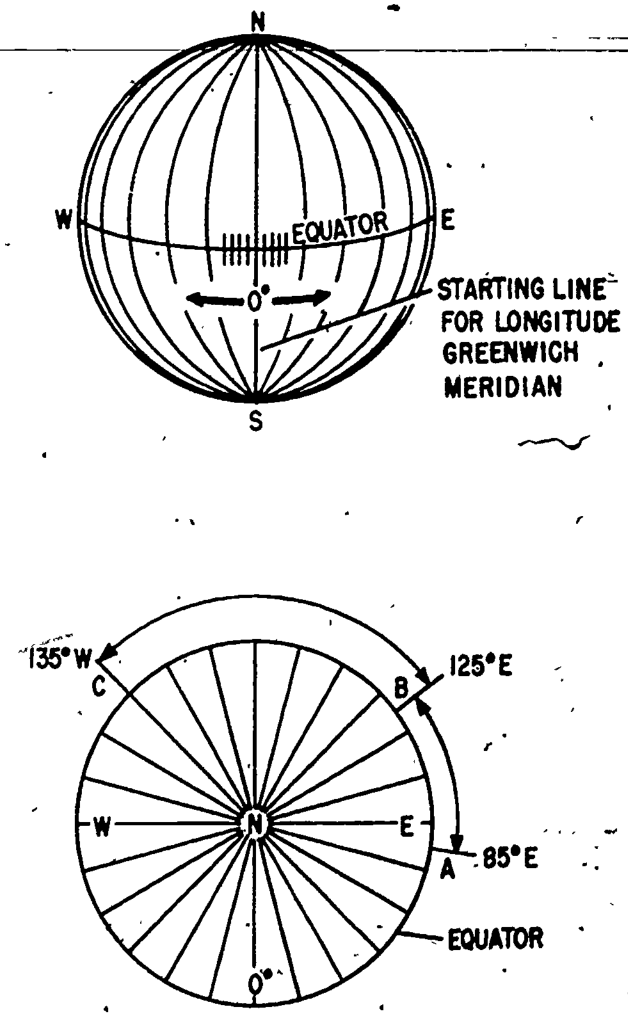

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Figure 4-7.—Difference of longitude.

west longitude, the smaller longitude is subtracted from the larger. Therefore the DLo between 85°E at point A and 125°E at point B is 40°. If one point is in east longitude and the other in west longitude, the two longitudes are added. If their sum is greater than 180°, this figure is subtracted from 360°. Thus, the DLo of 125°E at point B and 135°W at point C is 100°.

DIRECTION

To walk across the street to a friend's house, one merely glances at the house and starts walking in that direction. But to fly from Norfolk to Jacksonville, the direction must be obtained in some other manner, usually from a chart. The pilot keeps the aircraft headed in the right direction in order to reach Jacksonville. From this example, it can easily be seen that direction is important in navigation, and that some system must be used for expressing the direction from any point to any other point.

North is the direction of the North Pole from any point on the earth, south is the direction of the South Pole; and as one faces north, east is to the right and west is to the left. These are only four of an infinite number of possible directions. In navigation, the system of designating direction permits more exact locating of positions.

Direction is expressed as an angle measured clockwise from north. At any position, imagine a circle whose circumference is divided into 360 equal units. If the divisions are numbered clockwise from north, they indicate true directions from the central point. Such a circle is called a compass rose. The direction of north is 000° or 360°, east is 090°, south is 180°, and west is 270°. In figure 4-8, the direction of B from A is the angle measured clockwise from north to the line AB. (Direction is navigationally defined as a point on the horizon toward which a craft is moving, and it is essentially a line.) Line AB is the angle between the meridian and AB and the direction of B is 045°. Likewise, the direction of C from A is 100° and the direction of D from A is 260°.

It will be helpful to think of directions as angles. Practice estimating the directions of lines by dividing a compass rose into quarters or quadrants, and note which directions fall into each quadrant. Unless there is an arrow, or some device, to show which way a line points, the line has two directions differing by 180°. Later in this chapter, it will be seen why it is important to learn to estimate direction now and avoid making a 180° error. In figure 4-8, the direction of B from A is 045°.

Magnetic Compass

As its name implies, the magnetic compass utilizes the force known as magnetism. The earth itself has a magnetized core, two magnetic poles, and lines of force that form a magnetic field. Like any other magnet, the earth also has a north magnetic pole and a south magnetic pole. Each is about 1,400 miles away from its corresponding geographic pole. Although they are placed at specific geographic sites on magnetic charts, the locations of the magnetic poles change slightly from time to time.

As in any magnet, lines of force run between the north and south magnetic poles of the earth. Its magnetic field affects any magnetic substance; and as a result, a freely suspended magnetic bar or needle will tend to align itself with the earth's lines of force. These lines of force are similar to meridians and are called magnetic meridians.

The magnetic compass is simple in construction. It contains two steel magnetized needles mounted on a float. A compass card is attached around the float. The needles are parallel, with their north-seeking ends pointed in the same

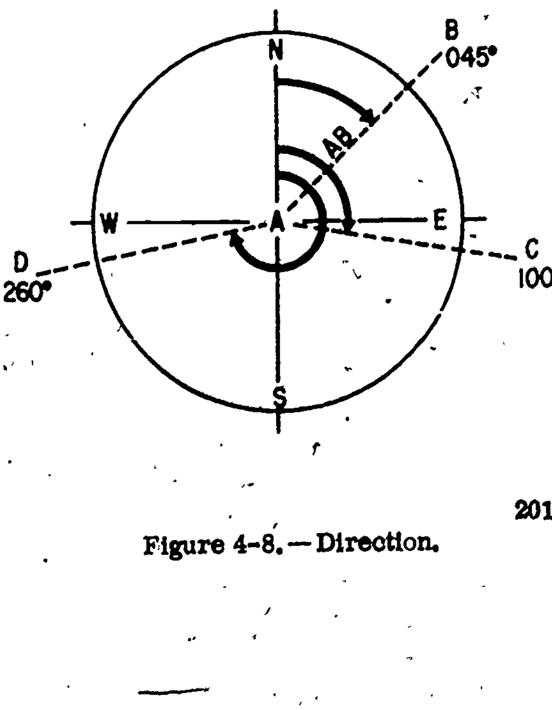

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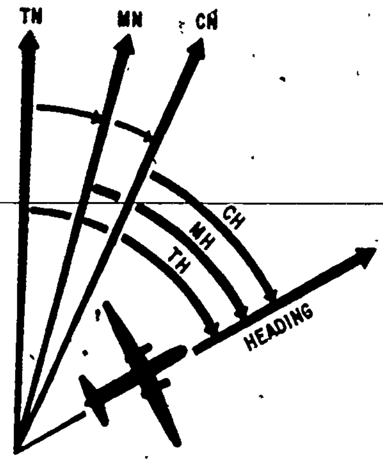
Figure 4-8.—Direction.

direction. The compass card has letters for cardinal headings (N, E, S, W). Each 30° is represented by a number, from which the last zero is omitted. Between these numbers, the card is graduated for each 5°.

Heading Determined by a Compass

Compasses are used for determining heading, which is the angle measured clockwise from a reference point to the longitudinal axis of the aircraft.



201.79
Figure 4-9.—Reference points in determining headings.

Notice in figure 4-9 that no specific reference point is mentioned. The reference point could be one of several. If the angle is expressed with relation to true north, it is known as TRUE HEADING (TH). If it is measured from magnetic north, it is called MAGNETIC HEADING (MH). Theoretically, it might be measured from compass north; and the term used would be COMPASS HEADING (CH). In each case, the angle is measured in a clockwise direction from the north reference to the longitudinal axis of the aircraft. It is important to designate which reference was used since all of them do not have the same value as shown in figure 4-9. This is accomplished by designating the reference by one of the terms true, magnetic, or compass.

Variation

It has already been stated that when a magnetized needle is influenced by the earth's magnetic field, the direction it points is magnetic north (MN), and the direction of the north geographic pole is called true north (TN). The angle between magnetic north and true north is termed the variation. Variation differs at different points on the earth. If the needle points to true north, then magnetic north and true north coincide and the variation is zero. When the needle points east of true north, the variation is said to be east; if the needle points west of true north, the variation is called west. (See fig. 4-10.)

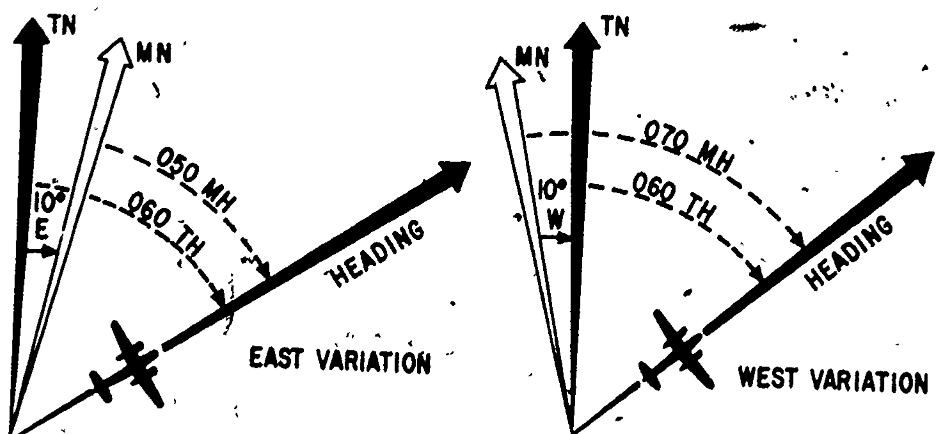


Figure 4-10.—Angles of variation.

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Note that most charts have information concerning lines of variation. The lines that connect points of equal variation are called isogonic lines. A line which connects points of zero variation is known as an agonic line. Usually, aircraft courses are plotted from a true north reference rather than a magnetic north reference simply because the grid on conventional charts is designed using true north as a reference. As the compass needle is deflected east or west of true north by an angular amount known as variation, a correction must be applied to the true heading in order to obtain magnetic headings. This amount of correction is found on the chart by noting the position of the aircraft in relation to the nearest isogonic line.

Deviation

It has been brought out that variation is caused by magnetic forces outside the aircraft. However, a compass is affected by ALL magnetic fields. A piece of iron close to a compass needle tends to deflect it from magnetic north. Whenever an electric current passes through a wire, a magnetic field is set up around the wire. The combined effect of all the magnetic fields within the aircraft (such as, metal containing iron, operation of electronic or electrical equipment) causes an error in the compass known as deviation.

To understand deviation better, assume that the compass needle always points directly to a nonexistent compass north pole. The direction in which the compass needle points is known as compass north. Compass directions may be expressed relative to compass north just as true directions are expressed relative to true north and magnetic directions are expressed in relation to magnetic north.

Although the compass needle primarily seeks alignment with the earth's magnetic field, deviation will vary as the aircraft changes heading. The metal structure and electrical devices naturally turn with the aircraft, creating a different alignment relationship. As this relationship to the compass needle changes, deviation also changes.

Since deviation may vary with each heading, deviation must be determined for each heading that differs by approximately 15° from the previous heading. This is accomplished by a process called swinging the compass. This may be done either in the air or on the ground. The most common method on the ground makes use of a large compass rose, on a concrete area, with magnetic headings inscribed at 15° intervals. Swinging the compass essentially consists of obtaining a compass reading from a known magnetic heading. If the compass reading is greater than the magnetic heading, that is, if the compass reads too high, the deviation is east; and if the compass reads lower than the magnetic heading, the deviation is west. The values of deviation are then recorded on a suitable deviation card and placed in the cockpit of the aircraft.

Applying Variation and Deviation

In navigation, it is necessary to be able to change a compass heading to a corresponding true heading, or to start with a true heading and determine the equivalent compass heading. For example, we may start with a compass heading. By applying deviation to this compass heading we obtain the magnetic heading. Variation applied to this magnetic heading gives us the true heading. To help solve a problem of this nature, the following formula is used:

COMPASS ± DEVIATION = MAGNETIC
MAGNETIC ± VARIATION = TRUE HEADING

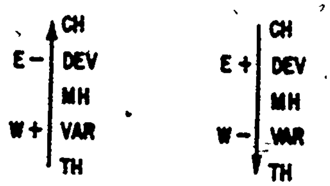
In going the other way, the same procedure is followed. If we know the true heading that is to be flown, it is necessary to find the compass heading to steer in order to maintain this true heading. In this case it is customary to proceed as follows:

TRUE ± VARIATION = MAGNETIC
MAGNETIC ± DEVIATION = COMPASS HEADING

Sometimes this information is summarized in the form of a memory aid by making use of the following statement:

Can Dead Men Vote Twice

Reading from left to right we have C D M V T — Compass, Deviation, Magnetic, Variation, True. Reading the other way, from right to left, we have T V M D C — True, Variation, Magnetic, Deviation, Compass.



201.81
Figure 4-11.—Application of compass errors.

However, it is impossible to add or subtract a quantity known as east or west. Therefore, it must be given an algebraic sign (plus or minus). To solve for compass heading when true heading is known, a good rule to remember is: East is least, and west is best. This means easterly errors are subtracted and westerly errors are added. When proceeding from compass heading to true heading, the signs are reversed. Figure 4-11 offers this easy method of application.

DISTANCE

Distance, as previously defined, is measured by the length of a line joining two points. In navigation the most common unit used for measuring distance is the nautical mile. Since miles have various lengths, one should be careful to specify which mile is meant.

In the U.S. one mile has been defined by statute to be 1,760 yards or 5,280 feet. This is called a statute mile. Navigators use the nautical mile as a distance unit. The DOD has adopted the International nautical mile which equals 6,076.10 feet.

For most practical navigation purposes, all of the following units are used interchangeably as the equivalent of one nautical mile:

1. 1,852 meters (6,076 feet approximately).
2. One minute of arc on the earth's Equator (geographical mile).
3. One minute of arc on a meridian (one minute of latitude).
4. 2,000 yards (for short distances).

Closely related to the concept of distance is speed, which determines the rate of change of position. Speed in air navigation is expressed in nautical miles per hour. When the measure of distance is nautical miles, it is customary to speak of speed in terms of knots. Thus, a speed of 200 knots and a speed of 200 nautical miles per hour are the same thing; however, it is incorrect to say "200 knots per hour" unless referring to acceleration.

TIME

One of your earliest experiences in the Navy was that of learning nautical time. This time is expressed in accordance with the approved naval practice—using the 24-hour day with the hours and minutes expressed in a 4-figure group. In working daily as an Air Controlman, a thorough knowledge of time is necessary, particularly in handling communications, processing flight plans, and checking on overdue aircraft.

As seen from the earth, the sun appears to travel across or orbit the earth. The fact that the sun rises in the east and sets in the west seems to substantiate this. However, the opposite is actually true. The earth orbits the sun, and the earth's rotation on its axis creates the illusion that the sun goes around the earth. This is called the "apparent motion of the sun." Since the sun, for all practical purposes, appears to move from east to west, it is a good idea to remember that TIME IS ALWAYS LATER TO THE EAST. (See fig. 4-12.)

Greenwich Mean Time

For uniformity, the meridian of Greenwich, England, has been selected as the prime meridian from which time is measured. You may recall the prime meridian is also the basis for measuring longitude. The moment the sun crosses the meridian, it is noon of that date. Therefore, it can be noon at only one meridian at the same moment. This gives us a common time known as Greenwich Mean Time (GMT) or Greenwich Civil Time (GCT). GMT gives us a reference time to locate time at other points on the earth.

Zone Times and Description

The world is divided into 24 time zones whose central meridians are 0°, 15°, 30°, 45°, etc. All places in any time zone keep the same mean time of the central meridian. Hence, the time can differ only by an integral number of hours from the time at Greenwich.

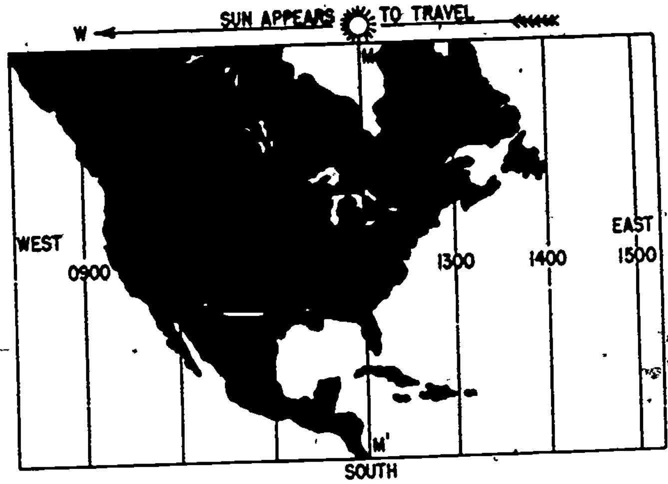


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Figure 4-12.—Noon over a meridian MM'.

The local mean time at any one place differs from the mean time at Greenwich by the difference in longitude, 1 hour for each 15°. If local mean time was in common use, there would be a great diversity in the times used at various places. For example, an aircraft flying in an easterly or westerly direction would find that changes in longitude would result in comparable changes in local time.

Late in the 19th century, Congress adopted a uniform system applicable to the continental United States, establishing four time zones. Each central meridian was designated the standard meridian and its local mean time was designated as standard time within its zones. The U.S. time zones are as follows:

ZONE	CENTRAL MERIDIAN
Eastern standard	75°W
Central standard	90°W
Mountain standard	105°W
Pacific standard	120°W

Boundaries of the standard time zones are somewhat irregular, to eliminate inconvenient time changes when traveling. In some cases, cities and states have placed themselves in zones east of the ones in which they would naturally fall.

Generally, in navigation, the standard time zones extend from pole to pole and are exactly 15° wide in longitude. In this system of zone time (ZT) the standard meridian is always the nearest meridian divisible by 15° of longitude. (See fig. 4-13.)

The zone is numbered for the multiple of 15° and labeled plus (+) if in west longitude and minus (-) if in east longitude. Thus, zone +1 extends from pole to pole 7 1/2° on each side of the standard meridian at 15°W, and zone -5 centered on 75°E, extends from 67 1/2°E to 82 1/2°E. The zero zone centered on Greenwich extends from 7 1/2°E to 7 1/2°W, and the twelfth zone centered on the 180th meridian, from 172 1/2°W, to 172 1/2°E; that half in west longitude being designated +12 and the half in east longitude -12. (See fig. 4-13.)

In the zone time system an instant of time is uniquely described by the time and the zone description (ZD) or letter suffix; for example, 1745 zone +5 or 1745 R. The limits, description, and letter suffix of each zone are shown in figure 4-13.

For brevity of communication, the zones are sometimes designated by a letter suffix (mentioned in the preceding paragraph) instead of a zone description. Thus, zones in east longitude are lettered A through M (omitting J),

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Figure 4-13.—Standard time zones.

and zones in west longitude are lettered N through Y. The letter Z is reserved for the zero zone, denoting Greenwich time, commonly referred to as ZULU time.

Zone Identification

One of the principal advantages of the zone time system in navigation is the ease with which any instant of time can be converted to GMT, or vice versa. In order to find the number for the ZD, you already know that you will divide any given longitude by 15°. If, when dividing, the remainder exceeds 7°30', add one unit to the answer that you received. For example, let us say that we desire to find the ZD for longitude 143°45'W. Immediately upon observing that it is a westerly longitude, we find the first component of our ZD to be a plus (+). Then we divide the longitude by 15° to find the zone in which we are located.

$$15^\circ \overline{)143^\circ 45'} \quad 9$$
$$\underline{135}$$
$$8^\circ 45'$$

Since the remainder exceeds 7°30', add one full unit to the quotient (9), resulting in a ZD of +10 removed in time from Greenwich. Figure 4-13 shows that longitude 143°45'W has a ZD of +10.

Zone Time, West

In examining figure 4-13, imagine the sun to be over the meridian 15°W. What time is it in the entire band from 7 1/2°W to 22 1/2°W? By referring to the basic rule we know that it is exactly 1200 in the entire time zone when the sun is exactly over the central meridian for that zone. What time is it now on the Greenwich meridian? It is one hour later, or 1300. Thus, GMT was found by adding the ZD, which obviously represents hours, to the ZT. From this calculation the formula

GMT = ZT + ZD

is derived, and consequently

ZT = GMT - ZD

GMT = ZT + ZD

GMT = 1200 + (+1)

GMT = 1300

and

ZT = GMT - ZD

ZT = 1300 - (+1)

ZT = 1200

At this point, if you are unfamiliar with the laws governing adding and subtracting signed (positive and negative) numbers, refer to Basic Mathematics, Volume I, NAVEDTRA 10069 (Series).

Zone Time, East

To determine times in east longitude, the same basic procedure and formulas are used. Imagine the sun directly over the meridian 30° east. What time is it at Greenwich? By referring to figure 4-13 or by dividing the longitude by 15, we know that the time zone or ZD is -2, and 30° east is the central meridian for this zone making the ZT 1200. Remembering that time is always later to the east and using the formulas we can determine the GMT.

GMT = ZT + ZD

GMT = 1200 + (-2)

GMT = 1000

(Adding unlike signs indicates subtraction.)

Time Conversions

Greenwich time provides a standard time to which all other times may be referred, and represents a most convenient method of determining times in different zones. For example, assume it is 1500 in a city in zone +5 (ZT_1), on 1 May, and you want to know the time in a city in zone -3 (ZT_2). Use the formulas as follows:

GMT = ZT_1 + ZD_1

GMT = 1500 + (5)

GMT = 2000

(Adding like signs is simply addition.)

ZT_2 = GMT - ZD_2

ZT_2 = 2000 - (-3)

ZT_2 = 2300

(Subtracting -3 is equivalent to adding +3.)

Frequently time conversion problems involve calculations which result in different dates. To see how this may happen, consider the apparent motion of the sun from 179° east longitude across the face of the chart in figure 4-13 to 179° west longitude. This suggests that exactly at 1200 on the 0° or Greenwich meridian, the date is the same around the world since in ZD - 12, ZT = 2400, and ZD+12, ZT = 0000 (ZT = GMT - ZD). This also suggests that each new day begins at the 180° meridian (international date line). Using Greenwich as the reference time to determine ZT in different ZDs, dates should be included in the calculation to maintain the correct day. Consider the following examples:

1. ZT = 0700, 15 June; ZD - 5. What is the correct time in ZD+4? Solution:

GMT = ZT + ZD

GMT = 0700, 15 June + (-5)

GMT = 0200, 15 June

ZT = GMT - ZD

ZT = 0200, 15 June - (+4)

(At this point we cannot subtract 4 hours from 0200, so we must add 24 hours (1 day) to the ZT to permit the mechanical operation of the problem. Since it is always later to the east, the 24 hours we are adding have already elapsed so we must subtract 1 day from the date.)

ZT = 2600, 14 June - (+4)

or

ZT = 2200, 14 June

2. ZT = 2100, 31 Aug., ZD+7. What is the correct time in ZD - 5? Solution:

GMT = ZT + ZD

GMT = 2100, 31 Aug. + (+7)

GMT = 2800, 31 Aug.

(Considering again that time is later to the east and the answer exceeds 24 hours, this would indicate that GMT = 0400, 1 Sep. However, it is usually more convenient to wait until the problem is complete to subtract the 24 hours.)

ZT = 2800, 31 Aug. - (-5)

ZT = 3300, 31 Aug.

or,

ZT = 0900, 1 Sep.

Chronometers and Time Signals

Time is determined in the various countries of the world by national observatories such as the U.S. Naval Observatory at Washington and the Royal Observatory at Greenwich. A bureau, coordinated by an international agency, sets up uniform computing procedures, compares time signals, etc.

Accurate time is essential in navigation and air traffic control. Chief among the navigational timepieces is the chronometer. It is a clock of unusually fine construction, designed for extreme accuracy and dependability, and built to withstand shock, vibration, and variations of temperature. Even a chronometer cannot keep exact time indefinitely. The chronometer is checked with a radio time signal to determine its accuracy.

On account of their simplicity and accuracy, time signals are transmitted mainly by radio. Naval Observatory time is broadcast in this country by the naval radio station NSS at Washington, D. C., NPG at San Francisco, Calif., and others. These broadcasts are sent on a continuous wave (CW) so that they can be heard only by receivers suited to code reception. Signals are transmitted during the last 5 minutes of the hour.

Station WWV at Fort Collins, Colo., continuously broadcasts signals based on Naval Observatory time. These broadcasts may be heard with any ordinary radio receiver. Complete schedules and information on Navy time signals can be found in FLIP, General Planning Section.

ELEMENTARY PLOTTING

From the time an aircraft departs one station until the time it arrives at its destination, the pilot or navigator is very busy. In order to get an aircraft to a given destination and back again, the navigator must keep an accurate account of the aircraft's progress on a chart, plus a complete record or log.

PLOTTING LINES OF POSITION (LOPs)

Suppose, for example, the aircraft is flying over a railroad, but its location along the length of the railroad is not known. If the railroad can be located on the chart, a line of position is established, but not a fix. Then, another railroad that crosses the first is seen. When the second railroad is located on the chart, the exact location of the aircraft along the first railroad is known. Thus, a fix is established. Remember, a fix is an accurate position. Therefore, a fix is determined when the aircraft is over two intersecting LOPs simultaneously.

With chart reading, a fix can often be obtained by finding a specific landmark. However, with other navigation aids, fixes are not obtained directly. Rather, with the exception of radar and TACAN, each fix is established by two or more LOPs which are independently obtained.

It has been seen that a LOP may be a visible line on the ground like a railroad track or another object of known position. However, a LOP is not usually visible until it is drawn on a chart. A radio LOP is obtained by finding the direction of a radio station from the aircraft by means of a radio compass. Having obtained this radio LOP, it is plotted on the chart. Once plotted, it is no different from one obtained by visual reference or by any other aid. LOPs of different types and origins may be crossed to obtain a fix.

LOPs ESTABLISHED BY BEARINGS

A bearing may be measured with reference to true north or with reference to the longitudinal axis of the aircraft; in either case, it is an angle between 0° and 360°.

There is a simple relationship between true heading (TH) of the aircraft, true bearings (TB) of an object, and relative bearing (RB) of an object. True heading is the angle measured from true north clockwise to the longitudinal (fore and aft) axis of the aircraft. Relative bearing is the angle measured from the longitudinal axis of the aircraft, clockwise to a line passing through an object. The sum of these two angles is the angle measured from true north clockwise to the line passing through the object. Therefore, this angle is the true bearing of the object expressed in the following equation:

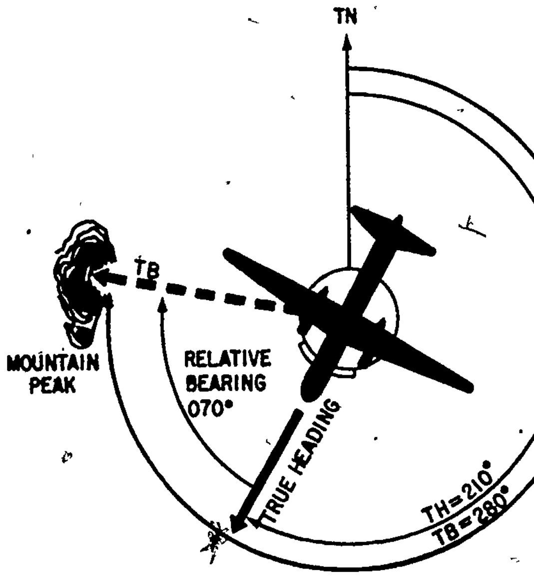

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Figure 4-14.—TH + RB = TB.

TH + RB = TB

Thus, to obtain the true bearing (TB), measure its relative bearing (RB) and add it to the true heading (TH) of the aircraft.

As illustrated in figure 4-14, an aircraft is flying a TH of 210°, and a relative bearing of 070° is obtained from a mountain peak. What is the true bearing of the peak? Add TH (210°) to RB (070°) to obtain TB (280°).

By changing the basic formula, you may obtain any one of three components if the other two are known. Thus, to find the true heading, change the formula to read TB - RB = TH. To find relative bearing, change the formula to read TB - TH = RB. Whenever an angle exceeds 360°, it is necessary to subtract 360° to determine the correct bearing.

PLOTTING FROM KNOWN POSITIONS

In plotting LOPs, it is obvious that a plot cannot be made from the aircraft's position as it is unknown. Plot the LOP from the origin, which is a known position. To plot the LOP, use the reciprocal of the true bearing of the object from the aircraft.

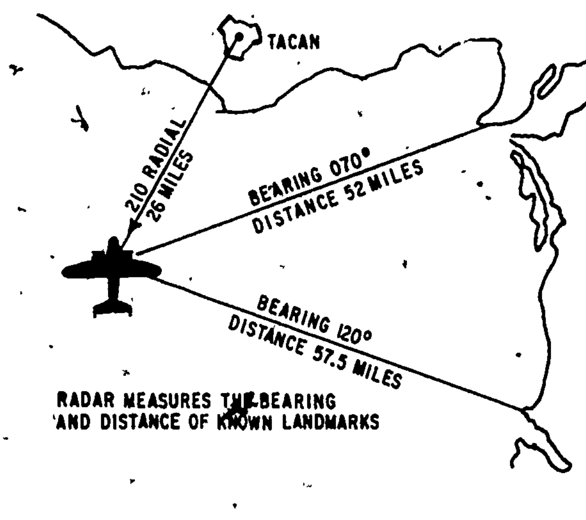

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Figure 4-15.—Positioning by RADAR and TACAN.

When using the plotter to draw a LOP, you need not compute the reciprocal mathematically. Simply align the plotter so that the point of origin lies on the straightedge and the center hole and true bearing (as read on the scale) are over the same meridian. Then draw the LOP toward your position.

Although two intersecting LOPs determine a fix, three intersecting LOPs give a more accurate fix. It is possible to combine a radio LOP with a radar LOP, or a loran LOP with a visual LOP, etc. If three LOPs intersect at one point, use that point for the fix. Usually, however, the errors in obtaining the LOPs and in plotting them will cause the LOPs to form a small triangle for the fix. When this happens, use the center of the triangle.

Positioning by RADAR and TACAN

Airborne radar is oriented so that 360° is represented by the nose of the aircraft. By use of a radar scope in the aircraft, the relative bearings and the distance the aircraft is from known landmarks can be determined, providing a fix. (See fig. 4-15.)

TACAN provides bearing and distance information. By use of aircraft instruments, the pilot can determine what TACAN radial his aircraft is on and its distance from the TACAN station. Since the position of the TACAN station is known, a fix, or the aircraft's position, can be determined relative to the TACAN station. (See fig. 4-15.)

AERONAUTICAL CHARTS

From ancient times, man has attempted to reproduce accurately the surface of a sphere on a plane surface. The procedure is similar to that of taking a hollow rubber ball and flattening it: the ball will stretch and split before it will flatten. This is exactly the problem which is encountered in chart construction. As in the case of the rubber ball, when the earth is displayed on a plane surface, some features are distorted and others are lost altogether. Much of the distortion is minimized with the introduction of various mathematical modifications of the geometric map, and the most desirable navigational properties can be accurately or very nearly accurately portrayed.

FACTORS IN CHART CONSTRUCTION

The surface of a sphere or spheroid is said to be undevelopable because no part of it may be spread out flat without distortion. A plane, cylinder, or cone, which can be easily flattened, is called a developable surface. The method of representing all or part of the surface of a sphere or spheroid on a plane surface is called a chart projection.

Geometric projections are actual projections of graticule (lines of latitude and longitude) of the reduced earth onto a developable surface. In theory, a chart could be constructed by placing a light source in a hollow plastic model of the earth with the parallels and meridians inscribed on it, and projecting this graticule on some developable surface. This surface, if it is not a plane, is unrolled to form a flat surface. Any chart that can be constructed in this manner is called a geometric or graphic projection. The appearance and properties of the resultant chart will depend upon two factors: The type of developable surface and the position of the light source within the plastic model of the earth. In actual practice, the projection is constructed mathematically.

Mathematical projections are constructed to provide certain properties which cannot, in theory, be constructed geometrically.

There are many projection methods available for use in chart construction. Each projection has distinctive features which make it preferable for certain uses. No one projection is best for all conditions. Some of the desirable features are:

1. Conformality. Conformality provides that the angle between intersecting curves on the earth will be preserved on the chart. For a chart to be conformal, parallels and meridians must intersect at right angles. In addition, scale or scale expansion must be the same along the meridian as it is along the parallel. Scale on a conformal chart will vary from point to point; but provided that the variation is the same in all directions, the requirement is met.

2. Constant and correct scale. An ideal model of the earth would have constant and correct scale; i.e., the distance of every place from every other place would bear a constant ratio to the true distance on the earth. Unfortunately, the earth's surface cannot be developed into a plane without stretching or shrinking, which prevents correct and constant scale representation over the entire projection.

3. Correct shape representation. To possess the property of correct shape, a chart must be conformal and the scale must be constant and correct in all directions. As pointed out previously, this latter prerequisite is not possible to obtain over the entire projection.

4. Straight line. The nature of a straight line on a chart is equally as important as conformality. The rhumb line (a line between any two points which crosses all meridians of the earth at the same oblique angle) and the great circle (defined previously in this chapter) are the two curves that a navigator might wish to have represented on a chart as a straight line. The rhumb line is desirable because it is convenient to fly, and the great circle is flown because it provides the shortest path between any two points.

5. Coordinates easy to locate. The geographic latitudes and longitudes of places should be easily found from their positions on the chart; conversely, positions should be easily plotted on the chart when the latitudes and longitudes are known.

Figure 4-16 shows types of projections and basic characteristics of the projections from which the majority of aeronautical charts used by ACs are constructed.

INFORMATION SHOWN ON AERONAUTICAL CHARTS

An aeronautical chart is a pictorial representation of the earth and its culture. It can provide a picture of any region of the earth.

Several miscellaneous terms frequently utilized in reference to aeronautical charts are defined as follows:

1. Small scale chart. A chart portraying large areas, as the world, a hemisphere, continent, or a country. Usually this is referenced to scales of 1:2,000,000; 1:5,000,000, etc.

2. Large scale chart. A chart portraying small areas with a relatively large amount of detail, as an area of less than state or county size. Usually this refers to scales of larger than 1:1,000,000, such as 1:500,000; 1:200,000; or 1:100,000.

3. Graticule. This is the portrayal of meridians of longitude and parallels of latitudes.

4. Base detail. This includes all features portrayed on the chart other than those on the aeronautical or grid overprint. It includes relief, culture, hydrography and vegetation.

5. Contours. A contour is represented by a line on a chart connecting all points of a given elevation above sea level. The shoreline of an ocean may be considered as the mean 0-foot contour. On a steep slope contours are close together; on a gentle slope they are farther apart.

6. Gradient tints. This means different colors used to depict intervals between certain contour lines.

7. Spot elevations. A dot with an elevation value depicts an accurately measured elevation above sea level at a specific location. On some charts a small "x" is used to indicate an approximate elevation at a specific location. If the exact location of an elevation is unknown, only the figures are shown.

8. Water tint. This depicts open water areas such as oceans and lakes by a solid tint, usually a light blue.

9. Water vignette. This is an alternate treatment of open water wherein the water is

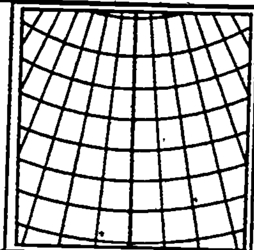
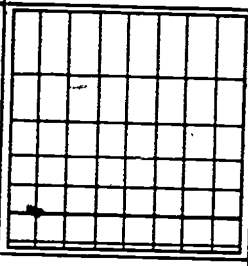
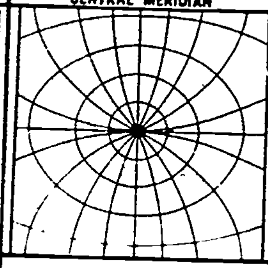
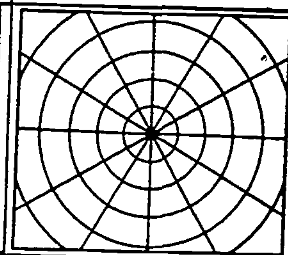
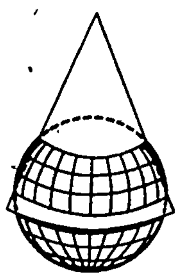
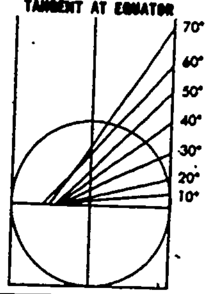
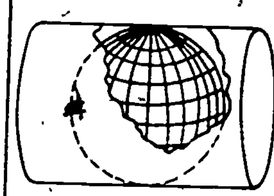
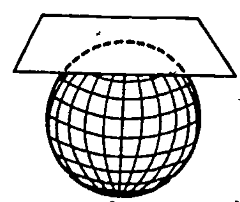
CHARACTERISTICS	LAMBERT CONFORMAL	MERCATOR	TRANSVERSE MERCATOR	POLAR STEREOGRAPHIC
PARALLELS	ARCS OF CONCENTRIC CIRCLES NEARLY EQUALLY SPACED	PARALLEL STRAIGHT LINES UNEQUALLY SPACED	CURVES CONCAVE TOWARD NEAREST POLE	CONCENTRIC CIRCLES UNEQUALLY SPACED
MERIDIANS	STRAIGHT LINES CONVERGING AT THE POLE	PARALLEL STRAIGHT LINES EQUALLY SPACED	COMPLEX CURVES CONCAVE TOWARD CENTRAL MERIDIAN	STRAIGHT LINES RADIATING FROM THE POLE
APPEARANCE OF GRID				
ANGLE BETWEEN PARALLELS & MERIDIANS	90°	90°	90°	90°
STRAIGHT LINE CROSSES MERIDIANS	VARIABLE ANGLE (APPROXIMATES GREAT CIRCLE)	CONSTANT ANGLE (RHUMB LINE)	VARIABLE ANGLE	VARIABLE ANGLE (APPROXIMATES GREAT CIRCLE)
GREAT CIRCLE	APPROXIMATED BY STRAIGHT LINE	CURVED LINE (EXCEPT EQUATOR AND MERIDIANS)	CURVED LINE	APPROXIMATED BY STRAIGHT LINE
RHUMB LINE	CURVED LINE	STRAIGHT LINE	CURVED LINE	CURVED LINE
DISTANCE SCALE	NEARLY CONSTANT	MID-LATITUDE		NEARLY CONSTANT EXCEPT ON SMALL SCALE CHARTS
GRAPHIC ILLUSTRATION	SECANT CONE 	CYLINDER TANGENT AT EQUATOR 		PLANE TANGENT AT POLE 
ORIGIN OF PROJECTORS	CENTER OF SPHERE (FOR ILLUSTRATION ONLY)	CENTER OF SPHERE (FOR ILLUSTRATION ONLY)	CENTER OF SPHERE (FOR ILLUSTRATION ONLY)	OPPOSITE POLE
DISTORTION OF SHAPES & AREAS	VERY LITTLE	INCREASES AWAY FROM EQUATOR	INCREASES AWAY FROM MERIDIAN OF TRUE SCALE	INCREASES AWAY FROM POLE
METHOD OF PRODUCTION	MATHEMATICAL	MATHEMATICAL	MATHEMATICAL	GRAPHIC OR MATHEMATICAL
NAVIGATIONAL USES	PILOTAGE AND RADIO (SUITABLE FOR ALL TYPES)	DEAD RECKONING AND CELESTIAL (SUITABLE FOR ALL TYPES)	GRID NAVIGATION IN POLAR AREAS	POLAR NAVIGATION, ALL TYPES
CONFORMALITY	CONFORMAL	CONFORMAL	CONFORMAL	CONFORMAL

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Figure 4-16.—Chart projections.

depicted with a deep or dark tone along the shoreline and rapidly but evenly lightened in tone with progression outward from the shore to a blank or white portrayal. This technique makes a chart with large white open water areas easier to plot on, and accentuates small bodies of water and small islands.

10. Land tint. Land tint is a solid tint over all land area with no gradient tints and often no contours.

11. Relief. This refers to physical features related to the relative differences in elevation of the land surface. It includes features such as mountains, hills, plateaus, plains, depressions, etc. Complexity of relief features is dependent upon scale and/or contour interval used. Generally large scale charts show many relief features, whereas very small scale charts can only show major mountain masses.

12. Culture. Culture includes populated places, roads, railroads, installations, miscellaneous construction, such as dams, bridges, and mines. Standard symbology is used. Density of portrayal is related to chart scale, chart use, and the geographic area covered.

13. Hydrography. Hydrography includes coast lines, oceans, lakes, rivers and streams, canals, swamps, reefs, etc. Density is indicated by reference to the principal or detailed drainage. Open water may be portrayed by water tint or vignette, or may be left blank.

14. Vegetation. This is not shown on most small scale charts. Forests and wooded areas in certain parts of the world are shown on some medium scale charts. Some large scale charts have park areas, orchards, hedgerows, and vineyards.

15. Aeronautical information includes airfields; electronic communications and navigational facilities such as radio beacons, VORs, D.F. stations, and broadcast stations; ADIZs, compulsory corridors, restricted airspace, and warning notes; lines of magnetic variation; and navigation grids.

The amount of detail, extent of features portrayed, and the density of information shown on a chart are governed by the designed purpose of the chart, and the altitude, range, and aircraft performance category for which the chart was designed. In other words, an attempt has been made to portray only that information which will be appropriate to and significant for the altitudes and speed ranges utilized in accomplishing the types of missions for which the chart was designed.

CHART, SOURCE, CORRECTIONS, AND PROCUREMENT

The importance of the availability of up-to-date Aeronautical Charts and Flight Information Publications at ATC facilities cannot be overemphasized.

Outdated or incorrect charts and publications have been the source of countless aircraft accidents and incidents.

ACs are required to possess a thorough knowledge of the procurement and maintenance of those charts and publications required at their facilities.

It is realized that the responsibility for this function is normally assigned to the Flight Planning/Approval Branch supervisor, but it remains incumbent upon all personnel assigned to this branch to become proficient in this vital area of flight safety.

Requisitioning and Distribution

The DOD Catalog of Aeronautical Charts and Flight Information Publications is a looseleaf-type publication which contains six sections as follows:

I. General information.
II. Requisitioning and distribution.
III. Flight information publications.
IV. Navigational charts.
V. General planning.
VI. Special purpose.

Sections II, III, and IV contain information relating to this chapter. Procedures utilized in the requisition and distribution of aeronautical charts and publications are found in Section II. Section III consists of a listing of all Flight Information Publications available. Section IV contains a list of Navigational Charts.

The catalog is kept current by semiannual publication of new or replacement pages containing changes or additions. There is also a classified DOD Catalog of Aeronautical Charts and Publications of similar construction for ordering classified charts and publications.

Whenever new or revised charts are needed by members of the naval service, all requests should be submitted on Form DD 1149 (shown in fig. 4-17) to the nearest Defense Mapping Agency Hydrographic Center Office or Defense Mapping Agency Hydrographic Center Depot.

The general stocking pattern of the Defense Mapping Agency Hydrographic Center distribution system is as follows:

1. DMA Hydrographic Center Depots, of which there are two: Clearfield, Utah, which supports the Pacific area and the continental U. S. (CONUS) west of the Mississippi River; Philadelphia, Pa., which supports the Atlantic area and CONUS east of the Mississippi River.

2. DMA Hydrographic Center Offices, of which there are three to provide service to the west coast and Pacific area and three to provide service to the east coast and the Atlantic area. They stock and issue aeronautical charts and publications, selected periodicals, air intelligence publications, and Army maps. Additionally, selected nautical chart portfolios and related publications are stocked uncorrected for emergency issue.

For complete mailing addresses, refer to the DOD Catalog of Aeronautical Charts and Flight Information Publications, section II.

Chart Maintenance

Charts available at Flight Planning are kept current by the following publications:

1. DOD Aeronautical Chart Updating Manual (CHUM), which contains:

a. A cumulative listing of significant additions or corrections to be considered when using current editions of USAF/USN published aeronautical charts.

b. Notices of special interest to aeronautical chart users.

NOTE: The CHUM should be made available to flight crews for use during preflight planning.

2. DOD Aeronautical Chart Bulletin, published monthly, which contains availability of new charts and publications; new editions of previously published charts; discontinued charts; and notices of special use to requisitioners.

Place this bulletin in the front of the DOD Catalog.

3. DOD Aeronautical Chart Bulletin Digest published semiannually which contains listings of current editions of charts on issue.

Naval activities are also provided with Memorandum to Aviators and NOTAMs which may include corrections to charts.

For a detailed listing of FLIPs and other associated publications required at ATC Flight Planning facilities refer to OPNAVINST 3721.1 (Series).

A partial listing of these publications can be found in chapter 14 of this Rate Training Manual.

FLIGHT PACKETS

PURPOSE

The purpose of a flight packet is to provide the pilot with the necessary tools (charts, approach plates, gas chits, flashlights, etc.) to complete the flight.

These flight packets (or nav kits, as they are more commonly called) are vitally important to each pilot as he prepares to depart on most types of flights. However, the mission of the flight, type of aircraft utilized, and the geographical location of the station cause the contents of the flight packet to vary.

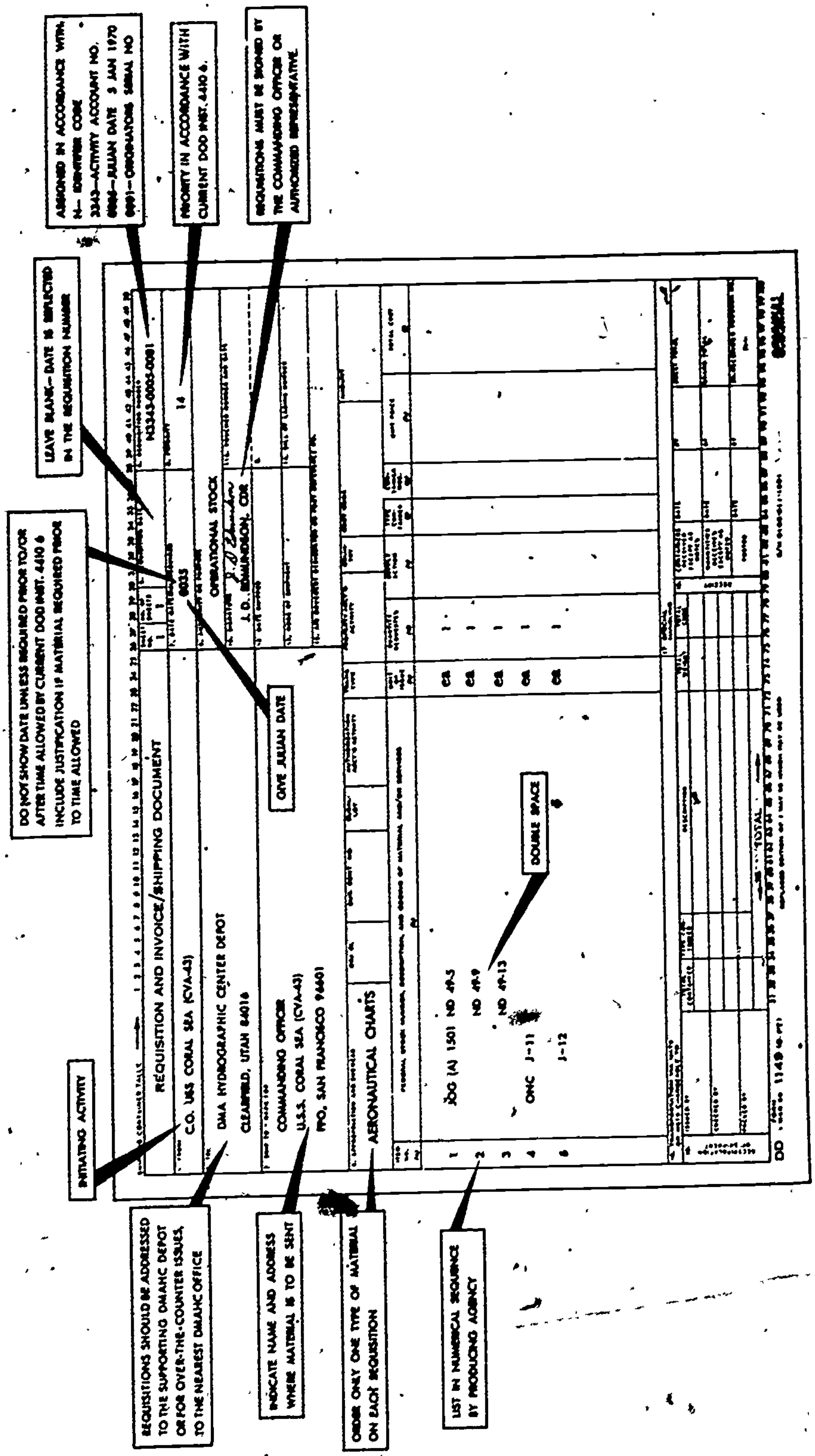
ASSEMBLY

The following items constitute the minimum required articles to be included in flight packets:

1. Appropriate Flight Information Publications (FLIPs).
2. Navigation computer.
3. Navigation Flight Log Forms.
4. Appropriate aeronautical charts.

Flight packets are maintained in the Flight Planning/Approval Branch for station aircraft only; that is, aircraft for which the station commanding officer is reporting custodian or for which he has responsibility. This usually limits the number of flight packets to 5 or less. Squadrons, units, etc., based at the facility maintain their own flight packets for their use.

Normally, the pilot or a representative of his crew stops at the flight planning room to obtain a flight packet prior to preparing his flight plan. Figure 4-18 is a sample flight packet checklist. This form can be expanded or shortened to meet the needs of the station. The pilot or his representative, when presented



201.90.1

Figure 4-17.—DD Form 1149 (9PT).

NAVKIT/FLIGHT PACKET RECEIPT
CNATRA-GEN 3710/3 (Rev. 8-69)

PILOT'S NAME	RANK	ISSUED BY		PACKET NO.
BELL, W.R.	LCDR	FRENCH, R		9
		UNIT ATTACHED	PHONE	DATE
		NAS	366	6-25-75

NAVIGATION KIT ITEM	OUT	IN	MISCELLANEOUS EQUIPMENT ITEM	OUT	IN
ENROUTE SUPPLEMENT IFR VFR	✓		WEIGHT AND BALANCE BOOK		
ENROUTE HI/LO ALTITUDE CHART	✓		LOAD ADJUSTER		
AREA ARRIVAL CHARTS			COMPUTER	✓	
APPROACH PROC. NEUS			PLOTTER		
APPROACH PROC. SEUS	✓		DIVIDER SET		
APPROACH PROC. NWUS			CHRONOMETER		
APPROACH PROC. SWUS			SEXTANT		
AERODROME SKETCHES			FLASHLIGHT	✓	
FOREIGN FLIP SET HI/LO			IFR HOOD		
			PENCILS	✓	
			UNSAT MATERIAL REPORT (UR) NAVAIR FORM 13070/5		

PROCUREMENT DOCUMENTS

DD FORM 1348 NUMBER	USED	DD FORM 1149 NUMBER	USED	STANDARD FORM 44 NUMBER	USED
309871				1256031	
309872				1256032	
309873					

TO BE COMPLETED BY PILOT *(If any of above listed documents used)*

The procurement documents checked above were used and copies are attached. Unless otherwise indicated below, no other obligations were incurred by me during the period from ________ to ________.

PILOT'S SIGNATURE ________ DATE ________

201.91

Figure 4-18. — Flight packet checklist.

one of these forms, fills out the top portion. Then the Air Controlman can quickly assemble those items that the pilot or his representative has indicated as being required for the particular flight.

A checklist such as shown in figure 4-18 not only allows the pilot or his representative to select the items deemed necessary for the flight but also greatly reduces the chance of an item being left out. In addition, the form serves as a temporary custody receipt. This is very important, as the value of the items that might be included in a flight packet may vary from a few cents to several hundred dollars.

CHAPTER 5

FLIGHT SERVICES

The importance of the assistance provided to pilots by Air Controlmen assigned to the flight planning/approval branch of an Air Traffic Control Facility cannot be overemphasized. There are countless numbers of incidents and accidents on record which could have been averted had the AC scrutinized a flight plan more thoroughly for completeness or discrepancies and relayed a particular item of importance to another airport. A careful study of this chapter and the references cited in it, coupled with close attention to detail, will assist you in becoming better prepared to carry out your assigned duties in this important phase of air traffic control.

FLIGHT HANDLING

The pilot in command of a flight is responsible for assuring that the appropriate flight service agency will be furnished with the essential elements of the flight plan as initially approved and a takeoff report. Delivery of a properly prepared flight plan-form to duty personnel at an established base operations office at the point of departure relieves the pilot of such responsibility. The local clearance authority must then ensure that the appropriate flight service agency is furnished the flight plan and takeoff report by duty personnel upon acceptance of the flight plan-form.

The pilot in command is also responsible for assuring that the appropriate flight service agency will be furnished a landing report (closeout) upon arrival at destination. Delivery of a copy of an executed flight plan-form to destination base operations duty personnel satisfies this responsibility. The local flight clearance authority must then ensure that duty personnel furnish the appropriate flight service agency with the landing report upon acceptance of the flight plan-form.

PREFLIGHT PLANNING BY PILOTS

OPNAV Instruction 3710.7 (Series) states that: "Before commencing a flight, the pilot in command shall familiarize himself with all available information appropriate to the intended operation. This information should include but is not limited to available weather reports and forecasts, NOTAM, fuel requirements, alternatives available if the flight cannot be completed as planned, and any anticipated traffic delays."

The pilot in command of a naval aircraft, or group of aircraft proceeding as a unit, must prepare and submit to the local ATC Facility a flight plan appropriate for the intended operation except:

1. Flights of urgent military necessity.
2. Student training flights under the jurisdiction of the Naval Air Training Command for which adequate flight guard is provided.

Although the overall responsibility for preflight planning rests with the pilot in command, the Air Controlman, as has been previously noted, shares in this responsibility. You must ensure that charts and publications are up to date and available for the pilot's use and you must remain abreast of recent changes which affect the safety of flight.

FLIGHT PLAN FORMS

DD Form 175

The DD 175 Military Flight Plan (fig. 5-1) must be used for all flights within the North American (NAM) Region and the Honolulu and San Juan domestic control areas.

NOTE: The NAM Region includes the Continental U.S. and Canada to the North Pole.

Flights departing from U.S. installations not having a military base operations facility may use FAA Flight Plan Form 7233-1.

Instructions for completing the DD Form 175 are contained in the FLIP Planning Manual, Section II.

MILITARY FLIGHT PLAN

AIRCRAFT UNIT OF ASSIGNMENT/HOME STATION	AIRCRAFT SERIAL NO.
NQA	133157

TYPE OF FLIGHT PLAN	RADIO CALL	AIRCRAFT DESIGNATION/TD CODE	ESTIMATED TRUE AIRSPEED	DEPARTURE TIME (Z) PROPOSED	ACTUAL
☑ IFR ☐ DVFR ☐ VFR ☐ FVFR	VV4M157	TS-2 A/B	170	0800	0805

INITIAL CRUISING ALTITUDE	POINT OF DEPARTURE	STANDARD INSTRUMENT DEPARTURE: NAME AND NUMBER	TO
10,000	NQA	RADAR VECTORS	MEM

IFR	VFR	ROUTE OF FLIGHT	TO	ETE
✓		→ MEM V9 JAN V11 MOB		
		V242 BFM V198 NUN	NPA	2+25
✓		170 80 NUN V198 BFM		
		V242 MOB V11 JAN		
		V9 MEM (5+30 BYH 0+18)	NQA	2+40

REMARKS: ONE HOUR DELAY NPA TO REFUEL

RANK/HONOR CODE	PSGR/CARGO CODE
	M4 VOID 6+00

HOURS FUEL ON BOARD	DIST TO DESTN	ALTERNATE AIR FIELD	ETE TO ALTN	NOTAMS	DD FORM 365F (Wt. and Bal.)	WEATHER	REQUEST CLEARANCE AFTER
5+30	382	NAS WHITING	0+20	✓	FILED NQA	✓	0745

INST RATING	SIGNATURE OF PILOT IN COMMAND	SIGNATURE OF APPROVING AUTHORITY	DATE
SPECIAL	WR Bell	H. L. Holt	11 MAR 75

CREW/PASSENGER LIST — ☐ Attached ☐ See Passenger Manifest

DUTY	NAME AND INITIALS	GRADE	SERVICE NO.	ORGANIZATION AND LOCATION
PILOT IN COMMAND	BELL, W.R.	LCDR	518286	NTPC/NQA
C.P.	BUDREJKO, D.S.	LTJG	754162	NTPC/NQA
	BAYER, N.C.	ACCS	2807937	NTPC/NQA
	McCOY, J.D.	YNC	2297807	NTPC/NQA

DD FORM 1 JUL 66 175 PREVIOUS EDITION OF THIS FORM WILL BE USED UNTIL STOCK IS EXHAUSTED. 0102-001-6500

201.4

Figure 5-1.—DD Form 175.

DD Form 175-1
(Flight Weather Briefing)

This form is not utilized as a flight plan by pilots, but since it is so closely associated with the planning phase of flight it will be discussed at this time.

1. GENERAL. Pilots are responsible for reviewing and being familiar with weather conditions for the area in which the flight is contemplated. Where Naval Weather Services are available, weather briefings shall be conducted by a qualified meteorological forecaster. They may be conducted in person or by telephonic, autographic, or weathervision means.

2. FLIGHT WEATHER BRIEFING FORM. A DD Form 175-1 (Flight Weather Briefing), (fig. 5-2), shall be completed for all flights to be conducted in accordance with instrument flight rules, when military weather services are available. The forecaster shall complete the form for briefings conducted in person and for autographic briefings. It is the pilot's responsibility to complete the form for telephonic or weathervision briefings. For VFR flights using the DD-175, the following certification on the flight plan may be used in lieu of a completed DD Form 175-1:

BRIEFING VOID ______Z, FLIGHT AS PLANNED CAN BE CONDUCTED UNDER VISUAL FLIGHT RULES. VERBAL BRIEFING GIVEN AND HAZARDS EXPLAINED.

(Signature of forecaster)

ACs should assist pilots in ensuring that the weather briefing is still valid at takeoff. The weather briefing void time is normally one-half hour after estimated time of departure (ETD). Except under unusual circumstances, this should not exceed 2 hours from the actual time of weather entries on the DD Form 175-1. Methods of checking weather briefing void times vary between facilities, but most require that the void time be included on the flight progress strips (discussed later in this chapter) used to maintain a file of current air operations.

Daily Flight Schedule/
Abbreviated DD Form 175

Clearance authorities may authorize the use of the daily flight schedule or an abbreviated DD Form 175 signed by the pilot in command, with the word LOCAL contained in the route of flight block, for clearing aircraft for flight within the established local flying area and adjacent offshore training areas provided that the following conditions apply:

1. Sufficient information is included to satisfy the needs of the local facility which guards the flight.

2. Base operations maintains cognizance of each flight and is responsible for initiating any overdue action or in-flight advisory service necessary.

3. Completed flight schedules are retained in base operations files for 90 days.

4. Flights are not conducted IFR within controlled airspace except as jointly agreed upon in writing between the local command and the air traffic control agency concerned.

DD Form 1801—DOD International
Flight Plan

DD Form 1801 is utilized for flights planning to operate in international airspace in accordance with International Civil Aviation Organization (ICAO) rules.

This flight plan is used when flight will originate within the North American Region (NAM) and proceed nonstop beyond the NAM region and for all other flights outside of the NAM region.

Detailed information pertaining to the DD Form 1801 and ICAO flight plans is contained in FLIP Planning, General Planning Section.

Handling of Flight Plan Forms

Approval of flight plans for aircraft of other military services must be in accordance with the individual service directives for those aircraft. FAA regulations are utilized to govern approval of flight plans for civil aircraft.

The concurrence of the pilot in command is required prior to any modification of a written Flight Plan Form.

It should be noted that copies of the flight plan and weather forms must be retained on file at the point of departure for 3 months; the same applies for copies of these forms turned in at point of landing.

STOPOVER FLIGHT PLANS

Flights which involve en route stops within the United States are authorized to utilize a single DD Form 175, provided that the following procedures are followed:

1. The DD Form 175 is prepared in accordance with the applicable instructions contained in the FLIP (Planning).

FLIGHT WEATHER BRIEFING

I. MISSION

DEP/ETD	DEST/ETA	ALTN/ETA	BRIEFING NO.	DATE	ACFT/NUMBER
0800 Z	1405 Z	1425 Z	140	11 MAR 1975	133157

II. TAKEOFF DATA

RUNWAY TEMP	DEWPOINT	SFC WIND	TEMP DEV	PRESSURE ALT	DENSITY ALT	RCR
16 °C	12 °C	2912	0 °C	+92 FT	FT	

CLIMB WINDS 270/14 — LOCAL WEA WARNING OR MET WATCH ADVISORY

REMARKS/TAKEOFF ALTN FCST

III. ENROUTE DATA

FLT LEVEL 10,000 — FLT LEVEL WINDS/TEMP 270/30 −8°C

CLOUDS AT FLT LEVEL: ☑ YES ☐ NO ☐ IN AND OUT

MINIMUM VISIBILITY AT FLT LEVEL OUTSIDE CLOUDS 5-7 MILES, DUE TO: ☐ SMOKE ☐ DUST ☐ HAZE ☐ FOG ☑ PRECIPITATION ☐ NO OBSTRUCTION

MINIMUM CEILING	LOCATION	MAXIMUM CLOUDS TOPS	LOCATION	MINIMUM FREEZING LEVEL	LOCATION
2,000 FT AGL	JAN	15,000 FT MSL	JAN-CBM	7000 FT MSL	JAN

THUNDERSTORMS (within fifty miles of route): MWWA NO.

	NONE	AREA	LINE
✓			
ISOLATED 1-2%			
FEW 3-15%			
SCATTERED 16-45%			
NUMEROUS-MORE THAN 45%			

HAIL, SVR TURB, SEVERE ICING, AND PRECIPITATION EXPECTED IN AND NEAR TSTMS. LOCATION

TURBULENCE (within ten miles of route not associated with TSTMS): CAT ADVISORY Z

	IN CLEAR	IN CLOUD
NONE		
LIGHT	✓	
MOD		
SVR		
EXTREME		

LEVELS 8000 - 9000; LOCATION JAN - BFM

ICING (within ten miles of route not associated with TSTMS): NONE

	RIME	MIXED	CLEAR
TRACE			
LIGHT	✓		
MOD			
SVR			

LEVELS 9000; LOCATION NPA

PRECIPITATION (within ten miles of route not associated with TSTMS): NONE

	DRIZ	RAIN	SNOW	SLEET
LIGHT				
MOD		✓		
HEAVY				
SHWRS		✓		
FRZG				

LOCATION NPA

IV. TERMINAL FORECASTS

	DESTINATION	CLOUD LAYERS	VIS/WEA	SFC WIND	ALTIMETER	VALID TIME
	NQA	25 Ⓞ 100 ⊕	7	2406	2992 INS	1305 Z TO 1505 Z
ALTERNATE	NSE	22 Ⓞ 70 ⊕	4RW-	2108	2995 INS	0945 Z TO 1145 Z
INTMED STOP	NPA	25 Ⓞ 80 ⊕	5RW-	2210	2994 INS	0925 Z TO 1125 Z
INTMED STOP					INS	Z TO Z

V. COMMENTS/REMARKS

VI. BRIEFING RECORD

BRIEFED ON LATEST RCR FOR DEST AND ALTN ☑ YES ☐ NOT AVAILABLE — VOID TIME 0830 Z

REQUEST PIREP AT — EXTENDED TO Z

SEE FLIMSY NO.	WEA BRIEFED	FORECASTER'S SIGNATURE	WEA REBRIEFED AT Z / FORECASTER'S INITIALS
	0700 Z	AG1 D. Shelton	

WEA FCLTY	TAPE NO.	START	STOP	PHONE CHARGE	NAME OF PERSON RECEIVING BRIEFING
		Z	Z		

DD FORM 1 JUN 70 175-1 PREVIOUS EDITION WILL BE USED. S/N 0102-001-6701

201.5

Figure 5-2.—DD Form 175-1.

2. A weather and NOTAM briefing for the planned route of flight is obtained. Weather data entered on the DD Form 175-1 must indicate forecast conditions for each leg of the flight, destination, and each alternate (if required). In addition, pilots are required to maintain a check as necessary to ascertain if an aviation severe weather forecast (WW) has developed or is forecast along the proposed route of flight.

3. Ensure that the weather at each point of intended landing and the alternate (if required) is equal to or better than the minima prescribed in OPNAV Instruction 3710.7 (Series).

4. No change of the pilot in command of the aircraft as originally filed is made.

5. When a change of passengers or crew occurs, a corrected manifest must be available at the en route station where the change takes place.

6. Weight and balance requirements are adhered to.

7. When conducting IFR Operations after the first leg of flight, the pilot must notify the Flight Service Station (FSS) serving the next stopover point of his ETD from that field.

8. The pilot must obtain an IFR clearance from ATC at each stopover point if one is required.

9. A revised flight plan VOID time must be filed with the appropriate FSS if required.

NOTE: For all stopover flights, a VOID time is entered in remarks. Such VOID times are computed by adding the ETE for each leg of the flight and the total estimated ground time for all stopovers to the ETD as entered on the flight plan; e.g., "VOID 6+05."

10. In the event the flight is terminated at an intermediate base, the pilot is required to ensure that the balance of the original flight plan is closed out.

With regard to item 6 concerning Stopover Flight Plans, although ACs are not normally concerned with the weight and balance requirements for military aircraft, a brief description of the pilot's responsibility in this vital area is included to acquaint you with this requirement.

Requirements for aircraft weight and balance control are contained in NAVAIRSYSCOM Instruction 13060.2 (Series) and the NATOPS Flight Manual for the particular type aircraft involved. These directives specify the maximum operating weights, center of gravity limitations, and restrictions.

Aircraft are classified as IA and IB (attack, fighter, and trainer) with the majority of patrol and cargo aircraft being class 2. The responsibility for ensuring safe loading of class IA and class IB rests with the reporting custodians.

The pilot in command of a class 2 aircraft certifies by his signature on the DD Form 175 that the aircraft's weight and center of gravity will be within safe limits at the time of takeoff and remain so for the duration of the flight. Such a pilot will submit a completed weight and balance form (DD Form 365F) (fig. 5-3) which represents the actual loading of the aircraft with the DD Form 175 or, by his signature, certify that a completed DD Form 365F, dated within the previous 3 months and which represents the actual loading of the aircraft, is on file at the aircraft's home base.

When a DD Form 365F is filed with the approval authority it should be retained for a period of 3 months.

SHORE/SHIP OPERATIONS

Prior to flight from a shore activity to a ship operating in an offshore area when a landing aboard the ship is intended, the pilot in command must file a flight plan. A DD Form 175 is required for IFR flight. A daily flight schedule or abbreviated DD Form 175 may be used for VFR flight.

Prior to flight from a ship operating in an offshore area to a shore activity where a landing is intended, the pilot in command must file a flight plan with the ship. The ship will relay the flight plan to the shore activity. If no communications link is available, the pilot should file his flight plan with the nearest shore activity by radio as soon as possible after takeoff.

Clearing authorities and, subsequently, duty personnel at base operations, are responsible for ensuring timely handling of flight movement information for each ship/shore operation.

Flight suspense for search and rescue purposes becomes the responsibility of the destination activity after acknowledging receipt of a flight plan.

When such flights will penetrate or operate within an ADIZ or DEWIZ (discussed in chapter 3) the appropriate air defense command must also be informed of the operation.

FLIGHT PLAN CODES

Various codes are established concerning highest rank aboard, VIP honors requested, and cargo/passenger control information for the purpose of brevity when processing information contained in the remarks section of a DD Form 175. (See fig. 5-1.) ACs are responsible for

WEIGHT AND BALANCE CLEARANCE FORM F
TACTICAL
(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN T O 1-1B-40 & AN 01-1B-40

DATE	AIRPLANE TYPE	FROM	HOME STATION
4 APRIL 1975	SP-2H	NQA	NQA
MISSION/TRIP/FLIGHT/NO.	SERIAL NO. 144681	TO PNA	PILOT W.R. BELL

REMARKS

REF	ITEM	WEIGHT	INDEX OR MOM
1	BASIC AIRPLANE (From Chart C)	53919	830
2	OIL (120 Gal.)	1200	838
3	DISTRIBUTION OF LOAD		

COMPT	CREW NO.	CREW WEIGHT	BAGGAGE	CARGO AND MISC.	WEIGHT	INDEX OR MOM
B	3	200 ea			600	701
C	5	200 ea	100		1100	551
D	3	200 ea			600	585
E			300			639

COMPUTER PLATE NO. (If used)

Pertinent instructions to the pilot for shifting load and crew during takeoff and landing should be noted above

REF	ITEM	WEIGHT	INDEX OR MOM
4	OPERATING WEIGHT	57419	634
5	AMMUNITION — COMPT / ROUNDS / CALIBER		
6	BOMBS, ROCKETS, ETC. — FORWARD		
	SONOS-60	900	839
	PDC-50	250	891
	EXTERNAL		
	ROCKETS		
7	FUEL — BUILT IN (Gal.)	13680	890
	BOMB BAY (Gal.)		
	EXTERNAL (Gal.)		
8	WATER INJ FLUID (Gal.)	375	868
9	JATO OR RATO		
10	TAKEOFF CONDITION (Uncorrected)	72624	868
11	CORRECTIONS (If required)		
12	TAKEOFF CONDITION (Corrected)		
13	TAKEOFF C. G. IN % M. A. C. OR IN.	31.1%	
14	LESS EXPENDABLES — JATO OR RATO		
	BOMBS		
	AMMUNITION		
	FUEL	11000	879
15	ESTIMATED LANDING CONDITION	61624	879
16	ESTIMATED LANDING C. G. IN % M. A. C. OR IN.	29.9%	

CORRECTIONS (Ref 11)

COMPT.	ITEM	CHANGES (+ or −) WEIGHT	INDEX OR MOM
TOTAL WEIGHT REMOVED		−	−
TOTAL WEIGHT ADDED		+	+
NET DIFFERENCE (Ref. 11)			

LIMITATIONS

[1] GROSS WT. TAKEOFF (lb)	[2] GROSS WT. LANDING (lb.)	
[3] PERMISSIBLE C. G. TAKEOFF	FROM	TO (% M. A. C. or IN)
[4] PERMISSIBLE C. G. LANDING	FROM	TO (% M. A. C. or IN)

1 *Enter constant used*
2 *Enter values from current applicable T. O.*
3 *Applicable to gross weight (Ref. 12).*
4 *Applicable to gross weight (Ref. 15)*

COMPUTED BY (Signature) AN3 D.E. Venn
WEIGHT AND BALANCE AUTHORITY (Signature) CDR J.O. Landaker
PILOT (Signature) LCDR W. R. Bell

DD FORM 1 SEPT 54 365F

201.6

Figure 5-3.—DD Form 365F.

ensuring that timely action is effected and appropriate personnel are made aware of such information.

Since these codes are quite lengthy and subject to relatively frequent changes, they are not listed in this training manual. The AC should refer to a current edition of Flight Information Publication, Planning, Section II, for accurate and complete information contained in flight plan codes. OPNAVINST 3722.8 (Series) is also a good reference for flight plan codes.

RELAY OF FLIGHT DATA

A Flight Service Station (FSS) is a facility within the National Airspace System (NAS) having the prime responsibility for en route communications with VFR flights, assisting lost VFR aircraft, and accepting and closing flight plans.

Services that FSSs provide, in addition to the services already mentioned, are the dissemination of Notices to Airmen (NOTAM), assisting in the search for missing VFR aircraft, and operating the national teletypewriter systems.

An agreement between the FAA and Department of Defense (DOD) provides that the FAA assume certain communications functions dealing with military flight plans and related messages. Designated FSSs, called tie-in stations, are connected to adjacent military bases by local interphone for handling traffic. This does not include flights to or from carriers, which are handled via Navy communications.

The FAA uses two interphone systems for the purpose of rapid voice communications. Service F is an interphone system which connects ARTCCs and associated terminal facilities for handling IFR movement and control messages which are time-critical. Flight Service Interphone is the landline connection between tie-in stations and adjacent military bases to handle messages between such stations for entry into the teletype circuit.

Interphone Procedure

The equipment used with interphone systems varies according to local requirements; i.e., loudspeaker, handset, headset, manual signaling by use of pushbutton, key, or dial, etc. Generally, naval facilities have a loudspeaker at the necessary control positions which must be monitored continuously since they will be called by voice. To call the center or flight service (tie-in FSS), there is usually a pushbutton or dial to engage which activates a buzzer or light at the facility called. There may be several stations on one circuit, all of which may be called by voice except the center or flight service. Each termination on the line has a transmit and receive capability. Voice recorders may be installed to monitor and record the systems.

Standard phraseology must be used on the interphone systems. Messages are terminated with operating initials (locally assigned all ACs). The following are examples of interphone operation:

1. Tower . . . (Signals the center manually).
   Center . . . . OAKLAND CENTER.
   Tower . . . . ALAMEDA TOWER, REQUEST CLEARANCE NAVY SIX ONE EIGHT THREE FOUR.
   Center . . . . ATC CLEARS NAVY SIX etc., ... MB (operating initials).
   Tower . . . . BR.
2. Center . . . . . BRUNSWICK APPROACH CONTROL, BOSTON CENTER, ESTIMATE.
   Approach Control . . . . . BRUNSWICK APPROACH CONTROL, GO AHEAD.
   Center . . . . . NAVY ONE TWO ONE SIX ONE, ESTIMATING etc., . . . RW.
   Approach Control . . . ST.
3. FSS . . . . WHITING OPERATIONS, FLIGHT SERVICE, FLIGHT PLAN.
   Operations . . . WHITING OPERATIONS, GO AHEAD.
   FSS . . . . NAVY SIX ONE TWO ONE TWO, FLIGHT OF THREE etc. . . . WW.
   Operations . . . . AZ.
4. Operations . . . . . (Signals flight service manually)
   FSS . . . . FLIGHT SERVICE.
   Operations . . NORFOLK OPERATIONS, ARRIVAL.
   FSS . . . GO AHEAD.
   Operations (arrival message) CB.
   FSS . . . BC.

Clear enunciation is necessary at all times. Words should be spoken directly into the interphone instrument in a moderate tone of voice. The transmitting operator should not speak faster than the receiving operator can accurately copy. Spelling is not necessary unless a word is peculiar or seldom used. When spelling is necessary, use the phonetic alphabet discussed in chapter 11 of this Rate Training Manual.

PRIORITY OF INTERPHONE COMMUNICATION.—Only those messages necessary for air traffic control, contributing to air safety, or directly related to aircraft movements are authorized on the interphone systems. Priority of such messages is established as follows:

1. First priority—Emergency messages including essential information on aircraft accidents or suspected accidents. After an actual emergency has passed, a lower priority should be given messages relating to an accident.
2. Second priority—Clearances and control instructions.
3. Third priority—Movement and control messages using the following order of preference when possible:

   a. Progress reports.
   b. Departure or arrival reports.
   c. Flight plans.

4. Fourth priority—Movement messages on VFR aircraft.

NOTE: The words EMERGENCY or CONTROL are used for interrupting lower priority messages when necessary.

ACs should refer to OPNAV Instruction 3722.8 (Series), FAA Flight Services Handbook 7110.10 (Series), and Terminal ATC Handbook 7110.8 (Series) for possible changes or more detailed information on interphone procedures.

Teletype Procedures

The FAA uses a teletype system called Service B to handle communications requirements of aircraft movement and control messages. The system consists of two separate teletype networks, Area B and Center B. Area B circuits are generally arranged to serve ARTCC areas in the conterminous U.S. All FSSs are on an Area B circuit and those FSSs designated as tie-in stations actually enter military messages on the FAA teletype circuit for adjacent military bases. ARTCCs use Center B to handle emergency and IFR movements and control messages addressed to other centers.

A related circuit, called Military B, connects most base operations with ARTCCs for transmiting proposed IFR flight plans.

Equipment and procedures for transmitting IFR flight plans via teletype may vary at different ATC facilities. However, required items of information to be relayed are normally standard.

An example of a proposed IFR flight plan teletype message, utilizing the data contained in the sample DD Form 175 (fig. 5-1) is as follows:

ZEM MEM 0715121 FP VV4M157 TS-2A/B 0170 NQA PO800 100 NQA V9 JAN V11 MOB V242 BFM V198 NUN NPA

Figure 5-4 shows a typical teletypewriter unit which is utilized to send and receive flight plan messages.

FLIGHT PROGRESS STRIPS

Flight progress strips are used to post current data on air traffic and clearances required for air traffic control and air traffic services. Terminal facilities providing approach control service must use the flight progress strips as listed in FAA Handbook 7110.8 (Series). At some locations these strips are also used in the tower and flight planning/approval branches for recording data in a manner prescribed locally.

Presently one type of form is utilized to record flight data for both arrivals and departures: FAA Form 7230-8 (7-70). Figure 5-5 shows a flight progress strip with each box numbered for the purpose of explaining each part as it pertains to either an arrival or a departure.

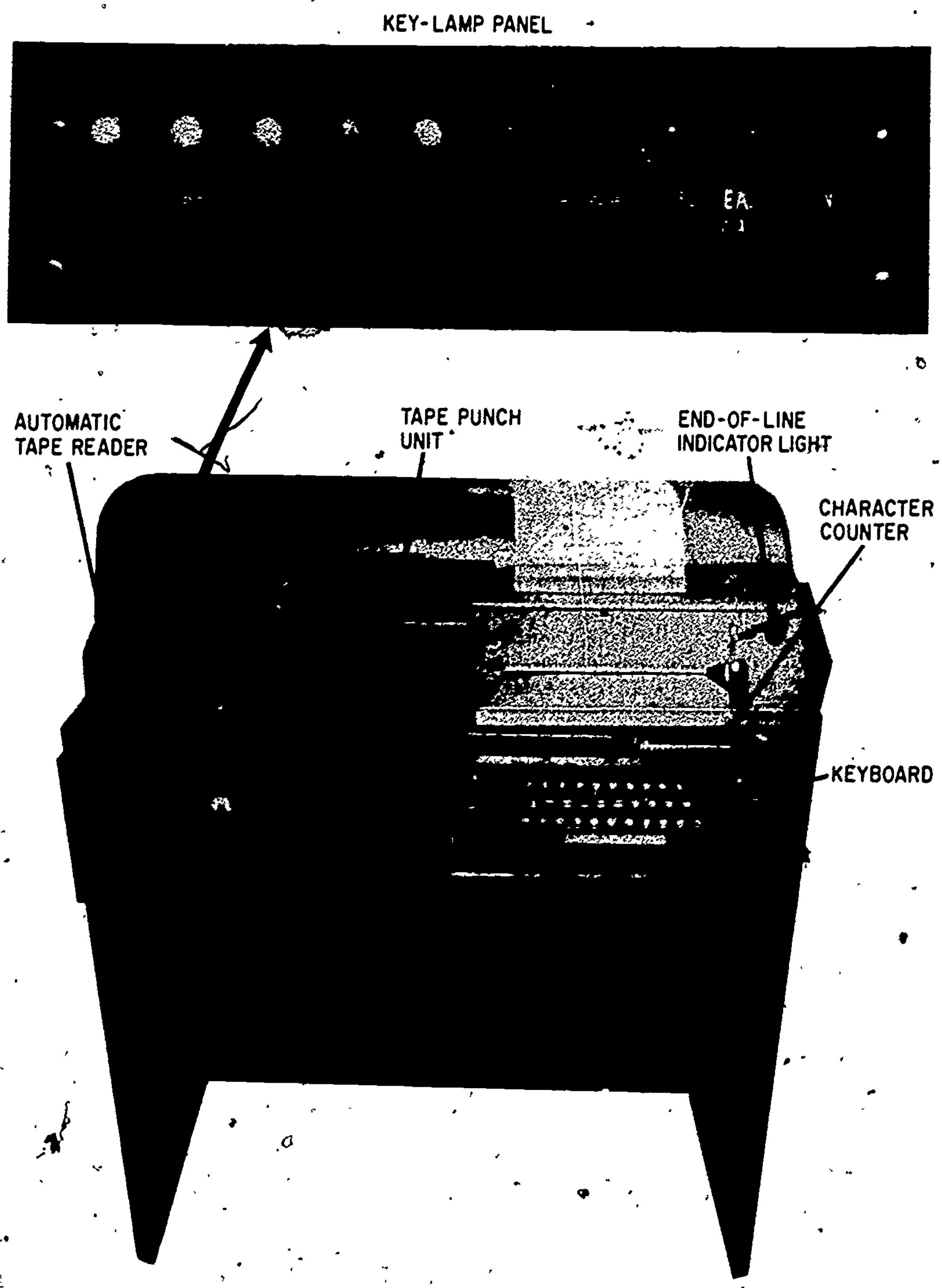
The following numbered items are appropriate entries in the correspondingly numbered boxes on the flight progress strip:

ARRIVALS:

1. Aircraft identification.
2. Revision number (FDEP locations only)
3. Number of aircraft, if more than one type of aircraft and suffix indicating any special equipment; e.g., DME, transponder, etc.

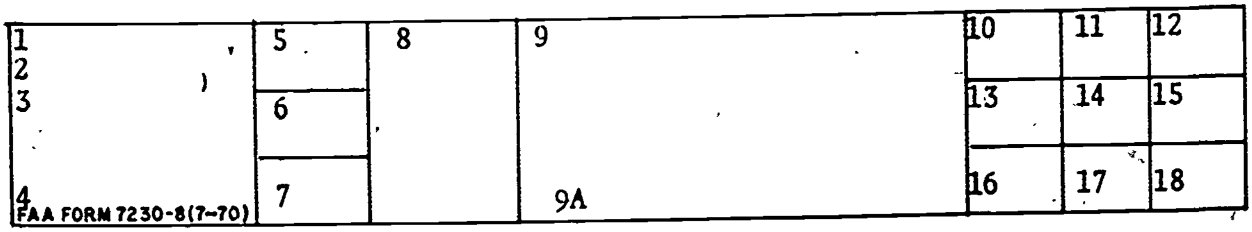
Note: When the maximum allowable takeoff weight of the aircraft is 300,000 lb. or more, enter the symbol "H/" as a prefix to the type aircraft designation; e.g., H/C-5, H/C-141.

4. Computer identification number, if required.
5. Secondary radar (beacon) code assigned.
6. Previous fix (FDEP locations only) or inbound airway.
7. Coordination fix.
8. Estimated time of arrival at the coordination fix or destination airport.
9. Altitude (in hundreds of feet) and remarks.
   9A. Destination airport.



201.70

Figure 5-4.—Model 28 ASR teletypewriter.



201.7

Figure 5-5.—Flight progress strip.

10. through 18. Enter data as specified by Facility Directive. Radar facility personnel need not enter data in these spaces except when nonradar procedures are used or when radio recording equipment is inoperative.

DEPARTURES:

1. Aircraft identification.
2. Revision number (FDEP locations only)
3. Number of aircraft, if more than one, type of aircraft and suffix indicating any special equipment; e.g., DME, transponder, etc.

NOTE: When the maximum allowable takeoff weight of the aircraft is 300,000 lb. or more, enter the symbol "H/" as a prefix to the type aircraft designation; e.g., H/C-5, H/C-141.

4. Computer identification number, if required.
5. Secondary radar (beacon) code assigned.
6. Proposed departure time.
7. Requested altitude.
8. Departure airport.
9. Route, destination, and remarks.
10. through 18. Enter data as specified by Facility Directive. Items such as departure time, runway used for takeoff, check marks to indicate information forwarded or relayed may be entered in these spaces.

Recording Flight Data

Only authorized control information symbols, abbreviations, and phrase contractions should be used for recording position reports, air traffic clearances, and instructions on flight progress strips. Plain language, abbreviations or contractions contained in FAA Contractions Handbook 7340.1 (Series), and control information symbols contained in FAA Handbook 7110.8 (Series) must be used as necessary so that any written message may be read and understood.

The following list includes approved prefixes used in conjunction with the serial number to identify the branch of military service to which the aircraft is attached. These prefixes are appropriate for use in box number 1 on flight progress strips.

Prefix	Branch
A	U.S. Air Force
C	U.S. Coast Guard
G	Army or Air National Guard
VM	U.S. Marine Corps
R	U.S. Army
VV	U.S. Navy
CAF	Canadian Armed Force
CAM	Canadian Armed Force (Transport Command)

The following list includes approved military mission prefixes which may be used with or in place of the prefix indicating branch of service that may be used in conjunction with the aircraft serial number. These prefixes are appropriate for use in box number 1.

Prefix	Mission
E	Medical Air Evacuation
L	LOGAIR (USAF Contract)
S	Special Air Mission
M	MAC (Military Airlift Command)
F	Flight Check

The following list is approved aircraft equipment suffixes to indicate that an aircraft has transponder DME, RNAV, or TACAN-only navigational capability. These suffixes are used following a slant mark (/) after the aircraft type. They are appropriate for use in box number 3.

Suffix	Meaning
/X	Transponder with no-code capability.

/T Transponder with 64-code capability.
/U Transponder with 4,096-code capability.
/D DME.
/L DME, and transponder with no-code capability.
/B DME, and transponder with 64-code capability.
/A DME, and transponder with 4,096-code capability.
/M TACAN-only, and transponder with no-code capability.
/N TACAN-only, and transponder with 64-code capability.
/P TACAN-only, and transponder with 4,096-code capability.
/C RNAV and transponder with no-code capability.
/F RNAV and transponder with 4,096-code capability.
/S RNAV and transponder with 64-code capability.
/W RNAV and no transponder.

Figure 5-6 shows control information symbols used for recording clearances, instructions, and information on flight progress strips. Some of the symbols can be used in various boxes on both the departure and arrival flight progress strip; however, the most consistent use of these symbols may be in box number 9 on the flight progress strip where the ATC clearance to be issued to a departing IFR aircraft is recorded.

The following list includes approved clearance abbreviations used to record a particular clearance issued or to be relayed to an aircraft, or the status of a clearance. These abbreviations may be used in various boxes on flight progress strips.

Abbreviation	Meaning
A	Cleared to airport (point of intended landing).
B	Center clearance delivered.
C	ATC clears (when clearance relayed through a non-ATC facility).
D	Cleared to depart from the fix.
F	Cleared to the fix.
H	Cleared to hold and instructions issued.
L	Cleared to land.
N	Clearance not delivered.
O	Cleared to the outer marker.
Q	Cleared to fly (courses, quadrants, radials) within _____ miles from (location).
T	Cleared through (for landing and takeoff through intermediate point).
V	Cleared over the fix.
X	Cleared to cross (airway, route, radial) at (point).
Z	Cleared to tower jurisdiction.

The following listed miscellaneous abbreviations are used mostly by approach control; however, there are occasions when control tower operations make use of them.

Abbreviation	Meaning
CT	Contact approach.
I	Initial approach.
F	Final approach.
JP	Jet penetration.
MA	Missed approach.
SI	Straight-in approach.
TA	TACAN approach.
TL	Left turn.
TR	Right turn.
VA	Visual approach.
VR	VOR approach.
FM	Fan marker approach.
ILS	ILS approach.
OTP	VFR conditions on top.
PT	Procedure turn.
RX	Report crossing.
SA	Surveillance approach.
PA	Precision approach.

Figure 5-7 shows the standard recording procedure for hand-printed characters on flight progress strips.

ATC Clearances

With a proposed IFR flight plan on file, the AC on duty at the ground control position in the control tower, clearance delivery, or departure control position, as appropriate, will request an ATC clearance from the ARTCC when the pilot calls the tower for taxi instructions or requests his clearance. ATC clearances, advisories, or requests must be relayed verbatim.

The following is an example of an ATC clearance received via Service F from the ARTCC of the proposed IFR flight plan shown in figure 5-1.

"NAVY FOUR MIKE ONE FIVE SEVEN CLEARED TO THE NAVY PENSACOLA AIRPORT AS FILED MAINTAIN TEN THOUSAND SQUAWK ONE ONE ZERO ZERO

Symbol	Meaning
↑	Climb and maintain
↓	Descend and maintain
→	Cruise
@	At
X	Cross
	Maintain
	Join or intercept airway/jet route/track or course
=	While in controlled airspace
△	While in control area
	Enter control area
	Out of control area
	Cleared to enter control zone (direction) (arrow may indicate direction aircraft is entering control zone, however, appropriate letter shall follow the symbol), maintain special VFR/IFR conditions, (altitude, if appropriate), while in control zone
	Cleared to depart control zone (direction) (arrow may indicate direction aircraft will depart control zone, however, appropriate letter shall follow the symbol), maintain special VFR/IFR conditions, (altitude, if appropriate), while in control zone
	Cleared through control zone from (direction) to (direction) (arrow may indicate direction of flight, however, appropriate letters shall follow the symbol), maintain special VFR/IFR conditions (altitude, if appropriate), while in control zone
Ⓦ	Local Special VFR operations in the vicinity of (name) airport are authorized until (time). Maintain Special VFR conditions (altitude, if appropriate)
>	Before
<	After or past

Symbol	Meaning
T→( )	Depart (direction, if specified)
/	Until
( )	Alternate instructions
Restriction	Restriction
	At or below
	At or above
— (dash)	From—to (route or altitude)
V<	Clearance void if aircraft not off ground by (time)
	Pilot cancelled flight plan
✓	Information forwarded (indicated information forwarded as required)
(50)	Other than assigned altitude reported (circle reported altitude)
10/6	DME holding (use with milages) (Upper figure indicates distance from station to DME fix, lower figure indicates length of holding pattern. In this example, the DME fix is 10 miles out with a 6 mile pattern indicated.)
(mi.) (dir.)	DME arc of VORTAC or TACAN
(Freq)	Contact (facility) on (frequency) (time, fix, or altitude, if appropriate). (Insert the frequency only when it is other than standard)
R	Radar contact
~~R~~	Radar service terminated
R	Radar contact lost
Ⓡ	Radar handoff (circle symbol when handoff completed)
RV	Radar vector
RX	Pilot resumed own navigation
W (red)	Warning
E (red)	Emergency
ALT (red)	Inappropriate altitude/flight level for direction of flight. (Underline assigned altitude/flight level in red).

NOTE 1.—The absence of an airway or route number between two fixes in the route of flight indicates "direct"; no symbol or abbreviation is required.

NOTE 2.—Use an "X" to delete a climb and maintain or descend and maintain arrow.

201.8.1

Figure 5-6.—Control information symbols.

Typed	Hand Printed	Typed	Hand Printed	Typed	Hand Printed	Typed	Hand Printed
A	A	J	J	S	S	1	1
B	B	K	K	T	T	2	2
C	C	L	L	U	U	3	3
D	D	M	M	V	V	4	4
E	E	N	N	W	W	5	5
F	F	O	O	X	X	6	6
G	G	P	P	Y	Y	7	7
H	H	Q	Q	Z	Ƶ	8	8
I	I	R	R	Ø	Ø	9	9

Underline "S s" and cross zeros when a controller believes a misunderstanding might occur.

201.10

Figure 5-7.—Recording of hand-printed characters.

AFTER DEPARTURE CONTACT MEMPHIS CENTER. HOTEL ROMEO."

Figure 5-8 is a completed flight progress departure strip on which the clearance is recorded using appropriate symbols and contractions.

VFR FLIGHT HANDLING

When a pilot delivers a DD Form 175 to base operations and subsequently departs, the AC on duty must transmit the necessary information to flight service to be entered on the Area B teletype circuit for transmission to destination. All flights are held in suspense, or kept track of (until the aircraft lands), for the purpose of search and rescue service. The following is a brief discussion of what transpires from departure to arrival to give the AC an idea of the entire operation.

All messages concerning flight movements must be transmitted to flight service within 5 minutes after the required information is received.

Flight Notification Message

After an aircraft has departed or before actual departure for flights of short duration with mutual agreement, the following information from the flight plan must be transmitted to flight service:

1. Type of flight.
2. Aircraft identification.
3. Type of aircraft/special equipment suffix. (Include number and type if a formation flight.)
4. Point of departure.
5. Point of destination.
6. Estimated time of arrival (ETA), at destination.

VV4M 157	1100	NQA	C.A.F.	05	✓	
	0800			21		
TS-2 A/B FAA FORM 7230-8(7-70)	100		MEM			

201.11

Figure 5-8.—Completed flight progress strip (Departure).

7. Remarks (VIP and passenger/cargo information).

The FSS will then relay a flight notification message to the tie-in FSS serving the destination airport and will hold the flight in suspense until the destination FSS acknowledges the message. If an acknowledgment for a flight notification message is not received from the destination FSS within the following time limits, FSS personnel may use regular telephone to assure delivery:

1. Before ETA, if estimated time en route (ETE) is 30 minutes or less.
2. 30 minutes after departure if the ETE is between 30 minutes and 2 hours.
3. 1 hour before ETA, if the ETE is 2 hours or more.
4. 30 minutes after departure if the message contains VIP/RON (remain overnight) information.

When destination tie-in FSS acknowledges the flight notification message, the departure FSS then files it in a completed file. The destination FSS relays the message to the destination airport and holds the flight in suspense until an arrival report is received from the destination airport.

Stopover Flights

Flights which include stopovers en route to final destination are handled basically the same as VFR flights with the following exceptions:

1. The point of the first stopover and an ETA (in lieu of ETA at destination) at that point, followed by each stopover point and ETE in order of stops and destination, is included in the original flight notification message.

2. Each intermediate tie-in FSS will:

a. Acknowledge receipt of departure message.
b. Notify Base Ops of the inbound.
c. Suspend the message until an arrival or closeout is received or take the necessary action if overdue.
d. When received, forward a departure time to the tie-in FSS for the next stopover point and obtain an acknowledgment.

Destination tie-in FSS will take the same action as the intermediate FSSs except that the flight plan is closed out when an arrival report is received from destination Base Ops, or if no further information, such as departure time, is received from the preceding stopover point by the message VOID time.

En Route Changes

Flight service stations, when advised of a change in ETA or flight plan (VFR to IFR) by an en route aircraft, will forward this information, or any other data requested by the pilot, to the destination station.

The FSS will transmit a revised flight notification message, when a change in destination is received, to the departure point and to the original and new destination. The message will include the type flight plan, aircraft type and identification, departure point, original destination, and the time and position when the aircraft requested the change. Included will be the words "CHG DESTN," new destination, ETA, and any pertinent remarks.

Arrival Reports

Arrival reports are not transmitted to the departure FSS unless an aircraft arrives for which a flight notification message was not received. In such cases, ACs at the destination airport must provide the tie-in FSS with the aircraft identification, point of departure, and time of arrival to be relayed to the departure tie-in FSS and finally to the departure airport. Arrival reports are also required for overseas flights and special military flights of Presidential or Vice Presidential aircraft. An exception is that in Alaska an arrival report is required on a military aircraft when departure is from a military base.

IFR FLIGHT HANDLING

Federal Air Regulations require, in part, that a flight plan be filed and an ATC clearance obtained prior to operation within controlled airspace in accordance with instrument flight rules.

When a pilot files an IFR flight plan with base operations, the ACs on duty must transmit the proposed IFR flight plan message to the ARTCC in whose area the IFR flight originates.

The message may be sent to the ARTCC via Military B teletype (Area B may be used through flight service in some cases) if the aircraft's proposed departure time is 30 minutes or more (15 minutes if center is computer-equipped) from transmittal time. If time is critical, the message is transmitted via interphone (Service F). Any subsequent change or cancellation to the proposed flight plan message must be called to the ARTCC via interphone.

IFR Flight Plan Message

The IFR flight plan message consists of the following items, all of which are from the filed DD-175 with the exception of items 1 through 4:

1. The 3-letter identifier of the ARTCC.
2. The 3-letter identifier of the originating station and four figures to indicate the time the flight plan was received by the station.
3. Three figures to indicate the number of the message. This number sequence begins with 001 each day at 0000Z.
4. The alphabetical characters FP. (All proposed IFR flight plan messages must contain these characters).

NOTE: Items 1 through 4 are required on teletype only.

5. Aircraft identification.
6. Type aircraft/special equipment suffix.
7. True airspeed.
8. Departure point.
9. Proposed departure time.
10. Altitude.
11. Departure point and route of flight. The route of flight must include the departure point, since it may be different from the station transmitting the message; the route of flight to the next fix; the identifier of that fix and route of flight to the next fix; and so on until destination which is the last part of this item.
12. Remarks: Preceded by the remarks code—the clear sky symbol (teletype only).

ARTCCs will acknowledge all movement messages on Military B and Area B circuits except domestic proposed IFR flight plan messages.

NOTE: An example of a proposed IFR flight plan message for relay by teletype is depicted in the section pertaining to teletype procedures.

Flight Service for IFR Flights

All procedures and reports as discussed earlier in this chapter for handling VFR flights apply to IFR flights as well. The exchange of information between base operations and the ARTCC is additional flight plan handling procedure required for the purpose of providing separation between aircraft operating IFR. In many instances certain reports must be sent to both Flight Service and the ARTCC.

If you will compare the information in the route of flight section of the DD Form 175 depicted in figure 5-1 with the example of a proposed IFR flight plan message listed earlier in this chapter under RELAY OF FLIGHT DATA, Teletype Procedure, you will see that all of the information contained on the proposed flight plan is not included in the initial IFR flight plan message sent to the ARTCC for this flight.

The significance is that the flight plan is an IFR stopover proposal. Only the first leg of the flight plan is sent to the ARTCC as shown in the teletype message example since that is the extent of the ATC clearance that will be issued the pilot initially. However, the entire flight plan is transmitted to the departure tie-in FSS via interphone upon departure. Departure FSS will then enter a flight notification message addressed to destination tie-in FSSs on Area B teletype. Then, when the pilot arrives at the first destination and notifies this FSS of his proposed departure time, the new departure FSS will submit the next applicable leg of the stopover flight plan to the appropriate ARTCC as a proposed IFR flight plan message so the pilot can obtain ATC clearance to his next destination. This procedure is repeated until the pilot completes the flight.

IFR Departure Reports

Immediately after an IFR flight is airborne, a departure report must be sent via interphone (Service F) to the control facility with which the flight plan was filed. The departure report must contain the aircraft identification and the actual time of departure.

IFR Flight Progress Reports

IFR flight progress reports consisting of the aircraft identification, position, time, altitude or flight level, estimate of the next reporting point, name of the subsequent reporting point, and any remarks or requests as received from a pilot must be relayed to the appropriate ATC facility via interphone (Service F).

IFR Arrival Reports

The actual time that an IFR flight lands or cancels the IFR flight plan must be relayed to the appropriate ATC facility via interphone (Service F).

Combination IFR/VFR Flights

Pilots may file flight plans containing both VFR and IFR operations. Such flight plans are handled in the same manner as regular VFR or IFR flight plans except that the proposed IFR flight plan message is sent to the ARTCC in whose area of responsibility the aircraft changes from VFR to IFR.

If the first portions of such flights are IFR, or the change from VFR to IFR occurs at a position within the ARTCC's area within which the departure airport is located, the proposed flight plan message may be sent via Military B teletype or Service F by base operations at the departure airport. If the first portion is VFR and subsequent portions are IFR in a different ARTCC's area, the proposed flight plan message would probably be sent via interphone to Flight Service for transmission on Area B teletype to the ARTCC in whose area the change from VFR to IFR occurs.

FLIGHT ADVISORY MESSAGES

If hazardous conditions arise which might affect an aircraft already in flight, it may be necessary to issue a flight advisory message to make sure the pilot is aware of the situation.

If a military aircraft's destination is a civil airport, the destination FSS is responsible for screening weather, airport, and navaid conditions, and issuing the necessary advisory to inbound aircraft. If the destination is a military base, the responsibility rests with base operations.

The tie-in station originating the advisory or receiving it from the originating base operations will determine the FSS nearest the aircraft's position for VFR flights or the appropriate ARTCC for IFR flight, and transmit the message to that location.

If the receiving FSS or ARTCC is unable to deliver the flight advisory to the aircraft within 15 minutes after the requested delivery time, the originator must be informed and then the message is filed.

MILITARY OVERSEAS FLIGHT MESSAGES

Generally, all military foreign and overseas flights are required to clear through specified military bases. Pilots normally will not file flight plans directly with an FAA facility unless Base Ops is not available. Base Ops will forward an ICAO-type flight plan message via their tie-in station for relay through the AFTN. Base Ops should specify all addressees, both ATC and operational, in accordance with ICAO standards and military regulations.

For outbound flights the departure tie-in FSS holds the DEP FLT PLN in suspense until an arrival or acknowledgment message is received from the destination base.

For inbound flights the relaying IFSS holds the DEP FLT PLN in suspense until an arrival or acknowledgment message from the destination tie-in FSS has been forwarded to the departure base.

SEARCH AND RESCUE (SAR) PROCEDURES

Search and Rescue is a lifesaving service which provides search, survival aid, and rescue of personnel of missing or crashed aircraft. This vital responsibility is assigned to the U.S. Air Force and the U.S. Coast Guard as outlined in the National Search and Rescue Plan.

These two agencies are further assisted by the combined efforts of the Navy, FAA, Civil Air Patrol, State Police, and other organizations that may be called upon to render assistance.

The following is a list of terms or definitions with which the AC must be familiar, to better understand SAR procedure:

1. Inland SAR Region.—The area in which the USAF exercises the SAR coordinating function. It includes all of the inland area within the conterminous U.S. except the waters under jurisdiction of the U.S. Coast Guard for SAR purposes.

2. Maritime Region.—The area in which the U.S. Coast Guard exercises the SAR coordinating function, including the territories and possessions of the U.S. and the high seas.

3. Rescue Coordination Center (RCC).—A center which coordinates and controls SAR operations in a region, subregion, or sector.

4. Alert Notice (ALNOT).—Notice given to appropriate facilities and agencies that an aircraft is overdue.

5. Information Request (INREQ).—A request for information concerning an overdue VFR aircraft.

NOTE: For complete details of procedures used in Search and Rescue, refer to the National Search and Rescue Manual.

SAR PROCEDURES FOR VFR FLIGHTS

Responsibility

The departure station (tie-in station) is responsible for initiating SAR action on flights for which flight plans have been entered into the FAA communications system until receipt of the destination station's acknowledgment of the flight notification message. Then the responsibility is transferred to the destination (tie-in) station. Military operations offices are responsible for initiating action on all other flights.

AVFR or DVFR flight is considered overdue when communication cannot be established with it and it fails to arrive 30 minutes (15 minutes for jets) after its ETA.

A flight not on a flight plan is considered overdue if a reliable source reports it one hour overdue at destination.

Overdue Aircraft Action

As soon as a VFR aircraft becomes overdue, the destination tie-in station (including intermediate destination tie-in stations for military aircraft) shall attempt to locate the aircraft by checking all adjacent airports that can be reached by government circuits or local telephone. If necessary, a long distance telephone call may be made to the destination airport.

If this communications search (FAA's responsibility for SAR is limited to communications and alert) does not locate the aircraft, the signal QALQ is transmitted to the departure tie-in station.

NOTE: Q signals are listed in FAA Flight Service Handbook 7110.10 (Series). The Q signal above is a code for asking if the aircraft in question has landed at the station queried.

Upon receipt of such an inquiry, the departure tie-in station must check locally for any information about the aircraft. The results of the check must then be transmitted back to the destination station.

Information Request (INREQ)

If the aircraft is not located by the inquiry to the departure station, the destination station must transmit a numbered INREQ message to stations along the route, to the departure station, and to the destination RCC tie-in station (an FSS with interphone to the appropriate RCC) as follows:

1. For aircraft on a flight plan—1 hour after ETA (30 minutes for jets).
2. For aircraft not on a flight plan—1 1/2 hours after ETA.

NOTE: For special procedures peculiar to Alaska and Hawaii, refer to FAA Flight Services Handbook 7110.10 (Series).

En route stations receiving an INREQ must seek information about the aircraft by checking station records and inquiring at all local airports which can be contacted by interphone or telephone. A reply to the INREQ must be sent to the originating station within 30 minutes after receipt even if the report is negative. If a search cannot be completed within 30 minutes, a status report is sent to the originating station followed by a completion report when available.

The departure station has already conducted a local communications check and holds the INREQ message in suspense.

If the aircraft is located by the INREQ, the originator must transmit a numbered message to all original INREQ addressees informing them of the fact.

Alert Notice (ALNOT)

If replies to the INREQ have been negative or the aircraft has not been located within 1 1/2 hours (2 hours for no-flight-plan aircraft) after ETA, whichever occurs first, the destination station must transmit an ALNOT to the RCC tie-in station and all Area B circuits serving the ALNOT search area.

The ALNOT search area is normally that area extended 50 miles on either side of the proposed route of flight from the last reported position to the destination station. However, if requested by the RCC, or at the discretion of the destination station, the ALNOT search area may be expanded to the maximum range of the aircraft.

Upon receipt of an ALNOT, each station whose area of responsibility extends into the ALNOT search area must conduct a communications search of those airports which could accommodate the aircraft and which were not checked during the INREQ search.

Receiving stations must notify the originator within 1 hour after receipt of the results or the status of the search.

If the ALNOT search fails to locate the aircraft or 1 hour has elapsed since transmission, whichever occurs first, the destination station must notify the RCC by message via the RCC tie-in FSS.

The ALNOT remains current until the aircraft is located or the search is suspended by the RCC. The ALNOT originator must then cancel the ALNOT by message on all circuits over which it was originally transmitted. All agencies which have been alerted must be informed.

Information Furnished RCC

All available information about an overdue aircraft must be given the RCC, including:

1. Agency and the person calling.
2. Details of the flight plan, or if the aircraft was not on a flight plan, all the facts about the source of the report.
3. Time of last radio contact, with whom the contact was made, and the frequency used.
4. Last position report.
5. Action taken and proposed action by the reporting station.
6. Positions of other aircraft known to be along or near the route of flight of the missing aircraft upon request.

Hazardous Areas

When regularly traveled VFR routes cross large bodies of water, swamps, mountains, or other hazardous areas where survival depends upon rapid rescue, a plan may be established by local authorities for special rescue procedures.

Because of the variety of possible situations, a standard procedure is not prescribed. Generally, these plans depend on a contact every 10 minutes with aircraft crossing these areas. If contact is lost with the aircraft for more than 15 minutes, SAR is alerted.

NOTE: Refer to AIM Part I for the chart depicting these areas.

SAR PROCEDURE FOR IFR FLIGHTS

ARTCCs are responsible for assuring that SAR procedures are initiated for overdue IFR aircraft. ARTCCs serve as the central point for collecting information, coordinating with the RCC, and conducting a communications search for overdue or missing IFR flights.

For SAR purposes, ARTCCs consider combination VFR/IFR flights and air-filed IFR flights the same as IFR aircraft when 30 minutes have elapsed since the pilot requested clearance and radio communication or radar contact cannot be established.

An IFR aircraft is considered overdue when neither radio communication nor radar contact can be established with it and 30 minutes have elapsed since an ETA over a specified or compulsory reporting point or clearance limit.

Overdue Action

The ARTCC in whose area of responsibility an IFR aircraft is first unreported or overdue is responsible for making this determination and initiating the necessary action. When an IFR aircraft is determined overdue, the appropriate ARTCC must alert the associated RCC and transmit an ALNOT.

The ALNOT is sent to all ARTCCs and Area B circuits 50 nautical miles on either side of the route of flight from the last reported position to destination. Included in the ALNOT is the original or amended flight plan, as appropriate, and the last known position. At the recommendation of the RCC or at the discretion of issuing ARTCC, the ALNOT search area may be expanded to cover the maximum range of the aircraft.

The responsibility for further search is transferred to the RCC under any of the following conditions:

1. When 30 minutes have elapsed after the estimated fuel exhaustion time.
2. When the aircraft has not been found within 1 hour after issuing the ALNOT.
3. When the ALNOT search has been completed with negative results.

The ALNOT remains in effect until the aircraft is found or the search is abandoned by the RCC, at which time it must be cancelled by the originating ARTCC.

Handling procedure for stations receiving the ALNOT, including broadcasting the ALNOT, are the same as those listed under SAR procedure for VFR flights.

NOTICE TO AIRMEN (NOTAM)

The purpose of the NOTAM system is to assist the pilot in conducting safe and efficient flight operations. You, as an AC, will be directly concerned with the preparation, receipt, and posting of NOTAMs.

A NOTAM is a notice containing information concerning the establishment, condition, or change to any component of, or hazard in, the National Airspace System, the timely knowledge of which is essential to personnel concerned with flight operations.

Since you will be primarily associated with U.S. Naval facilities, the function of the joint U.S. Air Force/U.S. Navy Notice to Airmen system will be of the utmost importance to you.

USAF/USN NOTAM SYSTEM

The USAF/USN NOTAM system was established to provide for rapid dissemination of Navy, Air Force, and selected civil NOTAMs in plain language to USAF and USN air activities, and provide for frequent, periodic summaries of current NOTAMs.

This system is centrally coordinated and operated by the USAF Central NOTAM Facility (CNF). The USAF CONUS Meteorological Teletype System (COMET) is used for the transmission of these NOTAMs. Navy and Marine Corps air facilities in the conterminous U.S. have transmit and/or receive capabilities on the COMET system.

Central NOTAM facilities are also established at certain overseas locations for the purpose of exchange of Navy and Air Force NOTAMs within each area and between each area, and the U.S. NOTAMs in these systems are transmitted over existing administrative and operational circuits.

NOTAM RESPONSIBILITY

The responsibility for originating a NOTAM rests with the commanding officer having jurisdiction over a facility where a hazardous condition exists or is contemplated. This responsibility includes ensuring that NOTAM dissemination is adequate and timely and that NOTAMs are promptly canceled.

NOTE: Originators must not transmit NOTAMs earlier than 24 hours prior to their effective date. NOTAMs that concern runway closure, runway length restrictions, Prior Permission Required (PPR), or total field closures may be submitted up to 72 hours prior to their effective date.

Additionally, the commanding officer (clearing authority) is responsible for the promulgation of all NOTAMs received. This responsibility includes, but is not limited to, conspicuous posting within flight planning areas and dissemination to local units within their area of jurisdiction.

The Defense Mapping Agency Hydrographic Center (DMAHC) monitors Navy NOTAMs to ensure compliance with the appropriate instructions governing NOTAM procedure.

Each activity concerned with the issuance of NOTAMs must implement standard procedures to assist appropriate duty personnel in the correct preparation, transmission, and display of NOTAMs.

Originators of NOTAMs must ensure the following:

1. Adequate on-station procedures to provide rapid reporting of navaid malfunctions that affect the operation of the station, regardless of the operating agency of the facility concerned.
2. Standardized station procedures for the preparation of each NOTAM in accordance with the requirements for the particular circuit on which it is to be transmitted. The NOTAM is normally prepared by ATC personnel.
3. Each item is carefully phrased and identified as a separate NOTAM, and the same accountability identifier is used in any revisions to or cancellation of the NOTAM.
4. Ensure that your station NOTAM is retransmitted by the CNF within a reasonable timeframe (normally one hour) and ensure it was retransmitted as submitted to the CNF.
5. Follow-up of station-originated NOTAMs to provide for prompt and accurate publication, revision, and cancellation as soon as the condition is rectified or published in FLIPs.

6. Forwarding to the DMAHC any amplifying data necessary for permanent or semi-permanent changes to the appropriate FLIPs.

CONDITIONS REQUIRING A NOTAM

The subject matter of a USAF/USN NOTAM must be limited to a condition which would affect an aviator's decision to operate to or from an airfield, or which would affect the safe en route passage of his aircraft. Examples of these conditions are as follows:

1. Establishment, permanent withdrawal, breakdown, outage, or change to electronic air navigation aids or lighting equipment.
2. Complete or partial closing of an aerodrome by a condition which precludes or seriously limits aircraft operations.
3. Significant corrections or changes to current editions of FLIPs or flight charts.
4. Temporary conditions affecting an instrument approach procedure which constitute a hazard to flight. In such cases, a NOTAM shall be issued amending or suspending the affected approach procedure.
5. Change in entry regulations or other significant conditions in foreign areas which may affect U.S. military flight operations.
6. Special operations and exercises affecting flight safety.

NON-NOTAM INFORMATION

1. Local aerodrome items, such as taxiing conditions, which could constitute a safety hazard but not prohibit aircraft operation, are non-NOTAM information and should be made available to airmen through air traffic control, control tower, or local posting. BOQ availability, minor service limitations, and information concerning DF and visual landing aids (VASI, mirrors, etc.) are also non-NOTAM. Runway (ice/snow/braking) and unusual meteorological conditions are weather items which are to be appended to the weather sequence.

2. When a requirement exists to issue a NOTAM about a condition that is normally non-NOTAM, the text should include the statement "URGENT OPERATIONAL REQUIREMENT" and in addition, identify the responsible authority issuing the NOTAM.

Use of Clear Text, Code, or FLIP Abbreviations

If the NOTAM is being transmitted within CONUS or within the USAF Communications System, it is sent in clear text. If the NOTAM is being transmitted via a designated ICAO communications circuit, it should be prepared in accordance with the ICAO NOTAM code that is contained in Flight Service Handbook 7110.10 (Series).

HOW TO PREPARE A NOTAM

Each NOTAM is identified by its date and accountability number; for example, 290114437 which is broken down as shown in figure 5-9.

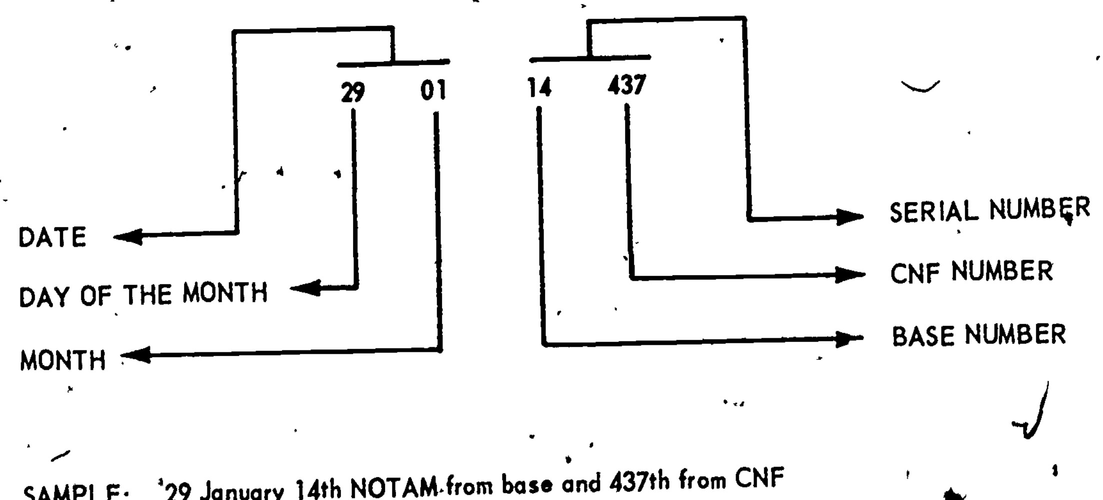


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Figure 5-9.—Numbering system for USAF/USN NOTAM.

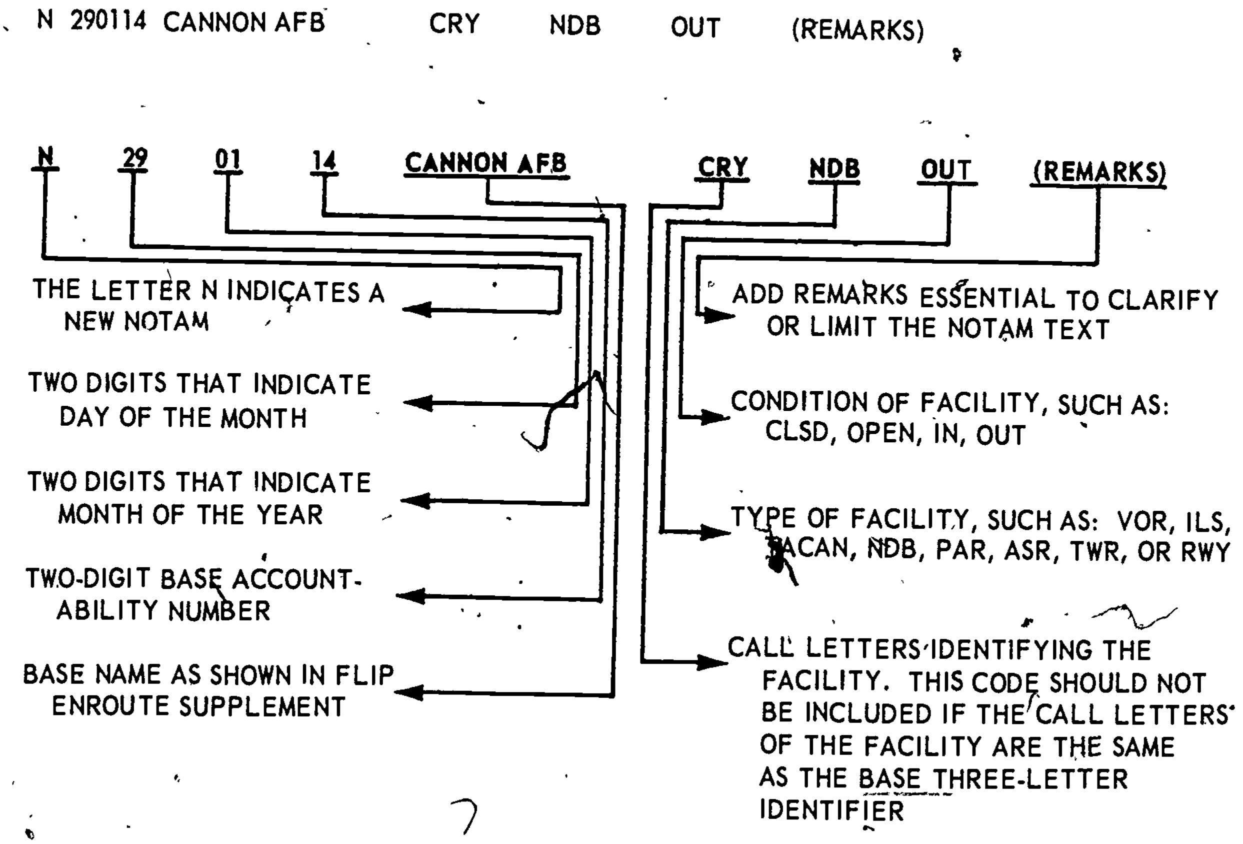

Figure 5-10.—NOTAM format. 201.14.1

Once this number is assigned, it must be used to refer to the NOTAM for all purposes, including revision, extension, and cancellation. The accountability number is always composed of five digits. The first two digits are assigned consecutively by the initiating base and begin with "01" each month, as computed from Greenwich Time. The CNF uses this portion of the number to verify that it has received all NOTAMs from the respective bases. The last three digits are assigned consecutively by CNF, and run from "001" to "999." This portion of the number provides a means for each receiving point to ensure that it has received all NOTAMs retransmitted by the CNF.

NOTAM Content

In addition to the accountability number, each NOTAM contains the base name submitting the NOTAM, base call letters, type of facility being reported, the condition of the facility, and a remarks section. Amplifying information is put in the remarks section, such as the time frame for the outage of the reported facility. When this is done, it automatically makes it a self-cancelling NOTAM. (See sample NOTAM in fig. 5-10.)

NOTAM Time Representation

The following rules apply to the use of dates and times in NOTAMs and are included in the remarks section of the NOTAM. (Fig. 5-10)

1. All dates and times expressed in NOTAMs are Greenwich Mean Time. The letter "Z" will not be used following time or date time groups. "Zulu" time is implied.

2. If a NOTAM is to be effective at 2400 hours, the time 0001 should not be included. Use only the date. Example: 05 Dec.

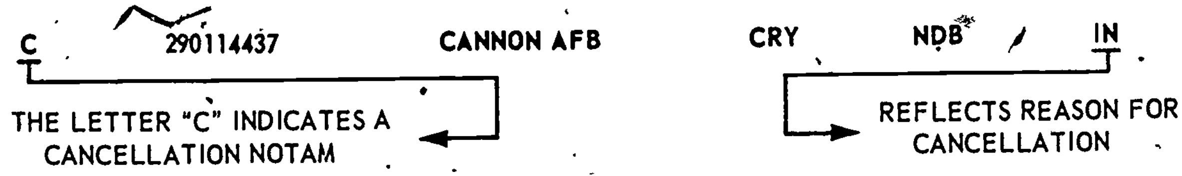

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Figure 5-11.—Cancellation NOTAM.

3. The time 0500/1600 indicates 0500 through 1600. At 1601 the NOTAMed condition is cancelled.

4. The DATE "through 15 Nov" indicates the NOTAM is valid until 2400 hours on the date indicated.

5. "Through NOV" indicates the NOTAM is in effect until 2400 hours on 30 Nov.

Cancellation NOTAM

Each NOTAM that cancels a current NOTAM must use the letter "C" instead of the letter "N", and must repeat the same accountability number that was assigned to the NOTAM it cancels. The cancellation NOTAM must tell the present condition of the facility. (See example in fig. 5-11). When a NOTAM has caused information to be added to or removed from FLIP, a cancellation NOTAM is sent, if appropriate, after the removal/addition is made. (The appropriate FLIP is consulted to determine whether the information has already been corrected.)

Revised NOTAM

This NOTAM is sent to revise or correct a current NOTAM. The letter "R" is used preceding the accountability number, and the same accountability number as the NOTAM being revised or corrected is used. (See how this is indicated in fig. 5-12.)

NOTAM SUMMARY DISTRIBUTION

Each CNF will transmit a summary of active NOTAMs as required for its area(s) of operation in accordance with the following schedule.

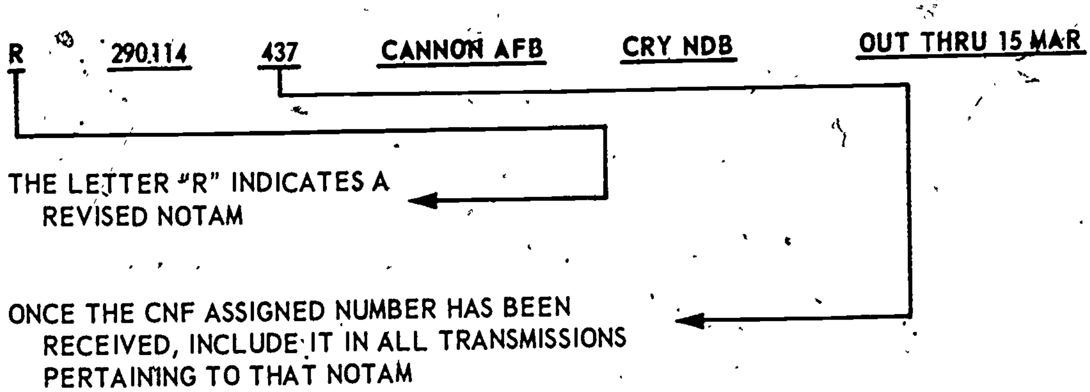

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Figure 5-12.—Revised NOTAM.

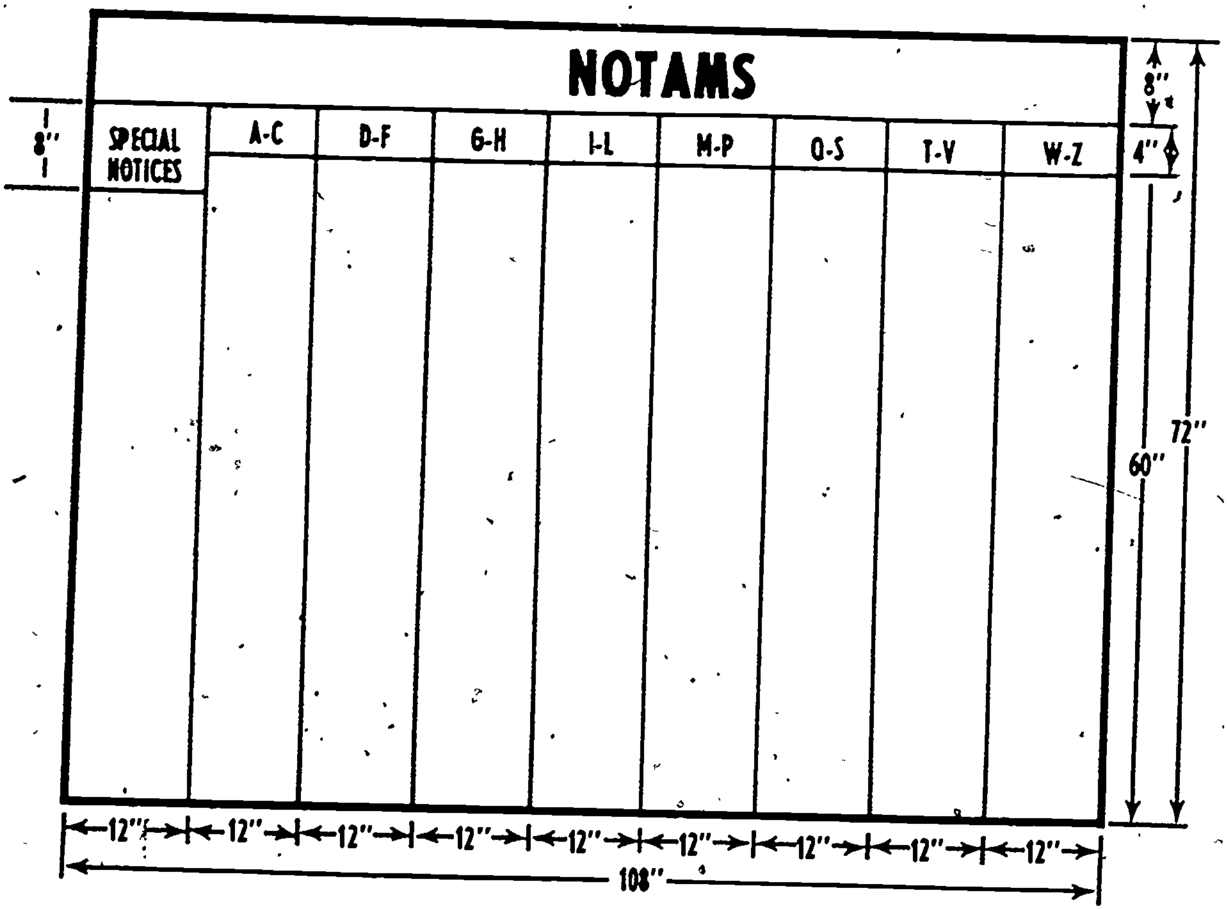

Figure 5-13.—NOTAM display board.

201.12.1

1. CONUS/Alaska/Canada area—every 12 hours.

2. Central/South America area—every 24 hours.

3. European/African/Mid-east area—every 24 hours.

4. Pacific area—every 24 hours.

CNFs automatically delete from their master file each NOTAM that has been cancelled or is self-cancelling before transmitting the daily summaries. Each summary is to be used until a new one is received.

POSTING NOTAMs

Each activity must maintain a standard NOTAM Display Board (fig. 5-13) in the flight planning area in accordance with the procedure outlined in OPNAV Instruction 3721.1 (Series). Standard Display procedure must be implemented at each activity to assist ACs on duty in maintaining the NOTAM display including the following:

1. Adequate procedures for the receipt, on-station dissemination, and posting of incoming terminal, en route, and special NOTAMs from appropriate circuits.

2. Constantly updating the display and removing obsolete information at least once each hour, or more often.

3. Checking new Summaries for completeness before destroying old Summaries.

4. Monitoring NOTAMs and NOTAM Summaries, and new editions of FLIPs, to ensure that they reflect current conditions for their station, and initiate corrective NOTAMs on any deficiencies.

5. Decoding ICAO coded NOTAMs and identifiers to plain language before posting.

6. Availability of sufficiently knowledgeable personnel to assist the pilot in checking NOTAM information.

For more detailed study and information concerning NOTAMs, the AC should refer to OPNAV Instruction 2112.2 (Series), Air Force Regulation 55-16, and OPNAV Instruction 3721.1 (Series), Flight Services Handbook 7110.10 (Series).

CHAPTER 6

METEOROLOGICAL ELEMENTS AFFECTING AVIATION

Naval aviation plays an important role in this country's first line of defense. Consequently, our naval aviators must be prepared to fly anywhere at any time. In order to successfully carry out this mission, teamwork is a must. You, as an Air Controlman, are a vital link in this team. Like the naval aviator, the Air Controlman is not expected to become an expert forecaster. That job is left to those specially trained in meteorology. However, the Air Controlman must have a basic understanding of weather in order to correctly and intelligently pass along weather information both to the pilot and the weather service personnel.

A thorough understanding of the material contained in chapters 6 and 7 will enable the Air Controlman to recognize not only minimum flying conditions but also any differences between the actual weather conditions, as observed from the tower, and those indicated by the current report. Also, the Air Controlman must become competent in reporting impending weather changes that, because of their unexpectedness, may not be immediately observed by the weather service personnel. At the same time, weather elements in general may be transmitted to pilots for them to make an immediate decision in the interest of safety and/or survival.

PRESSURE

ATMOSPHERE

Atmosphere is measured by the atmospheric pressure of a column of air at any given place from the earth's surface to the top of the atmosphere. This weight is approximately 14.7 pounds per square inch at sea level. The atmosphere is acted upon by the forces of gravity; thus, air is denser at lower levels than at higher levels due to the greater mass pushing down on it. Consequently, pressure is greater at sea level and diminishes with any increase of altitude. (See fig. 6-1.)

Instruments have been designed to measure this pressure. To calibrate these instruments, the International Committee of Air Navigation adopted 1013.2 millibars as a standard pressure at sea level. This pressure is considered when calibrating the instruments. Under standard conditions, 1013.2 millibars equal 29.92 inches of mercury when measured by a barometer at sea level with the temperature at 15°C(59°F).

The atmosphere is divided into concentric layers. Closest to the earth is the layer known as the troposphere; this layer is the one which concerns us most, since it is in this region that most of our weather occurs. Next are the stratosphere, mesosphere, and thermosphere. (See fig. 6-2.) These outer layers are important in theoretical meteorology, but for our purposes, a short discussion of the troposphere will suffice. The troposphere varies in thickness from the equator to the poles; its vertical extent is greatest over the equator (60,000 feet above sea level) and least over the poles (30,000 feet above sea level). This variation is due to the fact that the greater temperature in the region of the equator causes the air to be less dense and requires a greater volume, or tropospheric height, than at the poles where the cold air is very dense. The thickness of the troposphere varies with the seasons. It is at its highest in the summer and lowest in the winter. The boundary between the troposphere and the stratosphere is referred to as the tropopause.

PRESSURE AND TEMPERATURE CHANGES

Atmospheric pressure varies from the standard atmosphere over all areas of the earth's surface. Areas in which pressure is greater than surrounding areas are called

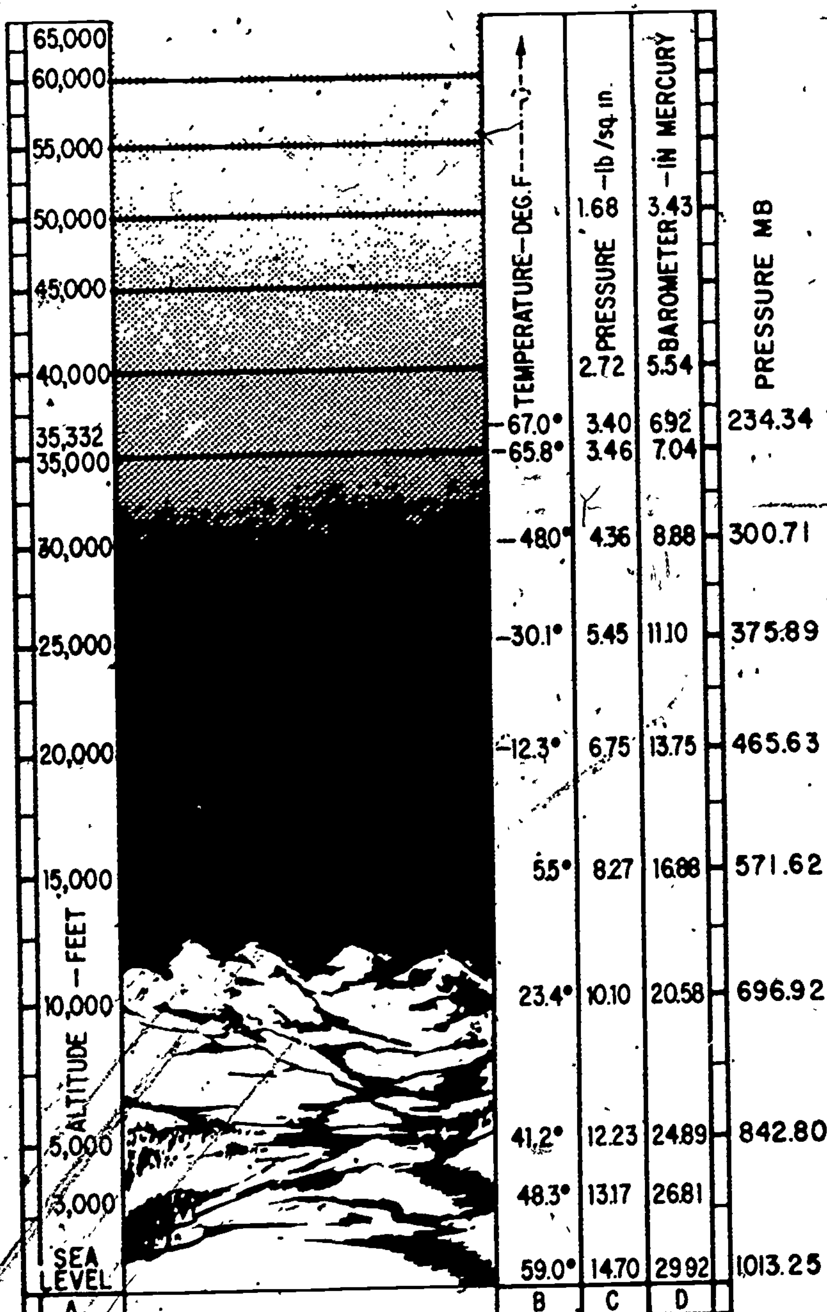

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Figure 6-1. — The standard atmosphere.

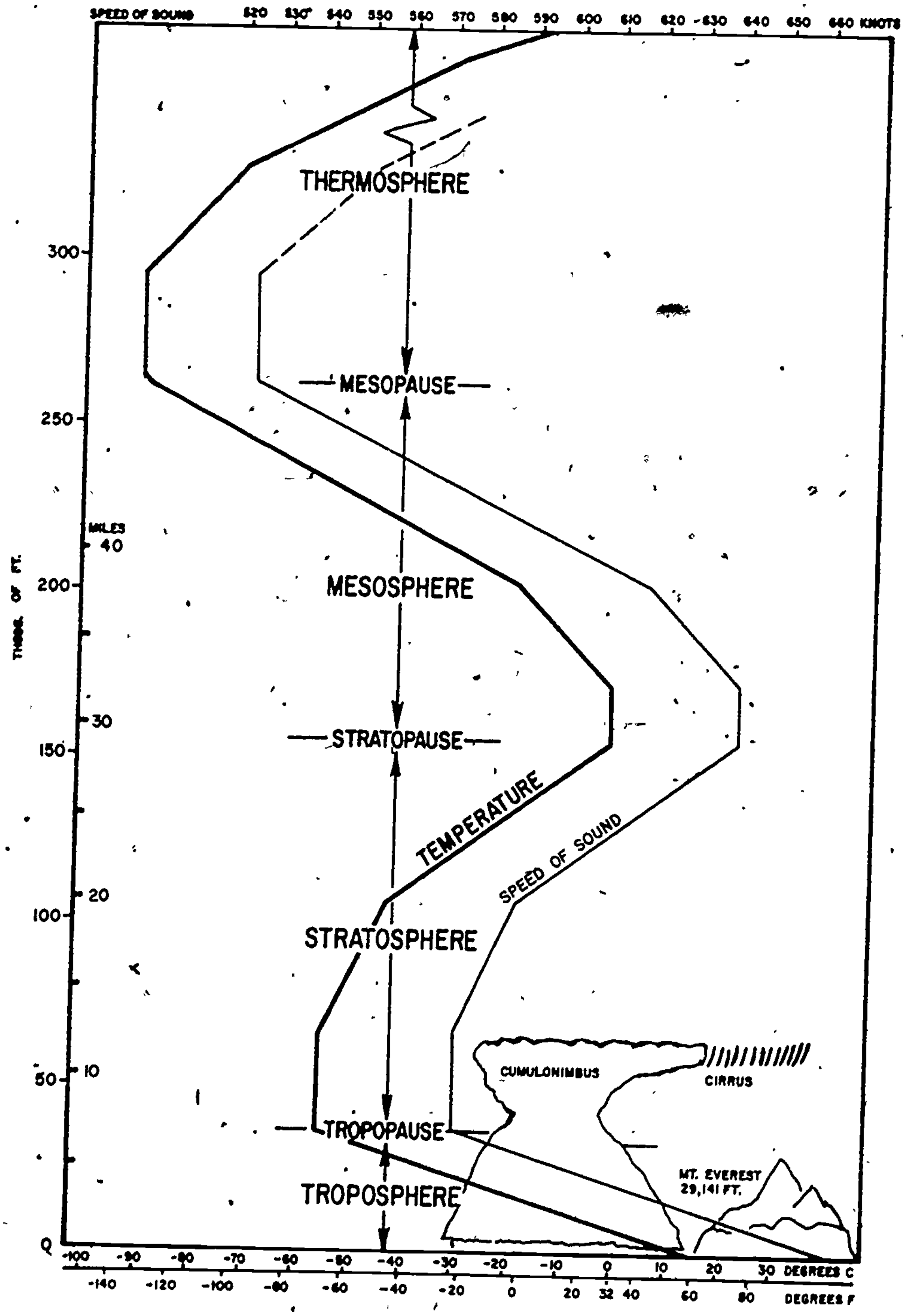

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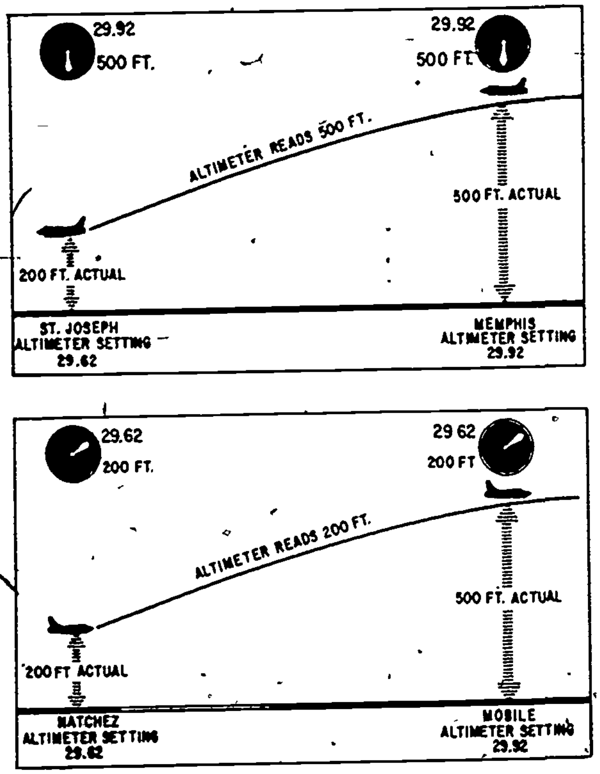
Figure 6-2.—Vertical structure of the atmosphere.

high-pressure areas, and those having less pressure that surrounding areas are called low-pressure areas. The atmospheric pressure at any given point on the earth's surface is constantly changing because of the movements of these high- and low-pressure areas.

In order for the sensitive altimeter and the altimeter setting indicator (discussed in chapter 9) to be read uniformly, they are calibrated in accordance with the standard atmosphere as shown in figure 6-1. Also in this figure, note that the atmospheric pressure decreases at the rate of about 1 inch of mercury per thousand feet of altitude up to 10,000 feet and that in the standard atmosphere any given altitude corresponds to a specific atmospheric pressure. The reason for the existence of the standard atmosphere is for it to serve as a base for calibrating pressure-activated instruments. This standard atmosphere assumes certain values of temperature and pressure for various altitudes. The scale of the altimeter is calibrated to these assumed values. The indications read from the altimeter are those that would be correct if the temperature and pressure were standard for that particular altitude.

Atmospheric pressure and temperatures change almost constantly throughout the length of a flight; thus, the altimeter must be reset periodically. If this is not done, incorrect readings are given by the instrument. For example, if an aircraft flies from a high-pressure area into a low-pressure area, the altimeter reads too high. Going from a low to a high-pressure area, the altimeter reads too low. (See fig. 6-3.) Simple rules to remember—HIGH TO LOW READS TOO HIGH AND LOW TO HIGH READS TOO LOW. The same rules apply to the temperature changes. Flying from a low-temperature area into a high-temperature area, the altimeter reads too low, and from a higher temperature area to a lower temperature area, the altimeter reads too high. The amount of approximate error in the altimeter readings, due to a noncurrent setting, can be determined for the lower levels of the atmosphere by applying the following corrections:

PRESSURE CHANGE	ALTIMETER ERROR
1 inch of mercury	1,000 feet
1/10 inch of mercury	100 feet
1/100 inch of mercury	10 feet



201.40

Figure 6-3.—Effect of pressure changes.

PRESSURE SYSTEMS

Pressure systems are either cyclones (low-pressure areas) or anticyclones (high-pressure areas). In the Northern Hemisphere, a general cycle of highs and lows moves through the Temperate Zones from west to east. (See fig. 6-4.)

Cyclones

A cyclone is a low-pressure system in which the barometric pressure decreases toward the center, and the windflow around the system is counterclockwise in the Northern Hemisphere. The terms low and cyclone are interchangeable. Any pressure system in the Northern Hemisphere with a counterclockwise (cyclonic) windflow is a cyclone.

Low-pressure systems with severe storm characteristics are called hurricanes, typhoons, tropical storms, tornadoes, or waterspouts to identify the exact nature of the storm.

Unfavorable flying conditions in the form of low clouds, restricted visibility by precipitation and fog, strong and gusty winds, and turbulence are common in low-pressure systems.

Anticyclones

An anticyclone is a high-pressure system in which the barometric pressure increases toward the center, and the windflow around the system is clockwise in the Northern Hemisphere. Any pressure system in the Northern Hemisphere with a clockwise (anticyclonic) windflow is an anticyclone.

Flying conditions are generally more favorable in high-pressure systems than in low-pressure systems because of less clouds, better daytime visibility, light or calm winds, and less concentrated turbulent areas.

Hurricanes and Tornadoes

The two most violent atmospheric disturbances found in the United States are the tornado and hurricane. Geography plays a large part in the names given to the hurricane. In the Atlantic it is called a hurricane, and in the Pacific a typhoon.

A hurricane is a low-pressure area with a whirling eddy of air having a diameter of 60 to 1,000 miles. It is accompanied by winds of speeds as high as 175 knots. Along with the winds there is an abundance of precipitation and thunderstorm activity.

A peculiarity of the hurricane is the calm center of the storm called the eye. When the eye of the storm passes over a given locality, the wind, which has been extremely violent, suddenly decreases to a much lower intensity and at times becomes a calm and precipitation stops. After the eye passes, the violent winds, precipitation, and thunderstorm activity begin anew. The winds are blowing from the opposite direction after the passage of the eye.

A tornado consists of a funnel cloud with a violently whirling center. It is usually a quarter

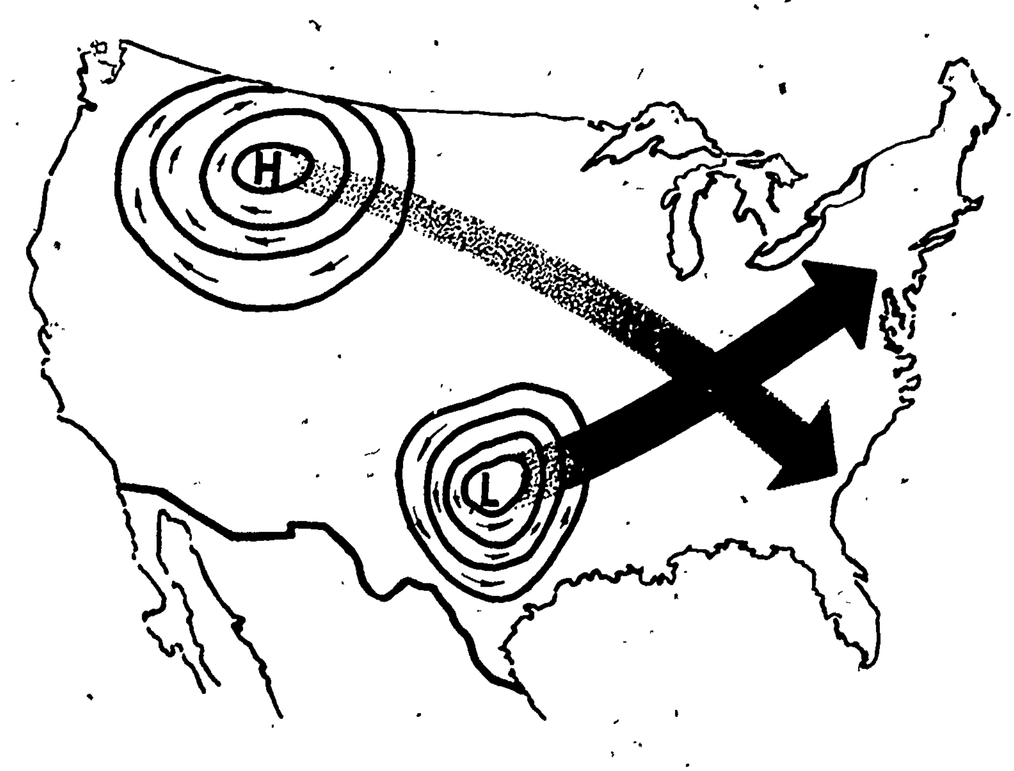


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Figure 6-4.—Directional movement of the pressure systems.

of a mile or less in diameter. The length of a tornado's track on the ground may be from a few hundred feet to 300 miles, the average being around 25 miles. Winds in the vortex of a tornado may exceed 500 knots. The speed of the tornado over the earth's surface is comparatively slow, usually 25 to 50 knots.

Because of a tornado's highly localized nature and its erratic tendencies, it is impossible for the meteorologists to forecast the exact location at which one will strike. However, forecasting centers do broadcast notices when conditions are favorable for tornado formation in specified areas.

AIR MASSES

An air mass is defined as any huge body of air whose physical properties (temperature and humidity) are horizontally uniform. An understanding of the characteristics of an air mass is essential to any study of weather phenomena in the temperate regions. The weather in these regions is a direct result of the continuous alternation of the influences of warm and cold air masses. Warm air masses predominate in the summer, and cold air masses predominate in the winter. However, both cold and warm air, alternately, may prevail almost anywhere in the temperate zone at any season. The basic characteristics of any air mass are temperature and humidity. These properties are relatively uniform throughout the extent of the air masses, and it is by measurement of these properties that the various types of air masses are determined.

The properties of an air mass depend directly upon the type of surface over which the air is lying. Thus, a knowledge of the type of surfaces over which the main bodies of air stagnate in the world circulation system is the basis of an understanding of air mass characteristics. These surfaces of origin are called source regions. They have a primary influence upon the characteristics of air masses. The path over which an air mass travels after expanding and leaving the source region and the length of time the air mass has been away from the source region (its age) also determine the characteristics of an air mass.

As an air mass expands and slowly moves out of its source region to influence other regions, it travels along a certain path. The surface over which this path takes the air after leaving the source modifies the air mass. For example, a warm, moist body of air moves out over cold, dry land and its characteristics are modified; therefore, moisture is lost and temperature is lowered.

Another factor which must not be overlooked in determining how an air mass is being changed or modified is the "age" of that body of air after leaving the source. For example, an air mass which has recently moved from the source region will not have had time to become modified significantly. However, an air body which has moved to a new region and stagnated for some time and is now old will have lost many of its original characteristics. It will have acquired many of the characteristics of the surface over which it now lies.

SOURCE REGION

The surface or region over which an air mass originates is called the source region. It is in this region that the basic characteristics of the air mass are acquired. In order to fulfill the requirements for a good source region, an area must be of uniform surface (either all land or all water), uniform temperature, and preferably, an area of high pressure where air has a tendency to stagnate.

AIR MASS CLASSES

Air masses are classified according to their source regions, as follows:

SYMBOL	SOURCE REGION	TEMPERATURE IN SOURCE REGION
A	Arctic	Coldest
P	Polar	Cold
T	Tropical	Warm
E	Equatorial	Warmest

Air masses are also classified according to the surface (water or land) over which they lie as follows:

SYMBOL	SURFACE	MOISTURE CONTENT
m	Maritime	High
c	Continental	Low

These symbols are combined to describe air masses as follows:

SYMBOL	SOURCE AND SURFACE	TEMPERATURE AND MOISTURE
cA	Continental arctic	Coldest, dry
cP	Continental polar	Cold, dry
mP	Maritime polar	Cold, moist
mT	Maritime tropical	Warm, moist
cT	Continental tropical	Warm, dry
E	Equatorial	Warmest, moist

Air masses are further classified according to their thermodynamic characteristics; that is, according to whether it is cold or warm in comparison to the surface over which it it passing as follows:

k	Cold	Colder than the surface
w	Warm	Warmer than the surface

EXAMPLE: mPw maritime polar air warmer than the surface it is passing over.

It should be noted that, due to the predominance of land masses or ice fields in the Arctic, mA (maritime arctic) would be a rare type. In like manner, E (equatorial air) is found exclusively over the ocean surface in the vicinity of the Equator and is designated neither c nor m but simply E.

CLOUDS

Varying weather conditions are intimately associated with different types of clouds and cloud formations. For this reason, it is highly important for the Air Controlman to be familiar with and thoroughly understand the different cloud classifications.

The international classification of clouds was established to provide a common nomenclature throughout the world for specific cumuliform and stratiform clouds. The names adopted are based upon the appearance of the clouds.

Observations have shown that clouds are generally encountered over a range of altitude varying from sea level to 25,000 feet in the polar regions, 45,000 feet in the middle latitudes, and 60,000 feet in the tropics. By convention, the part of the atmosphere in which clouds are usually present has been vertically divided into three levels—high, middle, and low. Each level is defined by a range of levels at which clouds of certain genera (classification) occur most frequently as follows:

High Clouds

1. Cirrus (Ci)
2. Cirrocumulus (Cc)
3. Cirrostratus (Cs)

The lower level of high clouds is 16,500 feet above the ground.

Middle Clouds

1. Altocumulus (Ac)
2. Altrostratus (As)
3. Nimbostratus (Ns)

The base of middle clouds may range from 6,500 feet to 23,000 feet above the ground.

Low Clouds

1. Stratocumulus (Sc)
2. Stratus (St)

The bases of the low clouds may range from near the surface to 6,500 feet above the ground.

In addition to the preceding classifications, cumulus and cumulonimbus clouds usually have bases in the lower level, but their tops often reach into the middle and high levels.

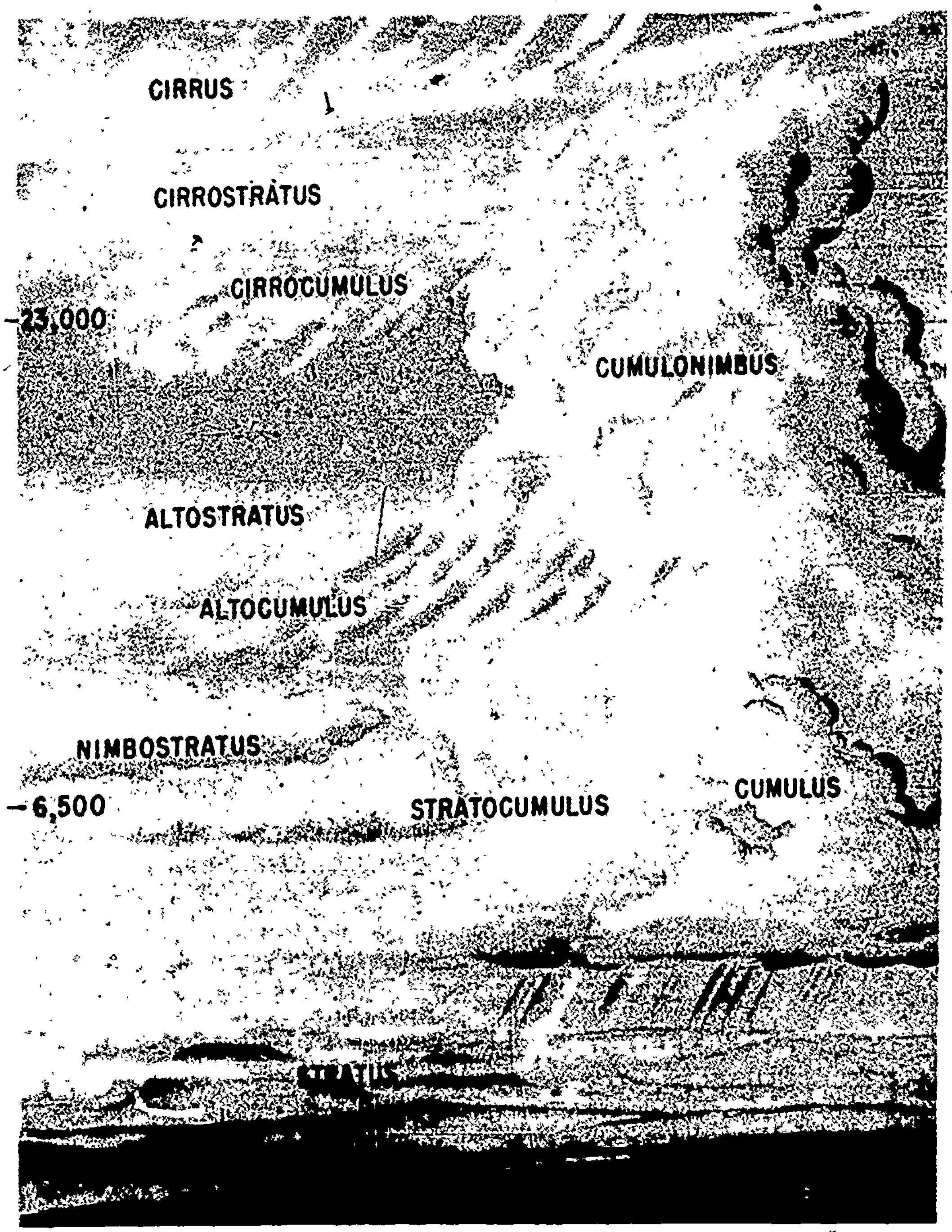
Figure 6-5 is a view of the cloud classifications being shown at their average heights.

CLOUD GENERA

Although clouds are continuously in the process of development and dissipation, they nevertheless have many distinctive features. Having outlined the classifications and average level of occurrence, it is now necessary to study cloud recognition features and the weather associated with each, as well as their appearance and how they affect aviation.

Cirrus Clouds

These clouds are fibrous and delicate in appearance, looking like white wisps against



201.42

Figure 6-5.—International classification of clouds.

201.43

Figure 6-6.—Cirrus clouds.

the blue of the sky. They appear in a number of forms, occasionally as curls or feathery plumes. (See fig. 6-6.)

Flying conditions within cirrus clouds are good. Turbulence is negligible, and the pure ice crystal composition of the cirrus clouds precludes surface icing. Cirrus clouds may indicate the first signs of approaching bad weather. Cirrus wisps, which become more and more compact and then merge into cirrostratus, may indicate an approaching warm front (fronts are discussed later in this chapter).

Cirrocumulus

These clouds appear like fleecy flakes or very small white cotton balls. The term "mackerel sky" is given to this family because the cloud pattern often appears much the same as the scales on a fish. (See fig. 6-7.) Cirrocumulus clouds are relatively rare and appear only in the presence of cirrus or cirrostratus clouds.

Cirrocumulus is a cumuliform cloud but offers only light turbulence. Due to its ice crystal composition no icing occurs on aircraft surfaces. Vapor trails can be noticed within these clouds due to the high moisture content.

Cirrostratus

Cirrostratus appears as a white veil covering all or most of the sky. It is a smooth, thin layer cloud and gives the sky a very milky appearance. It is easily recognized by the halo it produces around the sun or moon. (See fig. 6-8.)

If cirrus clouds precede the cirrostratus and the cirrostratus lowers, thickens, and merges into altrostratus, the approach of a warm front and bad weather is imminent.

Icing conditions and turbulence in cirrostratus clouds usually offer no hazard to flying.

201.44

Figure 6-7.—Cirrocumulus clouds.

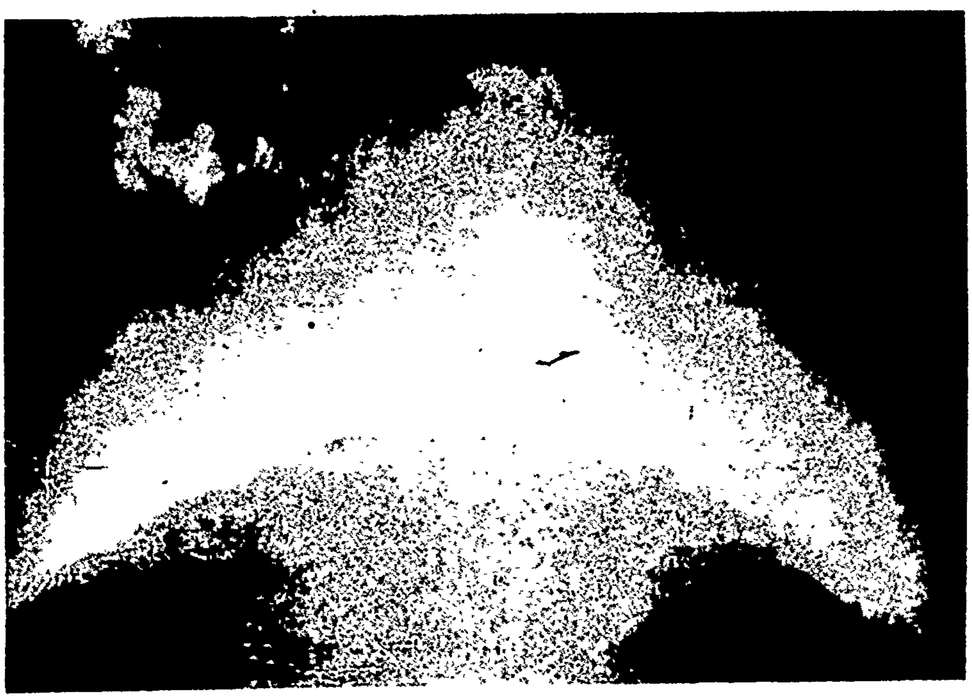


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Figure 6-8.—Cirrostratus clouds.

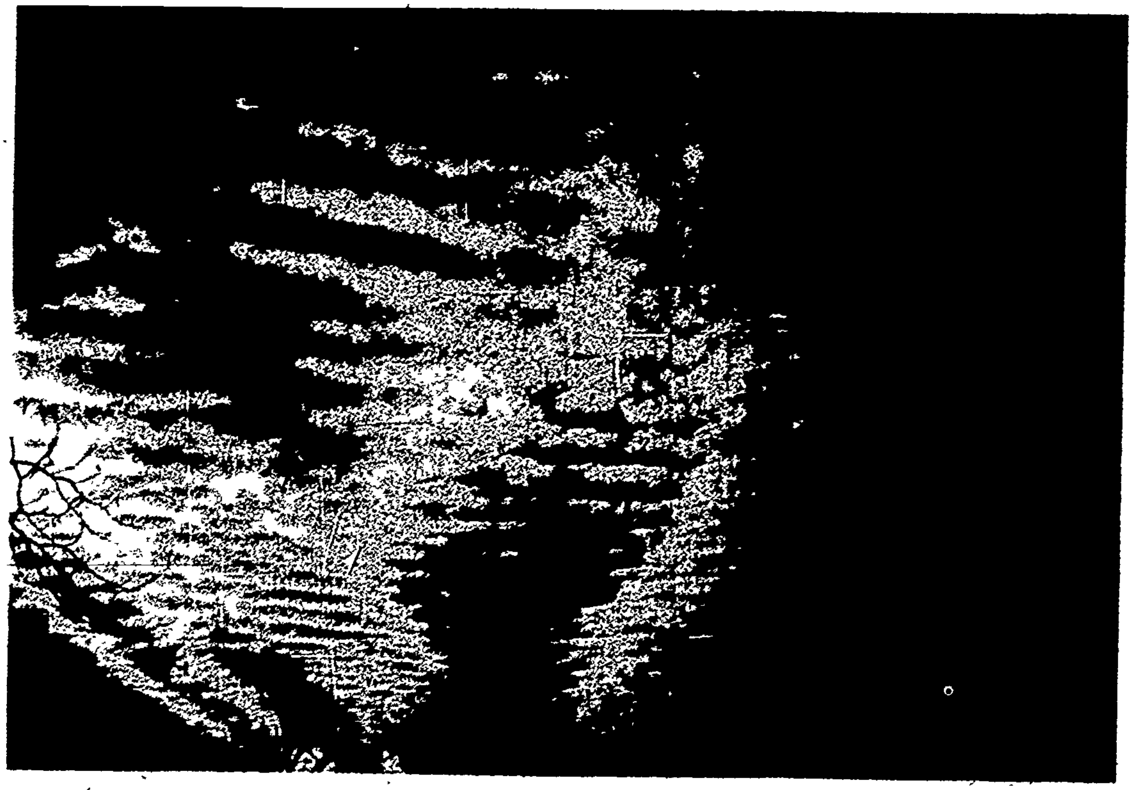

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Figure 6-9.—Altocumulus clouds.

Altocumulus

Altocumulus sometimes looks like cirrocumulus, but the individual cloud balls or flakes are always larger, thicker, and grayer. The center of the underside of each cloud is dark due to the cloud's thickness. These ball-like masses often appear similar to a herd of sheep in the sky. Sometimes altocumulus is arranged in parallel bands stretching across the sky. (See fig. 6-9.)

The visibility within this cloud is poor, and the cloud usually lacks continuity. Turbulence and icing are light to moderate. The icing, if present, is usually the clear type (types of air frame icing are discussed later in this chapter).

Altostratus

Altostratus appears as a thick gray or blue-gray smooth overcast. It is thicker and less transparent than cirrostratus, which often lowers and gradually merges with altostratus of the approaching warm front. The sun or moon shines through altostratus weakly as through ground glass. (See fig. 6-10.)

This cloud is composed of waterdrops, but ice crystals may also be present in upper levels. The icing conditions are light to moderate and predominantly form rime ice. Turbulence is light. The thickness is usually between 1,000 to 5,000 feet, but in some cases may be somewhat thicker. Visibility within the cloud averages between 50 to 200 yards. Precipitation falls from altostratus in the form of light rain or snow.

Nimbostratus

Nimbostratus is a thick, dark, gray cloud. (See fig. 6-11.) It is ominous and formless in appearance. Rain, snow, or other precipitation is actually falling from this cloud, whether it reaches the surface or not. The sun or moon disc is not visible through nimbostratus. There are also ragged scud clouds below the base of the nimbostratus. Turbulence and icing may be moderate to heavy with very poor visibility within and below nimbostratus.

Nimbostratus clouds are almost always in the middle cloud genera, but usually extend into the lower cloud genera. Low ragged clouds frequently occur below the nimbostratus layer, with which they may or may not merge.

Stratocumulus

Stratocumulus usually occurs as an extensive and fairly level layer marked by thick rolls and dark rounded masses of cloud. Its cloud masses are larger, thicker, and darker than those of altocumulus. They may have either small or large breaks between the rolls; however, they may form a continuous layer without any breaks. (See fig. 6-12.)

The visibility within this type cloud is poor. Turbulence in stratocumulus clouds is light to moderate, and the icing conditions are moderate and may form clear ice. The precipitation from stratocumulus clouds is generally showers of rain or snow.

Stratus

Stratus is a flat, shapeless, rather uniform layer of clouds which appear dull gray. (See fig. 6-13.)

Stratus yields precipitation in the form of drizzle only. Visibility within stratus is very poor. Only light turbulence and light to moderate icing may be present. Visibility below the base of stratus is very poor if drizzle is occurring.

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Figure 6-10.—Altrostratus clouds.

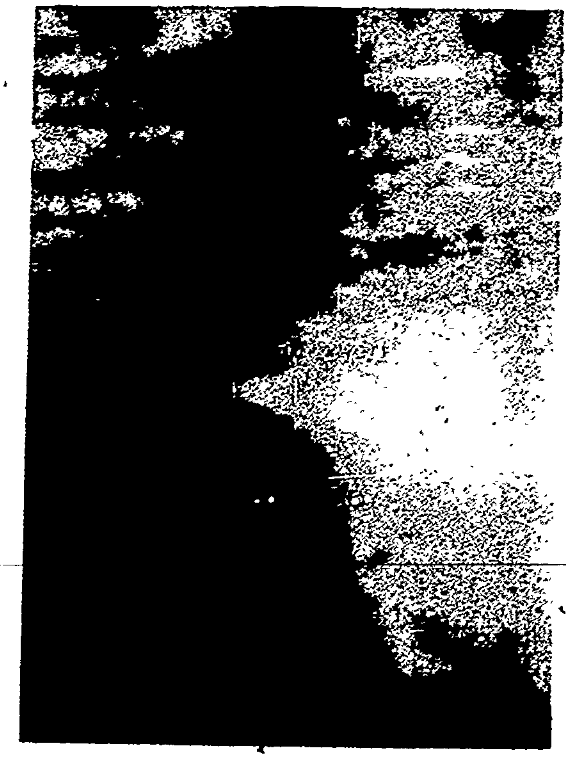

Figure 6-11.—Nimbostratus clouds. 201.48

Cumulus

Cumulus clouds are dense clouds with vertical development. Their upper surfaces are dome-shaped and exhibit rounded protuberances, while their bases are nearly horizontal. Strong updrafts exist under and within all cumulus formations. In fact, cumulus clouds are caused by updrafts. Turbulence and icing conditions

201.49

Figure 6-12.—Stratocumulus clouds.

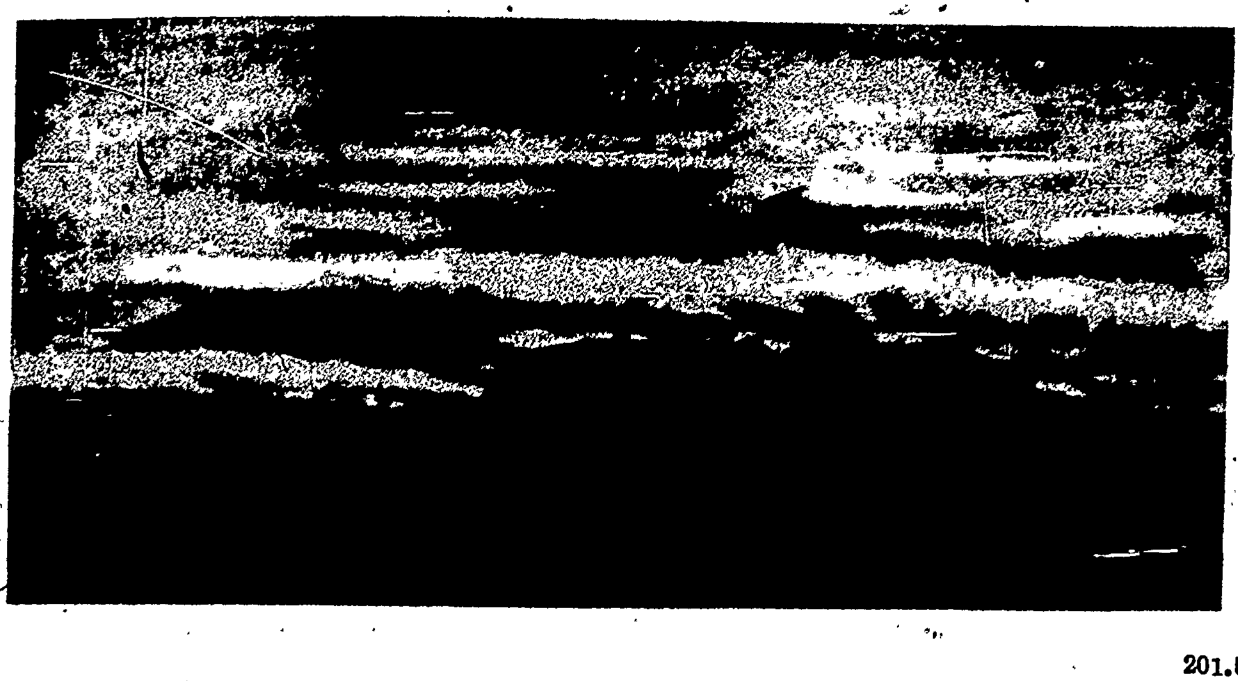

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Figure 6-13.—Stratus clouds.

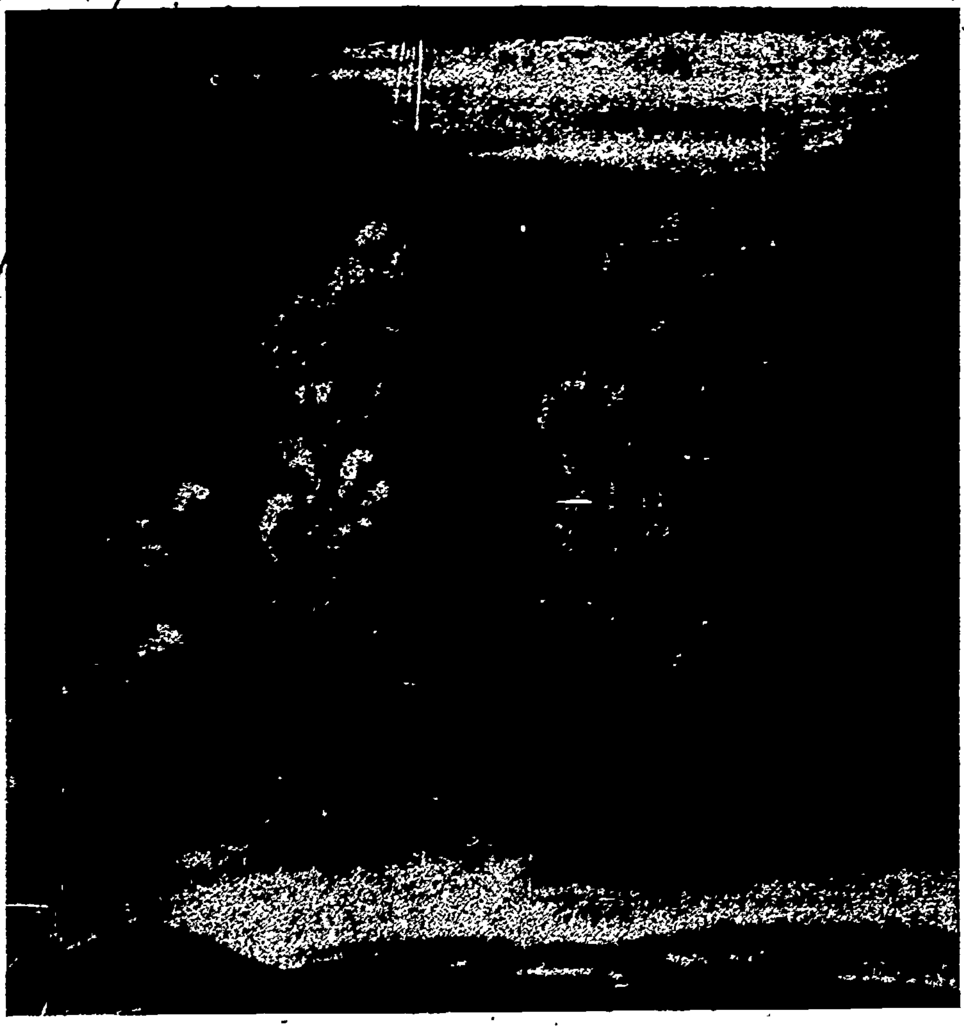

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Figure 6-14.—Cumulus and cumulonimbus clouds.

of varying intensities are common within cumulus clouds, depending upon the extent of vertical development.

Cumulonimbus

Cumulonimbus are cumulus clouds with great vertical development. Tops may extend higher than 60,000 feet. The top is composed of ice crystals and often resembles an anvil. (See fig. 6-14.)

FRONTS AND ASSOCIATED WEATHER

A front is defined as a boundary, or line of discontinuity, separating two different air masses. From the definition, you can see the close relationship that exists between air masses and fronts. In fact, without the air masses there would be no fronts. A front is a surface, like a thin elastic sheet, separating two air masses.

In our discussion of air masses, we learned that when air stagnates over certain regions it acquires properties from the underlying surface and forms an air mass. In time, these air masses move out of their source region. Due to the general circulation of the atmosphere, terrain, and other factors, the cold air from polar regions tends to move southward while the warm air from tropical regions tends to move northward in the Northern Hemisphere.

Therefore, it is inevitable that somewhere in the middle latitudes, these air masses meet. Upon meeting they do not mix readily; each air mass tending to remain intact. The surface which separates the air masses is called a frontal surface. This frontal surface, or line, is drawn on the surface weather maps, and its boundary is called a front. (See fig. 6-15.)

As previously stated, a front is indicated on a surface map by a line separating two air masses. However, this is a picture only of the surface conditions. These air masses also have vertical extent. (See fig. 6-16.) A cold air mass, being heavier, tends to underrun a warm air mass. Thus, the cold air is below and the warm air is above the surface of discontinuity. The slope of a frontal surface is usually between 1 to 50 (1 mile vertical for 50 miles horizontal) and 1 to 300 (1 mile vertical for 300 miles horizontal). For example, 100 miles from the place where the frontal surface meets the ground, the frontal surface might be somewhere between 2,000 feet and 2 miles above the earth's surface, depending on the slope. The slope of a front is of considerable importance in understanding the weather along the front.

COLD FRONTS

When cold air invades a region occupied by warm air, it wedges under the warm air pushing it upward. The frontal surface in this case is called a cold frontal surface, and its intersection with the earth's surface is called a cold front. (See fig. 6-17.)

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Figure 6-15.— The meeting of two different air masses.

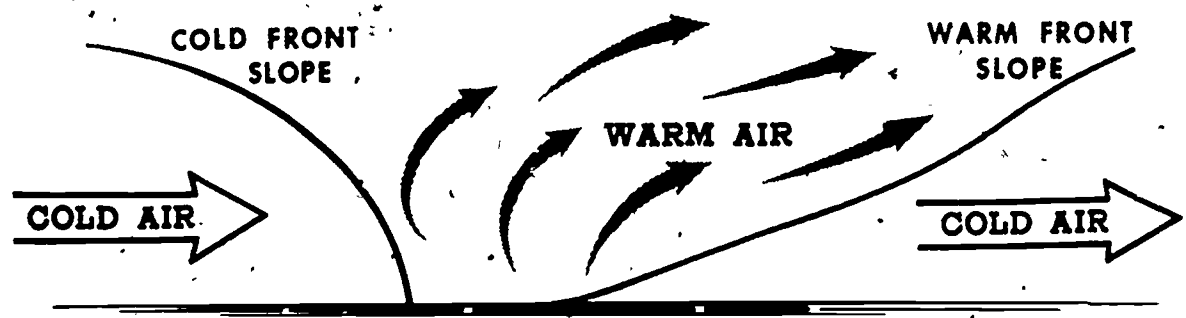

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Figure 6-16.—Vertical cross section of frontal systems (without clouds shown).

There are certain weather characteristics and conditions that are associated with the passage of cold fronts. In general, the temperature and humidity decrease, the pressure rises, and in the Northern Hemisphere the wind shifts clockwise (usually from southwest to northwest) with the passage of a cold front. The distribution and type of cloudiness and the intensity and distribution of precipitation depend primarily on the vertical velocities, stability, and moisture in the warm air mass. On the basis of these factors, cold fronts are classified as slow- and fast-moving cold fronts.

With the slow-moving cold front there is a general upglide of warm air along the entire frontal surface except for pronounced lifting along the lower portion of the front. The average slope of the front is approximately 1:100 (1 mile vertical to 100 miles horizontal). The cloud and precipitation area is extensive and is characterized by cumulonimbus and nimbostratus clouds, showers, and thunderstorms at, and immediately to the rear of, the surface front. This area is followed by a region of rain and nimbostratus clouds merging into a region of altostratus clouds and then cirrostratus clouds,

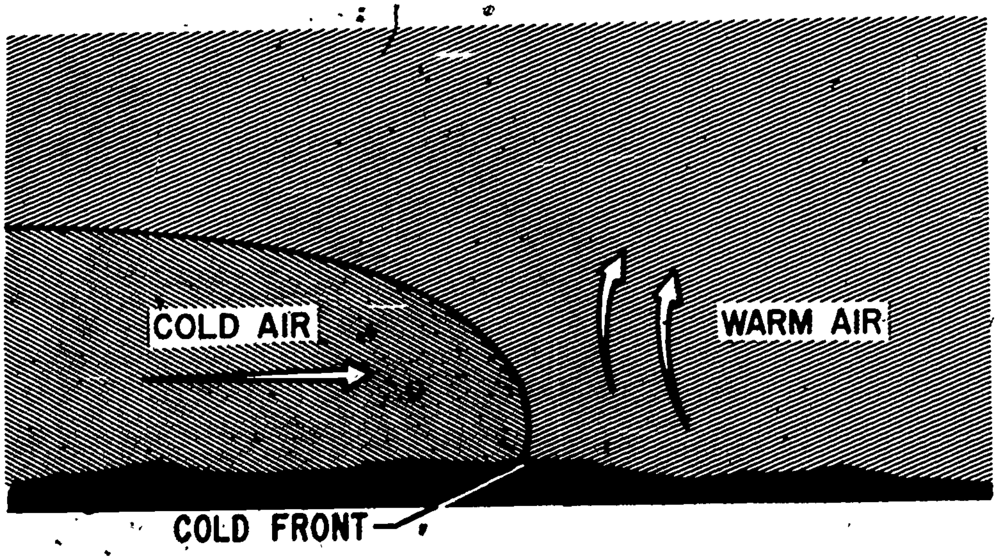

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Figure 6-17.—A cold front.

which may extend several hundred miles behind the front. The development of cumulonimbus clouds, showers, and thunderstorms is largely dependent on the original instability characteristics of the warm air mass. Within the cold air mass there may be some stratified clouds in the rain area, but there are no clouds beyond this area unless the cold air mass is unstable. In the latter case, some cumulus clouds may develop. This type of front is usually slow-moving; 15 knots may be considered average. (See fig. 6-18(A).)

With the fast-moving cold front, there is descending motion of the warm air along the frontal surface at high levels, and the warm air near the surface is pushed vigorously upward. This type of front has a slope of 1:40 to 1:80 and usually moves rapidly; 25 to 30 knots may be considered as an average speed of movement. As a result of these factors, there is a relatively narrow but often violent band of weather. If the warm air mass is conditionally unstable and moist, cumulonimbus clouds, showers, and thunderstorms occur just ahead of and at the surface front, and rapid clearing occurs behind the front. Frequently altostratus and altocumulus cloud layers form and drift ahead of the main cloud bank. The more unstable the warm air mass, the more violent the weather. If the warm air is relatively dry, this type of front may not produce precipitation or clouds. It is with the fast-moving cold front that squall lines are associated. (See fig. 6-18(B).)

The Air Controlman should note that cold fronts are indicated in blue penciled lines on a colored weather map. When color cannot be used, triangles are spaced along the line of the front with their points indicating the approximate direction in which the cold front moves across the earth's surface.

WARM FRONTS

If cold air is retreating before an advancing mass of warm air, the warm air slides over the cold air. The frontal surface in this case is called a warm frontal surface, and its intersection with the earth's surface is called a warm front. (See fig. 6-19.)

The weather associated with a warm front varies as it does with a cold front, depending on the degree of stability and moisture of the warm air mass. (See fig. 6-20.)

Certain characteristics and weather conditions are associated with the passage of warm fronts. In the Northern Hemisphere the winds veer from southeast to southwest or west, but the shift is not as pronounced as with the cold front. Temperatures are colder ahead of the front and are warmer after passage of the front. Not being greatly affected by daily heating and cooling of the earth's surface, the dew point is normally more constant than is the temperature through the day except with the passage of a front. Therefore, the dew point is a good index of frontal passage. The average slope of a warm front is 1:150 (1 mile vertical to 150 miles horizontal).

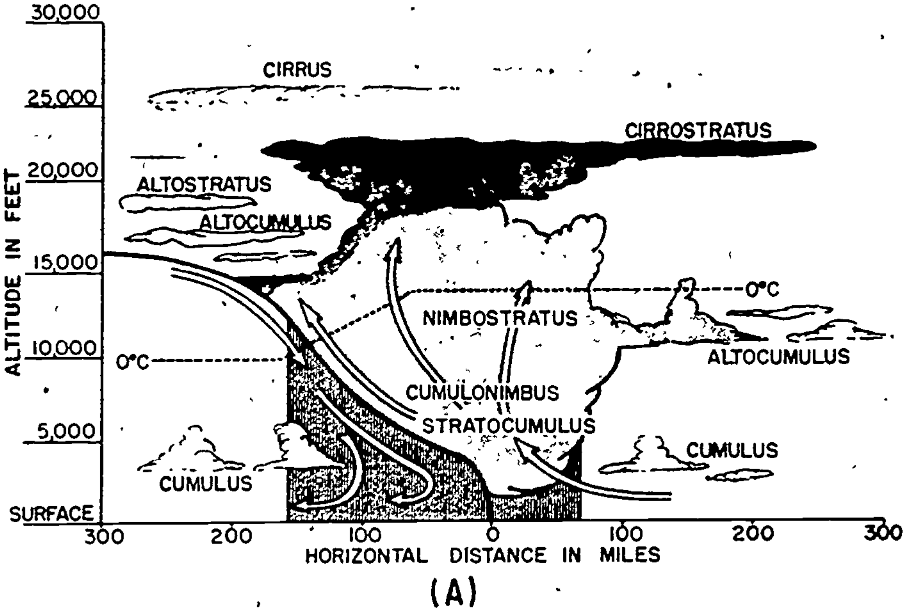
A characteristic phenomenon of a typical warm front is the sequence of cloud formations. These formations are noticeable in the following order: cirrus, cirrostratus, altostratus, nimbostratus, and stratus. The cirrus clouds may appear 700 to 1,000 miles ahead of the surface front followed by cirrostratus about 600 miles and altostratus about 500 miles ahead of the surface front. Precipitation in the form of continuous or intermittent rain, snow, or drizzle is frequent as much as 300 miles in advance of the surface front. The precipitation is associated with nimbostratus above the frontal surface and stratus within the cold air. However, when the warm air is convectively unstable, showers and thunderstorms may occur in addition to the steady precipitation.

Clearing usually occurs after the passage of a warm front, but under some conditions drizzle and fog may occur within the warm sector. Normally, the speed of a warm front is less than that of cold fronts; an average may be considered to be about 10 knots.

Warm fronts are indicated by red penciled lines on a colored weather map. When color cannot be used, half circles are spaced along the line of the front on the map on the proper side to indicate the approximate direction of the frontal movement across the surface.

OCCLUDED FRONTS

An occluded front occurs when a cold front overtakes a warm front. One of the two fronts is lifted aloft, and the warm air between the fronts is shut off from the earth's surface. An occluded front is often referred to as an occlusion. The type of occlusion is determined



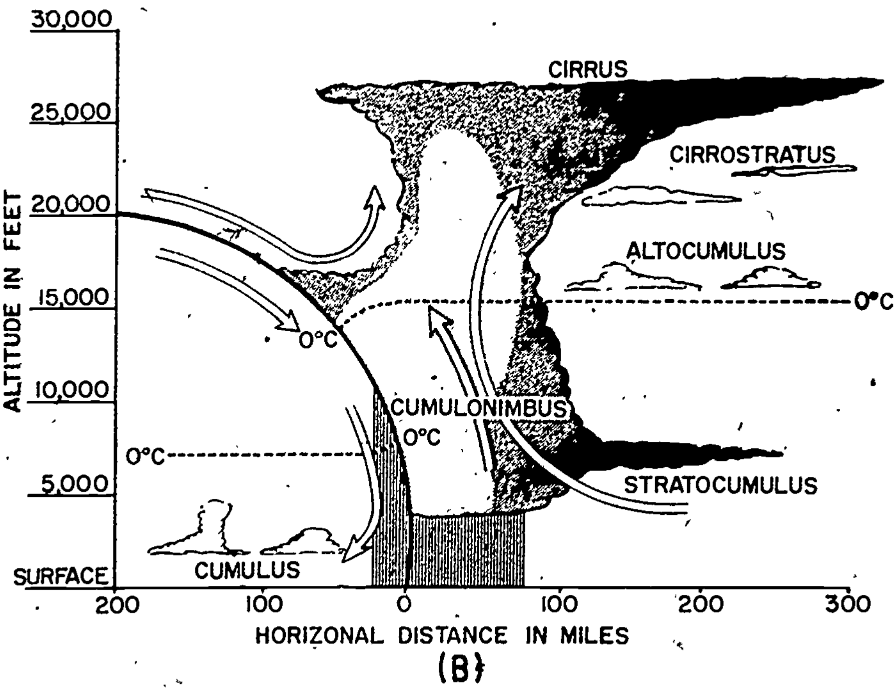


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Figure 6-18.—Vertical cross section of a cold front. (A) slow-moving cold front; (B) fast-moving cold front.

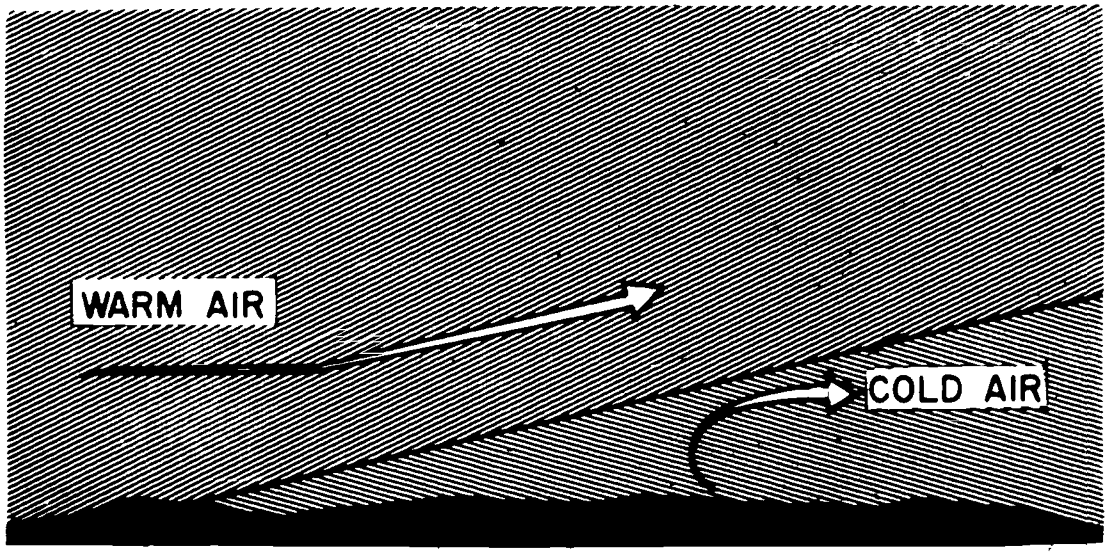

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Figure 6-19.—A warm front.

by the temperature difference between the cold air in advance of the warm front and the cold air behind the cold front.

If the air in advance of the warm front is colder than the air behind the cold front, the cold front rides along the warm frontal surface and the occluded front is referred to as a warm-type occlusion. If the cold air ahead of the warm front is warmer that the cold air behind the cold front, the cold frontal surface underruns the warm front and the occluded front is called a cold-type occlusion (See fig. 6-21.)

The primary difference between a warm-type and cold-type occlusion is the location of the associated upper front in relation to the surface front. In a warm-type occlusion the upper cold front precedes the surface occluded front by as much as 200 miles. In the cold-type occlusion the upper warm front follows the surface occluded front by 20 to 50 miles.

Since the occluded front is a combination of fronts, the resulting weather is that of the cold front's narrow band of violent weather and the warm front's widespread area of cloudiness and precipitation occurring in combination along the occluded front. The most violent weather occurs at the tip of occlusion. (The tip is the point at which the cold front is overtaking the warm front.)

Occluded fronts are indicated by a purple penciled line on the colored weather map. When color cannot be used, alternating half circles and triangles are spaced along the line of the front on the map and on the proper side to indicate the approximate direction of frontal movement across the surface.

STATIONARY FRONTS

One of the most annoying characteristics of a stationary front (a front that shows little or no apparent movement) is that it may greatly hamper and delay air operations by persisting in an area for several days.

The weather associated with a stationary front varies with the stability of the warm air or the moisture content of the cold air. (See fig. 6-22.)

If the warm air is unstable, rainfall from thunderstorms normally exists. If the warm air is stable, there generally is drizzle, and beyond the freezing level there are icing conditions, light snow, or light rain. At very high levels there are also some ice-type clouds present.

In the cold air there are generally lowered ceilings and extensive fog. Icing conditions, if present, are light.

The width of the weather band with its precipitation and low ceilings varies from 50 to 200 miles, depending upon the temperature of the air mass.

Stationary fronts are indicated by an alternating red and blue penciled line on the colored weather map. When color cannot be used, alternating half circles and triangles are spaced along the line of the front on opposite sides of the frontal line to indicate very little movement across the surface.

HUMIDITY

Weather conditions depend greatly upon the amount of water in the air. The water may be in any of three forms—gas, liquid, or solid. As a gas, it is called water vapor, which is invisible. Solid or liquid water is visible as precipitation or as clouds.

Humidity is a comprehensive concept; therefore, there are available many different definitions and many different manners of expressing humidity.

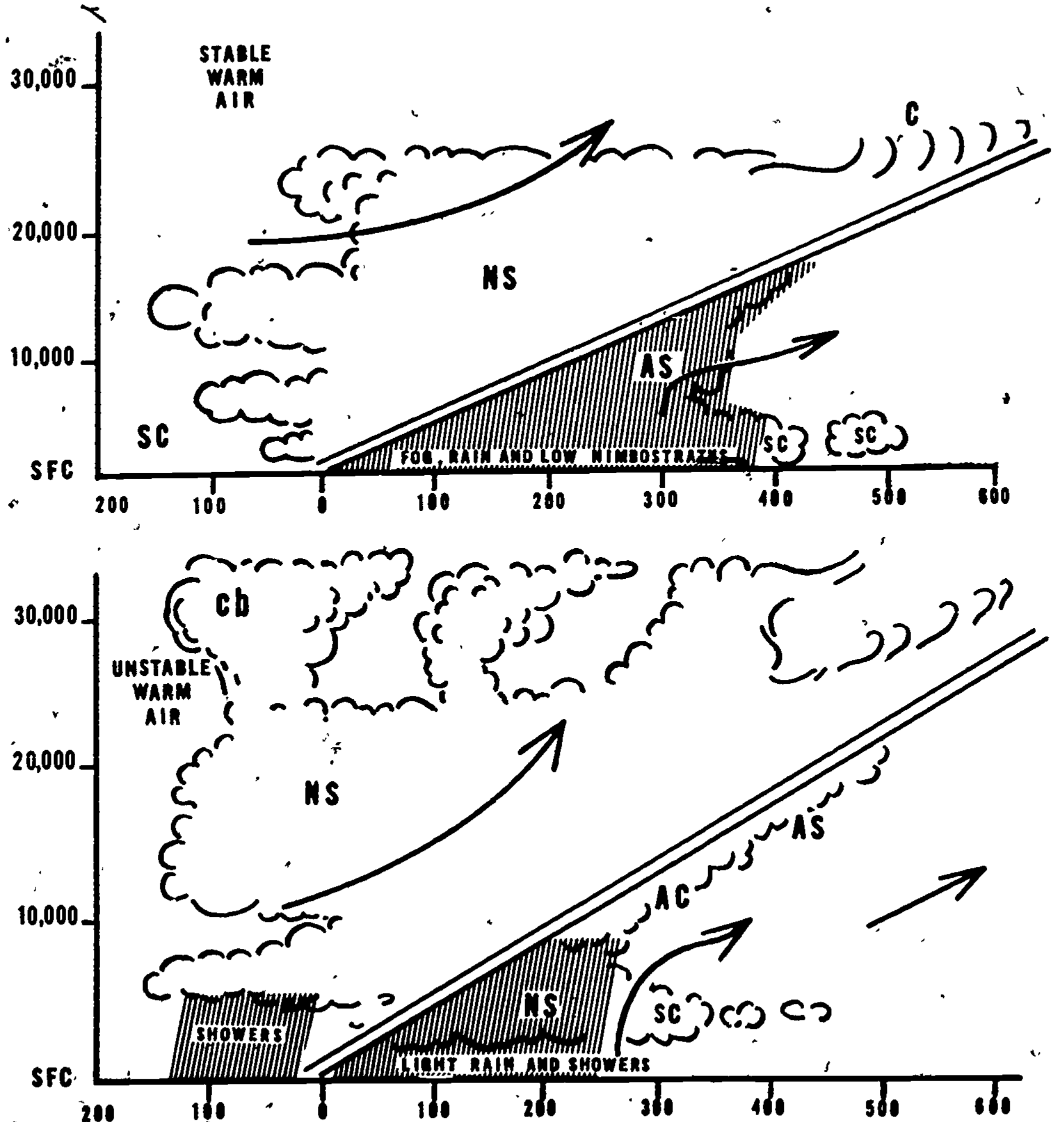

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Figure 6-20.—Vertical cross section of a warm front.

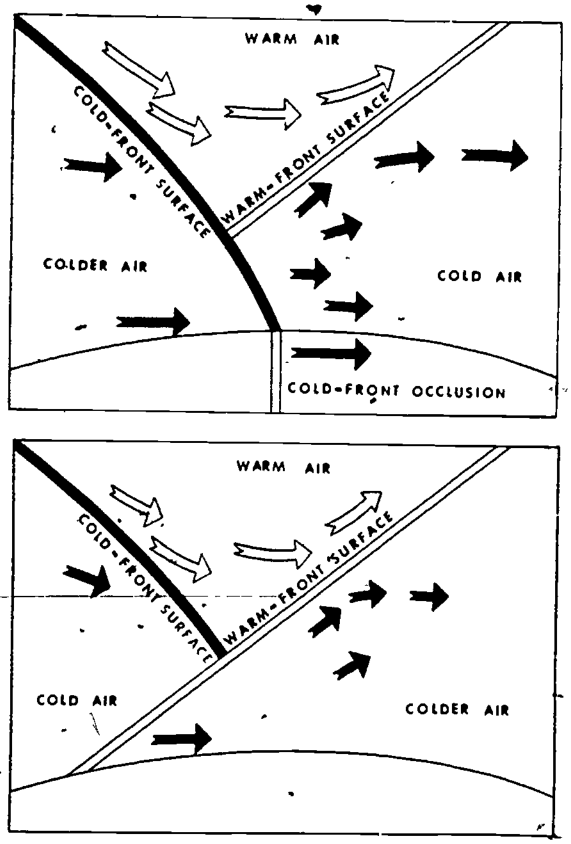

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Figure 6-21. — Vertical cross section of cold- and warm-type occlusions.

Most of the weather that interferes with the operation of aircraft is directly associated with water in some form. In this section, the characteristics of water vapor and two manners in which humidity is expressed are discussed.

WATER VAPOR CHARACTERISTICS

Water vapor is a universal constituent of the atmosphere. Any given volume of atmosphere at a given temperature can contain only a certain maximum quantity of water vapor. The maximum amount (by volume) of water vapor that the air can hold is about 4 percent. If more and more water vapor is injected into a given container of dry air kept at a constant temperature, a point is reached when the water vapor condenses, or becomes liquid, as fog within the container or as dew on its walls. As more and more water vapor is added, more of it condenses; but the total amount of vapor in the container remains unchanged, although the amount of liquid water in the form of fog or dew increases. The volume of air in the container is then said to be saturated with water vapor.

Although the quantity of water vapor in a saturated volume of atmosphere is independent of the amount of air present, IT DOES DEPEND ON THE TEMPERATURE. The higher the temperature, the greater the tendency for liquid water to turn into vapor. At a higher temperature, therefore, more vapor must be

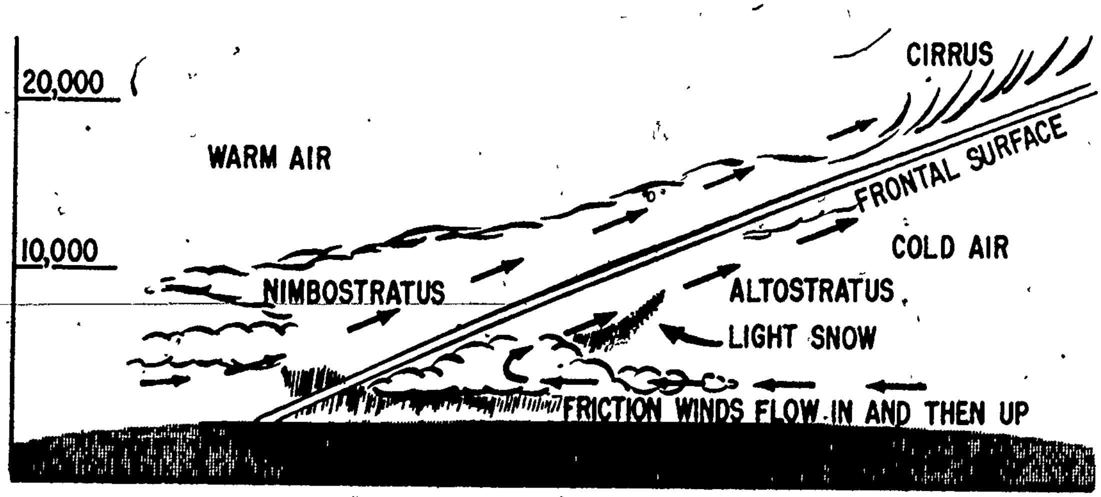

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Figure 6-22. — Cross section of a stationary front.

injected into a given volume before the saturated state is reached and dew or fog forms. On the other hand, cooling a saturated volume of air forces some of the vapor to condense and the quantity of vapor in the volume to diminish.

DEFINITIONS OF HUMIDITY

The actual amount of water vapor contained in the air is usually less than the saturation amount. The amount of water vapor in the air is expressed in several different manners. Two methods are described in the following portion of this section.

Relative Humidity

Although the major portion of the atmosphere is not saturated, it is desirable to be able to say how near it is to being saturated. This relationship is expressed as relative humidity. The relative humidity of a volume of air is the ratio (in percent) between the water vapor actually present and the water vapor necessary for the saturation at a given temperature.

Assume, for instance, that the temperature is 25°C. The amount of water vapor needed to saturate a cubic meter of air at this temperature is 23.05 grams. If observation indicates only 11.525 grams of vapor in a cubic meter, the sample volume is half saturated, or its relative humidity is 50 percent.

Relative humidity shows the degree of saturation, but it gives no clue as to the actual amount of water vapor in the air. Thus, other expressions of humidity are useful.

Dew Point

The dew point is the temperature to which air must be cooled, at constant pressure and constant water vapor content, in order for satration to occur. The dew point is a conservative and very useful element. When atmospheric pressure stays constant, the dew point reflects increases and decreases in moisture in the air, and also shows at a glance, under the same conditions, how much cooling of the air might result in condensed moisture.

FOG

Since the Air Controlman's job is primarily one of helping pilots by relaying known and anticipated information to them, it is essential that he have a fundamental knowledge of the classes and causes of fog.

Fog may be defined as a cloud on the earth's surface. It is a visible condensation in the atmosphere of sufficient density to interfere with visibility.

Fog consists of visible water droplets or ice particles suspended in the atmosphere. It differs from other clouds in that it exists on the ground or over the surfaces of bodies of water. It differs from rain or mist in that its water or ice particles are more minute, are suspended, and do not fall earthward.

FORMATION OF FOG

The differential between the dew point and the temperature is used in the prediction of fog formation. The smaller the difference between the temperature and dew point, the greater the possibilites of fog formation. Spread is the term used to define the difference in degrees between the two. All Air Controlmen should be alert to the possibility of fog formation whenever the spread decreases to 4 degrees or less.

There are two ways in which the temperature and dew point may become coincident:

1. The dew point rises until it equals the temperature. This results from the addition of water vapor to the air by evaporation from water surfaces, wet ground, or precipitation falling through the air.

2. The temperature lowers to the dew point as a result of cooling of the air by contact with a cold surface underneath.

Naturally, other factors influence the formation of fog. Wind is one. In a calm condition, fog will form and is generally very shallow. However, a light wind condition is ideal for fog formation, as it produces deep layers of fog. A moderately strong wind tends to keep fog from forming as it circulates the air too rapidly for fog-producing conditions to exist. Strong wind will often dissipate fogs already formed.

Air polluted with dust and smoke particles provides a great quantity of condensation nuclei. These nuclei, offering particles of matter upon which moisture may condense, make fog formation much easier and the fog more dense. Although all fog can reduce the ceiling and

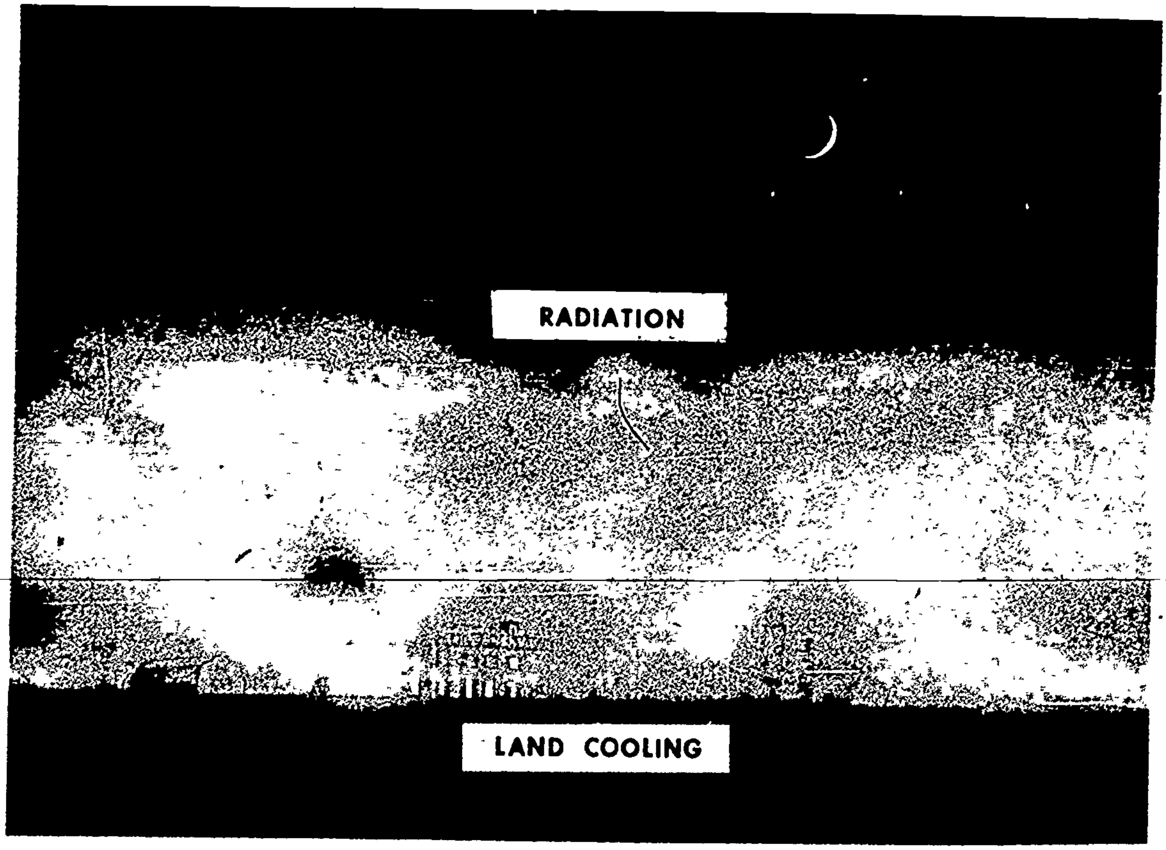

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Figure 6-23.—Radiation fog.

visibility to near zero, the most dangerous type of fog is one that covers large areas.

CLASSES

Fog is divided into two classes: air mass fog and frontal fog. Each class is discussed as there are different requirements which govern the formation of each class.

Air mass fog occurs within a given air mass and is formed when the layer of air close to the earth's surface is cooled by contact with a colder surface below.

There are four types of air mass fog. Each type gets its name from the particular manner in which air is cooled to the dew point or saturated to condensation. The four types are radiation fog, advection fog, upslope fog, and steam fog.

Radiation fog, which generally occurs as ground fog, is formed by the cooling of a land surface on clear nights by radiation of heat to the sky. (See fig. 6-23.) Radiation fog never forms over water.

After sunset, the earth receives no heat from the sun, but continues to radiate heat. The surface begins to cool because of this heat loss. As the earth cools, the layer of air next to the earth's surface is cooled by conduction. If the layer of air next to the surface is sufficiently moist, the conduction process chills the air to the dew point temperature and fog forms. In case of a calm wind, this cooling by conduction affects only a very shallow layer of air. In this case, the fog tends to be very thin. Wind from three to five knots provides enough mixing so that the fog will be fairly deep. If

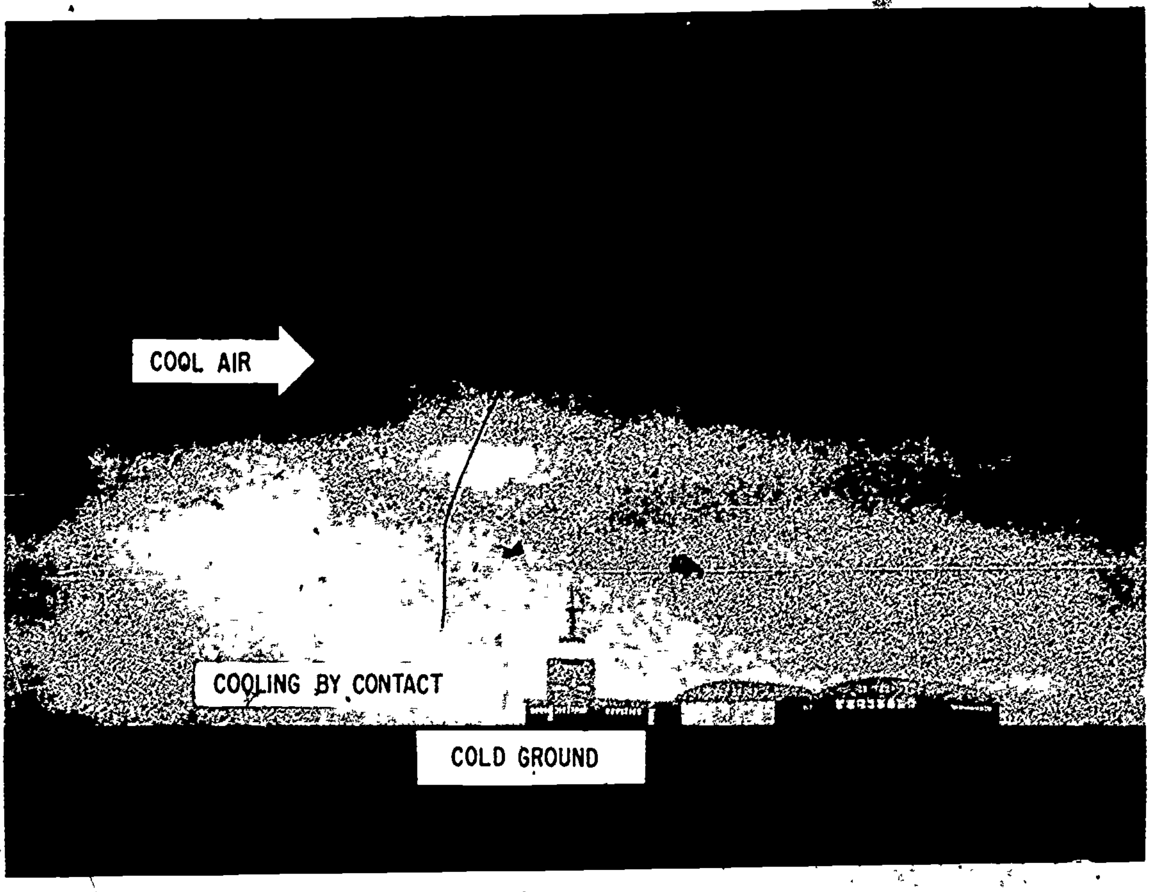

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Figure 6-24.—Advection fog.

the wind is too strong, it causes so much mixing that fog does not form. Radiation fog usually forms at night and generally dissipates before midmorning. The best condition for radiation fog is a clear cool night, light wind, and high humidity.

Advection fog is the name given to fog produced by air in motion or fog formed in one place and transported to another. This type of fog is formed when air is transported over a land or water surface colder than the air mass passing over it. (See fig. 6-24.) Cooling from below takes place and gradually builds up a layer of fog.

Advection fog forms in regions where marked temperature contrasts exist within a short distance of each other, and only when the wind blows toward the cold region. Areas of marked temperature contrast are usually found along the coastlines, places where snow-covered ground is adjacent to bare ground, and at sea where cold and warm water currents are adjacent.

Due to the fact that advection fog covers larger areas than the other types, it is generally considered the most dangerous type.

Upslope fog forms when air is forced to ascend a gradual slope. As the air rises up the slope, the atmospheric pressure decreases causing the air to expand and cool. If the air cools to a temperature equal to the dew point temperature, fog will form. Upslope fog forms in very deep layers and requires considerable

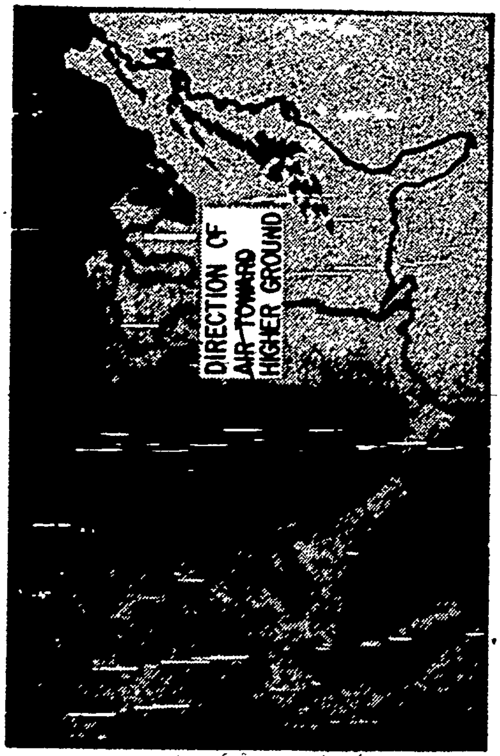

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Figure 6-25.—Upslope fog.

time to dissipate. The most common fog of this type is called Cheyenne fog and is caused by the westward flow of air from the Missouri valley, which produces fog on the eastern slope of the Rocky Mountains. (See fig. 6-25.)

Steam fog, sometimes referred to as sea smoke, occurs within air masses. However, unlike other air mass fogs which are formed by cooling of the air temperature to the dew point temperature, this type is caused by saturation of the air through evaporation of water. It occurs when cold air moves over warm water. Evaporation from the surface of the warm water easily saturates the cold air, causing the fog to form. This type of fog is most common in the northern latitudes. Marsh or swamp mist is a familiar example of steam fog. This type of fog generally forms in the fall of the year only. (See fig. 6-26.)

Frontal fog is another hazard which must be added to the list of weather troubles associated with fronts. Frontal fog forms under the frontal surface in the cold air mass. Frontal fog is divided into two classes: warm front fog and cold front fog.

The warm front fog is much more extensive than the cold front type and is a definite hazard to flight operations. It is caused by rain falling from warm air into the cold air beneath the front and is anticipated by a rise in the dew point to or very near to the free air temperature. (See fig. 6-27.)

Since the precipitation band accompanying a warm front is quite wide and the movement of the front is slow, this warm front fog may cover an extensive area for considerable time. After the passage of a warm front, an advection type fog frequently occurs in the warm air if the surface is much colder than the air that is moving in. Strictly speaking, this is not a frontal type fog, but is formed within the air mass itself by advection cooling.

Warm front fog is particularly prevalent along the eastern seaboard of the United States, where the cold waters offshore and the general upslope of the terrain are contributing factors toward this fog formation.

Cold front fog is comparatively rare because cold fronts move so rapidly and have associated with them such narrow bands of precipitation and high wind speeds that fog conditions dissipate or do not develop. On some infrequent occasions, fog does form in the cold air mass just behind the cold front. (See fig. 6-27.) When this happens, the fog dissipates rapidly due to the fast movement of the front over the surface of the earth.

AIRFRAME ICING

Another weather hazard to flying is airframe icing. The Air Controlman who has exact knowledge of when and how ice forms on aircraft is able to lend invaluable assistance to pilots at one time or another.

Formation of ice on an aircraft reduces lift and thrust by adding weight to the structure and changing the airfoil shape of wings, tail, and propeller(s). There are three types of airframe ice: rime, clear (glaze), and frost. Icing conditions encountered in flight will be a combination of rime and clear ice types with the characteristics of one or the other being

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Figure 6-26.—Steam fog.

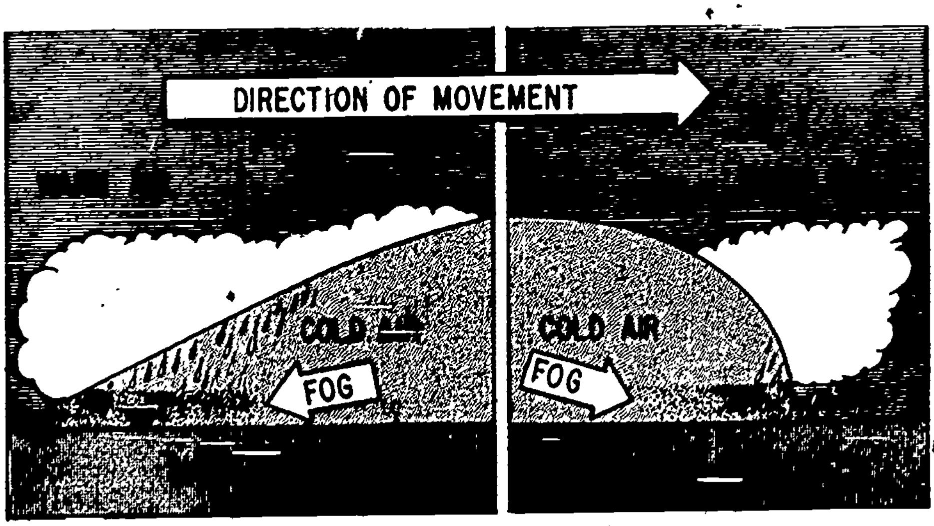

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Figure 6-27.—Warm- and cold-front fog.

dominant. Frost forms on aircraft while on the ground. An everyday comparison between rime ice and clear ice may be found in a home refrigerator. The ice that forms in the ice tray is an example of clear ice. It is very hard and glassy, and can be broken loose only with difficulty. Rime ice is the ice that forms on the refrigerator's coils. It is white and granular, and can be easily broken off. There are only two fundamental conditions necessary for the formation of ice on aircraft in flight. The aircraft must be flying through visible water in the form of rain, drizzle, or cloud droplets; and at the time the water droplets strike the aircraft, their temperature, and the temperature of the surface of the aircraft, must be 32°F or colder. The heaviest airframe icing will generally occur within the temperature range of 0°C to -10°C (32°F to 15°F) provided moisture is available.

CLEAR ICE

Clear ice, sometimes referred to as glaze ice, is considered to be the most serious of the three types. It is clear, dense, and solid, adhering firmly to structures upon which it forms. (See fig. 6-28.) If the water droplets strike an aircraft in such rapid succession that none has a chance to freeze before the next strikes in the same place, the leading edges of the aircraft structures are kept covered by a film of liquid water. This film of water, cooled by contact with the colder air and by partial evaporation, freezes from the inside out forming a clear, dense, strong layer of ice attached to the wing or other surfaces upon which it is freezing.

Some of the conditions which produce a liquid film of water on aircraft favorable to the formation of clear ice are as follows:

1. Large water droplets such as found in cumuliform clouds.
2. Large number of cloud droplets (dense clouds).

These first two conditions are most commonly found in unstable air.

3. Temperature just slightly below freezing.
4. An unstable or conditionally unstable air mass.
5. Rain or freezing rain.

RIME ICE

Rime ice is a granular, whitish, opaque, rough deposit of ice formed from tiny supercooled water drops found in stratiform clouds of stable air. (See fig. 6-29.) Rime ice usually occurs at a lower temperature than does clear ice.

Unlike clear ice, rime is formed as each supercooled water droplet that strikes the airfoil freezes completely before another strikes

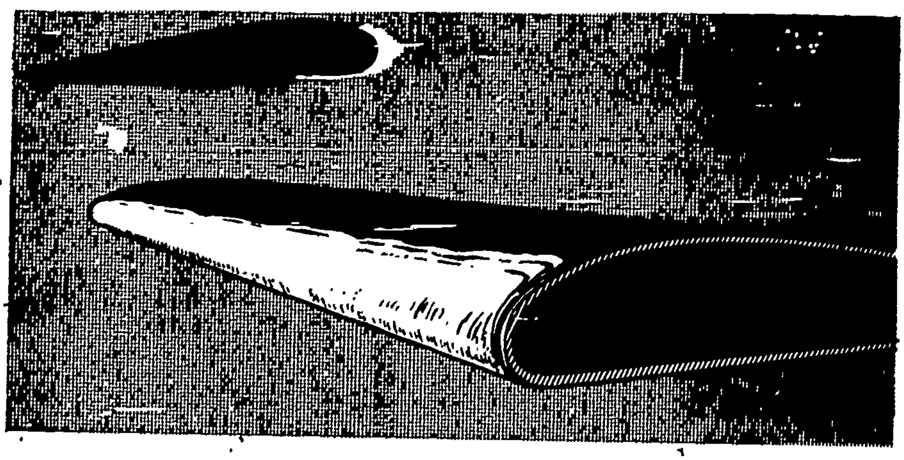

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Figure 6-28.—Clear ice on an airfoil.

in the same place. The resulting ice deposit is in the form of tiny pellets frozen together in a spongy mass.

The conditions which favor formation of rime ice are as follows:

1. Very small droplets such as found in stratiform clouds.
2. A relatively small number of water droplets found in clouds that are not dense.
3. Temperatures far below freezing.
4. An air mass that is stable or conditionally stable.
5. Drizzle.

FROST

Frost is a light, whitish, feathery crystalline structure, snowlike in character. It forms a dangerous coating on an aircraft surface which adds drag and alters the aerodynamic characteristics of an aircraft. Frost occurs when the temperatures of the surfaces of the aircraft are below freezing at the time condensation takes place. This icing condition usually forms on aircraft on the ground. It can also form on airborne aircraft if the aircraft very quickly flies from a region where the temperature is well below freezing to a region where the temperature is considerably higher and the air is very moist.

Other parts of the aircraft susceptible to icing which will decrease its flight capabilities are the propeller, pitot tube, and carburetor. Propeller ice reduces the power of the aircraft; pitot tube ice causes malfunction of the air speed indicator; and carburetor ice gives the effect of slowly closing the throttle. It occurs under a wide range of temperatures and can result in complete engine failure. Carburetor ice forms during vaporization of fuel combined with the expansion of air as it passes through the carburetor. Temperature drop in the carburetor can be as much as 40°C, but is usually 20°C or less. The temperature at which carburetor icing will form depends upon many factors such as relative humidity, type of gas and its ingredients, and the type of carburetors.

WINDS

In general, a reference to wind means air in natural horizontal motion relative to the surface of the earth. Actually, wind has many components of direction. It may be directed vertically upward or downward, or horizontally. The vertical components are difficult to measure. Thus we deal only with the horizontal components—the horizontal direction and speed. In meteorology, reference is generally made to the vertical component of the wind as turbulence, updrafts, or downdrafts.

The cause of windflow is the variation in pressure, which in turn results from a variation

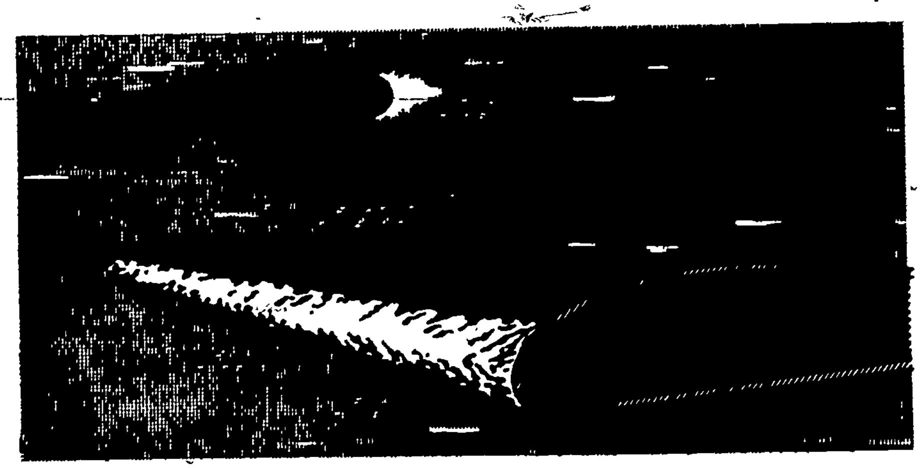

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Figure 6-29.—Rime ice on an airfoil.

in temperature caused by the global circulation of air which maintains a balance of heat on the earth. Since the earth heats unequally, the heat is carried away from a hotter area to a cooler one as a result of the operation of physical laws.

At times confusion arises from the meaning of wind direction. Wind direction is always the direction FROM which the wind is blowing. Windspeed is usually measured and expressed in knots.

PHOTOMETEORS

Photometeors are luminous phenomenon produced by the reflection, refraction, diffraction or interference of light from the sun or moon. They constitute such phenomena as solar and lunar halos, solar and lunar coronas, rainbows, and fogbows. Photometeors are not active elements; that is, they generally do not cause adverse weather. However, they are related to clouds which are indicative of what weather to expect.

HALOS

A halo is a luminous ring around the sun or moon. When it appears around the sun, it is a solar halo; when it forms around the moon, it is a lunar halo. It usually appears whitish, but it may show the spectral colors. Halos are formed by REFRACTION of light as it passes through ice crystals. This means that halos are almost exclusively associated with cirriform clouds. Refraction of light means that the light passes through prisms; that is, ice crystals which act as prisms.

CORONAS

A corona is a luminous ring surrounding the sun (solar) or moon (lunar) and is formed by DIFFRACTION of light by water droplets. It may vary greatly in size, but is usually smaller than a halo. All the spectral colors may be visible. Sometimes the spectral colors or portions of them are repeated several times and are somewhat irregularly distributed. It is difficult to distinguish between coronas and halos. The main feature may be size, as previously mentioned and the colors appear brighter, which is a result of light diffraction by water droplets. This would be associated with cumulus clouds or middle clouds.

RAINBOWS

The rainbow is a circular arc seen opposite the sun, usually exhibiting all the primary colors, with red on the outside. It is caused by diffraction, refraction, and reflection of light within raindrops.

FOGBOWS

A fogbow is a whitish semicircular arc seen opposite the sun in fog. Its outer margin has a reddish tinge; its inner margin has a bluish tinge. The middle of the band is white. An additional bow, with the colors reversed, sometimes appears inside the first.

ELECTROMETEORS

Electrometeors are a visible or audible manifestation of the atmospheric electricity. The more important electrometeors include thunderstorms, lightning, and aurora. (Because of its effect on aviation, the thunderstorm is discussed as a separate entity later in this chapter.)

LIGHTNING

Lightning is a flash of light from a sudden electrical discharge which takes place from or inside a cloud or from high structures on the ground or from mountains. Four main types of lightning can be distinguished as follows:

1. Cloud to ground lightning (CG). Lightning occurring between the cloud and the ground.

2. Cloud discharge (IC). Lightning which takes place within the thunder cloud.

3. Cloud to cloud discharge (CC). Streaks of lightning reaching from one cloud to another.

4. Air discharge (CA). Streaks of lightning which pass from a cloud to the air but do not strike the ground.

AURORA

Aurora is a luminous phenomenon which appears in the high atmosphere in the form of arcs, bands, draperies, or curtains. This phenomenon is usually white but may have colors. The lower edges of the arcs or curtains are usually well defined while the upper edges are not. Polar aurorae are due to electrically charged particles, ejected from the sun, acting on the rarified gases of the higher atmosphere. The particles are channeled by the earth's magnetic field; therefore, aurorae are mainly observed near the magnetic poles.

LITHOMETEORS

Lithometeors comprise a class of atmospheric phenomena, among which dry haze and smoke are the most common examples. In contrast to a hydrometeor, which consists largely of water, a lithometeor is composed of solid dust or sand particles, or the ashy products of combustion.

HAZE

Haze is suspended dust or salt particles so small that they cannot be individually felt or seen by the unaided eye. They reduce visibility and lend a characteristic opalescent appearance to the air. Haze resembles a uniform veil over the landscape that subdues its colors. This veil has a bluish tinge when viewed against a dark background and a dirty yellow or orange tinge when viewed against a bright background.

SMOKE

Smoke is fine ash particles suspended in the atmosphere. When smoke is present, the disc of the sun at sunrise and sunset appears very red and during the daytime has an orange tinge. Smoke at a distance, such as from forest fires, usually has a light grayish or bluish color and is evenly distributed in the upper air.

DUST

Dust is finely divided solid matter, uniformly distributed in the air. It imparts a tannish or grayish hue to distant objects. The sun's disc is pale and colorless or has a yellow tinge at all periods of the day.

SAND

Fine particles of sand picked up from the surface by the wind and blown about in clouds or sheets constitute a troublesome lithometeor in some regions.

HYDROMETEORS

Hydrometeors are composed primarily of water in either liquid or solid state. Hydrometeors comprise all forms of precipitation, such as rain, drizzle, snow, and hail, and such elements as clouds and fogs.

PRECIPITATION

Precipitation includes all forms of moisture that fall to the earth's surface, such as rain, snow, hail, drizzle, etc. Dew and frost are not forms of precipitation, although they are hydrometeors. Precipitation is classified according to its form (liquid, freezing, and solid), size, and rate of fall.

Rain

Precipitation which reaches the earth's surface as large water droplets is classified as rain. If the droplets freeze on contact with the ground or other objects, the precipitation is classified as freezing rain.

Drizzle

Drizzle consists of very small and uniformly dispersed droplets that may appear to float while following air currents. Sometimes drizzle is referred to as mist. Unlike fog droplets, drizzle falls to the ground. However, the rate of fall is very slow. The slow rate of fall and the small size of the droplets distinguish drizzle from rain. When the droplets freeze on contact with the ground or other objects, they are called freezing drizzle. Drizzle always restricts visibility.

Snow

Snow consists of white or translucent ice crystals. In their pure form the ice crystals are highly complex, hexagonally branched forms. However, most snow falls as parts of ice crystals, as individual crystals, or more commonly as clusters and combinations of these. Snow occurs in meteorological conditions similar to those in which rain occurs, except that with snow the initial temperatures must be at or below freezing.

Snow Pellets (Soft Hail)

Sometimes called soft hail, snow pellets are white, opaque, round (or occasionally conical) kernels of snowlike consistency, 0.08 to 0.2 inch in diameter. They are crisp and easily compressible. They may rebound or burst when striking hard surfaces. They occur almost exclusively in showers.

Snow Grains

Sometimes called granular snow, snow grains take the form of minute, branched, star-like snowflakes, or of very fine simple crystals.

Ice Pellets

Ice pellets are composed of frozen raindrops or drizzle, or largely melted and refrozen snowflakes that rebound when striking hard surfaces. Their fall may be continuous, intermittent, or showery.

Hail

Ice balls or stones, ranging in diameter from that of a medium-size raindrop to an inch or more, are referred to as hail. They may fall detached or frozen together into irregular, lumpy masses. They are composed either of clear ice or of alternating clear and opaque snowflake layers. Hail forms in cumulonimbus clouds and is associated with thundershower activity. Surface temperatures are usually above freezing when hail occurs. Determination of size is based on the diameter, in inches, of normally shaped hailstones.

THUNDERSTORMS

Intensive research is underway by various government agencies for the purpose of providing the air traffic control system with the capability to locate, identify, and measure the intensity of turbulence associated with severe weather which accompanies thunderstorms. Radar is a valuable tool in this research, and much has been discovered. Although this capability does not yet completely exist, controllers must still advise pilots of known weather conditions that should be avoided.

No firm rules can be given as such to avoid thunderstorm cells by a certain number of miles. Controllers must exercise good judgment based on knowledge of thunderstorm characteristics to adequately advise and assist pilots in the accomplishment of safe flight.

FORMATION

The thunderstorm represents a violent and spectacular atmospheric phenomenon. The thunderstorm is usually accompanied by lightning, thunder, heavy rain, gusty surface wind, and frequently by hail. A certain combination of atmospheric conditions is necessary for the formation of a thunderstorm. These factors are conditionally unstable air of relatively high humidity and some type of lifting action. Before the air actually becomes unstable, it must be lifted to a point where it is warmer than the surrounding air. When this condition is brought about, the relatively warmer air continues to rise freely until, at some point aloft, its temperature has cooled to the temperature of the surrounding air. In order to bring the warm surface air to a point where it will continue to rise freely, some type of external lifting action must be introduced. Many conditions satisfy this requirement. For example, an air mass may be lifted by heating, terrain, and fronts or convergence.

STRUCTURE

The fundamental structural element of the thunderstorm is the unit of convective circulation known as a convective cell. A mature thunderstorm contains several of these cells, which vary in diameter from 1 to 6 miles. By radar analysis and measurement of drafts, it has been determined that, generally, each cell is independent of surrounding cells of the same storm. Each cell progresses through a cycle which lasts from 1 to 3 hours. In the initial stage (cumulus development), the cloud consists of a single cell; but as the development progresses, new cells form and older cells dissipate.

The life cycle of the thunderstorm cell consists of three distinct stages; they are the cumulus stage, the mature stage, and the dissipating or anvil stage. (See fig. 6-30.)

Cumulus Stage

Although most cumulus clouds do not become thunderstorms, the initial stage of a thunderstorm is always a cumulus cloud. The

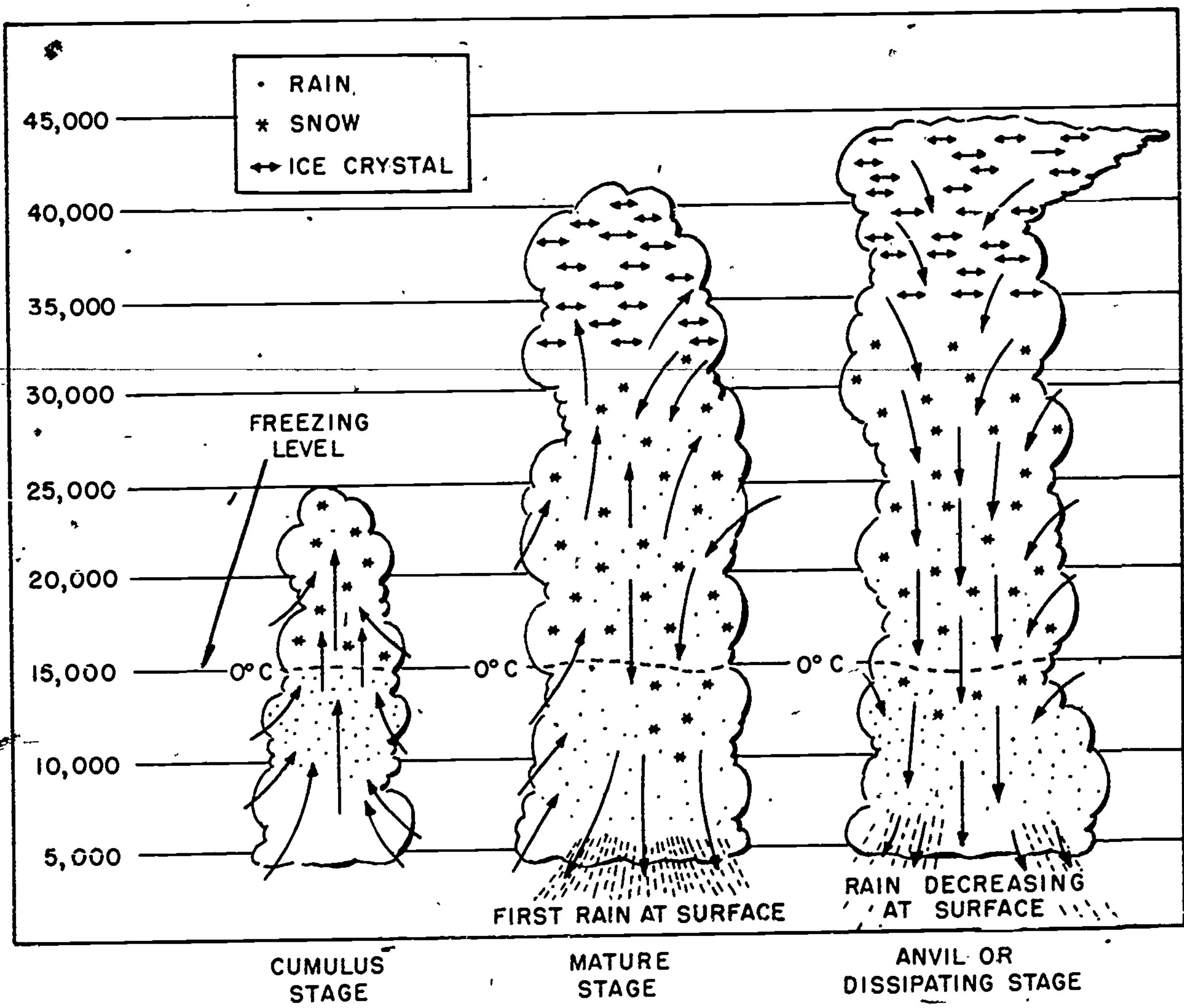


Figure 6-30.—Life cycle of a thunderstorm cell.

chief distinguishing feature of this cumulus or building stage is an updraft, which prevails throughout the entire cell. Such updrafts vary from a few feet per second to as much as 100 feet per second in mature cells.

Mature Stage

The beginning of surface rain, with adjacent updrafts and downdrafts, initiates the mature stage. By this time the apex of the average cell has attained a height of 25,000 feet or more. As the raindrops begin to fall, the frictional drag between the raindrops and the surrounding air causes the air to begin a downward motion. The descending saturated air soon reaches a level where it is colder than its environment; consequently, its rate of downward motion is accelerated. This is a downdraft.

Dissipating (Anvil) Stage

Throughout the life span of the mature cell, more and more air aloft is being dragged down by the falling raindrops. Consequently, the downdraft spreads out to take the place of the dissipating updraft. As this process progresses, the entire lower portion of the cell becomes an area of downdraft. Since this is an unbalanced situation, and since the descending motion in the downdraft effects a drying process, the entire structure begins to dissipate. The high winds aloft have now carried the upper section of the cloud into the anvil form, indicating that gradual dissipation is overtaking the storm cell.

THUNDERSTORM WEATHER

Rain

Liquid water in a storm may be ascending if encountered in a strong updraft; it may be suspended, seemingly without motion, yet in extremely heavy concentration; or it may be falling to the ground. Rain, as normally measured by surface instruments, is associated with the downdraft. This does not preclude the possibility of a pilot entering a cloud and being swamped, so to speak, even though rain has not been observed from surface positions. Rain is found in almost every case of penetration below the freezing level. In instances in which no rain is encountered, the storm probably has not developed into the mature stage.

Hail

Hail is a possibility in any thunderstorm, and the presence of damaging hail should always be considered with moderate or severe storms.

Turbulence

Data obtained by research indicates that the frequency and severity of turbulence encounters decrease slowly with distance from the storm cores. Moderate to severe turbulence may be encountered up to 20 miles from the center of severe storms at any altitude and up to 10 miles from the centers of less severe storms. Severe turbulence is often found in the anvil cloud 15 to 20 miles downwind from the severe storm cores. The storm cloud is only the visible portion of a turbulent system whose updrafts and downdrafts often extend outside of the storm proper. Very little evidence exists that maximum turbulence occurs at the middle heights of a storm. The same turbulence considerations which apply to flight at high altitudes near storms apply to low altitudes as well. No useful correlation exists between the external visual appearance of thunderstorms and the turbulence and hail within them.

Surface Wind

A significant hazard associated with thunderstorm activity is the rapid change in surface wind direction and speed immediately prior to storm passage. The strong winds at the surface accompanying a thunderstorm passage are the result of the horizontal spreading out of downdraft currents from within the storm as these currents approach the surface of the earth.

CHAPTER 7
AVIATION WEATHER REPORTS AND ADVISORIES

AVIATION WEATHER SERVICE

The National Weather Service (NWS), located in Washington, D.C., is the agency responsible for the nation's aviation weather service. It is the primary organization for providing weather service to pilots. To prepare, collect, and transmit the thousands of observations and forecasts now available to pilots would require an organization many times the size of the National Weather Service. Therefore, the National Weather Service obtains the cooperation of other government agencies, private individuals, and organizations to satisfy the overwhelming aviation weather service requirements.

The FAA is considered the principal distribution agency for weather information to aviation interests through its vast communications systems and pilot weather briefing service.

The military weather services cooperate extensively with the NWS at all levels by the exchange of weather information. However, the military weather services concentrate their efforts toward satisfying military requirements and directly serve military interests.

ANALYSES AND FORECASTING CENTERS

Some of the analyses and forecast centers of the National Weather Service directly support aviation, while others provide general or special services. The following centers are those which directly support the aviation weather service.

National Meteorological Center (NMC)

This center is the hub of the nation's weather information processing function. It receives weather information from all over the Northern Hemisphere and provides analyses and forecasts to other weather facilities for periods of up to 30 days in the future. Other facilities may interpret NMC products without having to perform identical tasks in preparing detailed forecasts for their areas.

National Weather Service Forecast Office (WSFO)

WSFOs have areas of forecast responsibility which roughly correspond with areas of responsibility of the FAA Air Route Traffic Control Centers (ARTCCs). These offices prepare and distribute aviation terminal and area forecasts with the assistance of guidance material from the National Meteorological Center.

Weather Service Office (WSO)

The WSO is the National Weather Service's main link between the aviation interest and the processing centers such as NMC and the WSFOs. The weatherman in a WSO is an observer-briefer. He depends mostly on material received from the larger centers, but must do some analyses and forecasting also. The WSO is responsible for the information given to pilots and other aviation interests.

Special Processing Centers

NATIONAL SEVERE STORMS FORECAST CENTER (NSSFC).—This facility, located in Kansas City, Mo., issues warnings of severe thunderstorms and their accompanying hazards including tornadoes, funnel clouds aloft, hail at the surface, areas of extreme turbulence, and surface wind gusts of more than 50 knots.

THE NATIONAL HURRICANE CENTER.—This facility is located in Miami, Fla. All efforts concerning tropical storms or hurricanes which may affect the southern and eastern United States (U.S.) are supervised and coordinated at this center. The Weather Service Office in San

Francisco serves as the hurricane center for tropical storms of all intensities in the Pacific Ocean along the west coast of the U.S. A corresponding service for tropical storms and typhoons in the central and western Pacific is provided through joint efforts of the National Weather Service and military weather services.

HIGH ALTITUDE FORECAST CENTERS.—These centers provide forecasts of temperature, wind, and significant en route weather for high altitude operations.

THE NATIONAL ENVIRONMENTAL SATELLITE SERVICE (NESS).—NESS prepares analyses for distribution. The analyses are based on pictures of cloud coverage of large areas taken by the cameras of the weather satellites orbiting the earth.

TYPES OF WEATHER OBSERVATIONS

The term "observation" is used to cover both measured and estimated existing values of weather elements. Observations are made at the ground (surface), from the ground, and aloft.

Surface Observations

Surface observations are the most readily obtained. They are made by National Weather Service personnel, military weather services personnel, and FAA Flight Service Specialists. Surface observations from Navy and commercial ships at sea further add to the weather picture. Automatic observing stations (AMOS), which automatically record wind, ceiling and precipitation information, etc., are being added to the network of surface observation sites.

Radar Observations

Radar observations afford a continuous presentation of significant cloud and precipitation patterns. These are made by the National Weather Service and military personnel at many locations.

Rawinsonde Observations

These observations are obtained by sending a balloon aloft with miniature weather observing equipment and radio gear. They furnish information on temperature, humidity, pressure, and winds often to heights above 100,000 feet.

Pilot Balloon Observations (PIBALS)

PIBALS supplement the rawinsonde observations. It is a balloon sent aloft and tracked visually to determine wind information.

Pilot Reports (PIREPs)

These observations come directly from the pilot and are often relayed through the Air Controlman to the weather service personnel. Much of the time, PIREPs are the only sources of information relating to conditions such as turbulence, icing, and cloud tops.

Aerial Weather Reconnaissance Flights

The Air Force and Navy make scheduled flights along fixed routes over relatively inaccessible land and water areas with trained weather personnel aboard to make weather observations.

Satellite Observations

Satellites orbiting the earth at altitudes above 400 miles furnish photographs of cloud patterns over a large area.

WEATHER COMMUNICATIONS SYSTEMS

Weather information is extremely perishable because of its changeable nature. The distributing function is a very large one, including the collection and dissemination of observed data and the delivery of products of the analyses and forecasting centers. Existing methods for collection and distribution of weather information over long distances are teletype circuits and facsimile networks. Weather information may be transmitted by landline, which is a fixed wire circuit from station to station or from a control station to a group of stations, or by radio. Radio is used to transmit and receive information where the use of landline is impracticable or impossible. Radio is the means by which weather information is transmitted to ships and overseas land stations.

Teletype Circuits

The teletype circuits used for distribution of aviation weather information are service A, C, and O, operated by the FAA and military teletype networks.

SERVICE A.—The primary purpose of this system is collecting and disseminating aviation weather reports and NOTAMs.

SERVICE C.—The primary purpose of this network is collecting and disseminating domestic synoptic weather information.

SERVICE O.—The Service O system is used primarily for collecting and disseminating international weather information.

MILITARY NETWORKS.—CONUS Meteorological Teletype System (COMET) is an Air Force network used to collect military aviation weather observations and pilot reports in the contiguous U.S. and to provide rapid distribution of this information to military users.

The Navy has established Fleet Weather Centrals which collect weather observations from ships at sea and other Navy weather facilities through the worldwide U.S. Naval Communications System. Navy-originated weather reports may be entered on the FAA weather circuits, COMET, or transmitted via naval communications depending upon their origin, content, and purpose.

Facsimile Networks

Facsimile networks are used to distribute analyses and forecasts in graphic form. Special depictions of other types, such as photographs, also can be made through this distribution method. There are four such networks presently; two operated by the National Weather Service and one each by the Navy and Air Force. This method may be considered preferable to the teletype; however, present facsimile networks are incapable of handling the volume of aviation weather required.

Local Distribution

Air Controlmen are concerned mostly with weather conditions in the immediate vicinity, and within 50 miles, of the airport. Weather forecasts are used regularly for planning purposes, such as selection of runway, etc. However, air traffic controllers are more concerned with conditions at the present and within the next hour.

Obviously, the amount of weather reports and forecasts discussed to this point (although necessary for complete weather service) is much more than is actually utilized by the Air Controlman in the performance of routine tasks. Therefore, weather service personnel digest all the weather information and supply the Air Controlman with the needed meteorological information.

This weather information is distributed locally by various methods including TelAutograph (a remote mechanical writing device), interphone, and closed circuit television.

HOURLY AVIATION WEATHER REPORTS

Weather information received from weather service personnel will consist of numerals, symbols, and contractions as used on Teletypewriter networks to describe a large amount of weather information in a small space. The Air Controlman must be able to decode this information for transmission to pilots via radio telephone.

The following section discusses the hourly aviation weather report and gives an explanation of encoding and decoding the symbols used. This explanation is limited to a brief coverage intended to provide the Air Controlman with a working knowledge of aviation weather reports.

CONTENT AND FORMAT OF THE HOURLY AVIATION WEATHER REPORT

Figure 7-1 is an example of an hourly aviation weather report as it would be received on Service A or the Air Force COMET network with minor variations.

Location Identifiers

Three-letter location identifiers identify the station sending the report. All location identifiers are contained in the FAA publication Location Identifiers 7350.1 Series.

Types of Reports

Aviation weather reports are classified as record (R), special (S), record special (RS), or local (L).

The designation of the report is determined upon the circumstances which prevail at the time of the observation.

With the exception of the Special report, the type of report is normally omitted since most

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
WEATHER BUREAU
SILVER SPRING, MD. 20910

DECODING AVIATION WEATHER REPORTS
Based on Instructions in Federal Meteorological Handbook No. 1, Surface Observations

STANDARD AVIATION REPORT FORMAT FOR MANNED STATIONS

EXAMPLE OF AN OBSERVATION AS FOUND ON HOURLY SEQUENCES

PIT -XM11V⊕38⊕ 7/8VL-FK 146/66/65 /2713 /967/ R10LVR26V55 FK3 / ⊕27/CIG 9V12 VSBY 1/2V1

- REMARKS: Visibility variable between 1/2 and 1 mile.
- REMARKS: Ceiling variable between 900 to 1200 feet.
- BASES AND TOPS OF CLOUDS: Tops broken layer 2700 ft. msl. Height of bases not visible at the station precede sky cover symbol. "U" indicates layer amount unknown. If the report is more than 20 minutes old, the time (GMT) precedes the entry.
- REMARKS: Fog and Smoke hiding 3/10 of sky.
- RUNWAY VISUAL RANGE: Runway 10L, Visual Range variable between 2600 and 5500 ft. in past 10 minutes. When visual range is constant for past 10 minutes, only the constant value is reported, e.g., R10LVR60+.
- ALTIMETER SETTING: 29.37 inches. Three figures, representing units, tenths and hundredths of inches, indicate the altimeter setting. "Low" is used preceding figures to indicate values below 29.00 inches.
- WIND: 270° true, 13 kts. To decode direction, multiply first 2 digits by 10. If product is >500, subtract 500 and add 100 to speed. Gusts and squalls are indicated by "G" or "Q" following speed and peak speed following the letter.
- DEWPOINT: 65° F.
- TEMPERATURE: 66° F. A minus sign indicates temperatures below zero.
- SEA LEVEL PRESSURE: 1014.6 millibars. Only the tens, units and tenths digits are reported.
- WEATHER AND OBSTRUCTIONS TO VISION: Light Drizzle, Fog & Smoke. Algebraic signs following symbols indicate intensity.
- PREVAILING VISIBILITY: Seven eighths statute mile and variable by the amount given in REMARKS.
- SKY & CEILING: Partly obscured sky, ceiling measures 1100 ft., variable broken, 3800 ft. overcast. Figures are height of each layer in 100s of feet above ground. A number preceding an X indicates vertical visibility into phenomena. A "V" indicates height varying by amount given in REMARKS. Symbol after height is amount of sky cover (Figure 7-2). The letter preceding height indicates that height is to be the ceiling and the method used to determine the height (Table 7-2).
- TYPE OF REPORT: "R" omitted when observation is in hourly sequence.
- STATION IDENTIFICATION: Identifies report for Pittsburgh by using FAA identifier.

Figure 7-1.—Hourly Aviation Weather Report. 201.249

other reports fall in the category of hourly weather reports.

The following discussion concerning the various types of weather observations conducted will allow you to better understand the types of reports associated with these observations.

Record Observation (R)

Record observations are normally taken at hourly intervals having a standard time of H + 00 (on the hour). They are the basic observations which supply the weather information for the hourly aviation weather report.

Special Observation (S)

Special weather observations are supplementary to the hourly record observation. They are taken and transmitted as soon as possible after certain significant weather changes have occurred.

Comparing the special to a record observation, the letter S and time of filing is an addition. The sea level pressure, temperature, and dewpoint are omitted.

CRITERIA FOR TAKING SPECIAL OBSERVATIONS.—A special observation is made whenever one or more of the elements listed below have changed in the amounts specified. The amount of change is derived from the last record or special observation.

In any instance when ceiling forms below, decreases to less than, or if below, increases to equal or exceed:

1. 3,000 feet.
2. 1,000 feet.
3. 500 feet.
4. All nationally published minima applicable to the airport.

At all stations, a special observation is made when the sky condition shows clouds below 1,000 feet, and when no clouds were previously reported below this level.

Additionally, a special observation is made whenever a layer of clouds or obscuring phenomena aloft is present below the highest instrument minimum, including circling minimums, applicable to the airport and no sky cover aloft was reported below this in the previous R, S, or RS observation.

In any instance when prevailing visibility decreases to less than, or if below, increases to equal or exceed the following criterion, a special observation is taken.

1. 3 miles.
2. 2 miles.
3. 1 1/2 miles.
4. 1 mile.
5. All nationally published minima applicable to the airport.

A special observation is to be made when a tornado is first observed, disappears from sight, or occurred within the past hour as reported by outside sources, but was not observed or recorded at the station.

A special observation is to be made when a thunderstorm begins (thunder is first heard), increases in intensity, (T to T+) or ends (15 minutes after thunder is last heard).

Precipitation causes a special observation to be made when hail begins or ends; freezing precipitation begins, changes intensity, or ends; and ice pellets begin, change intensity, or end.

Wind and wind shifts are causes for making special observations; these occur when the average 1-minute wind speed suddenly increases to twice or more than twice the currently reported 1-minute wind speed and exceeds 25 knots, or when a wind shift occurs.

A wind shift is defined as a change in the wind direction of 45 degrees or more which takes place in less than 15 minutes. Tornado activity and runway condition observations may be transmitted as single element specials on the teletype; i.e., the only information transmitted is that which actually requires the special.

Record Special Observations (RS)

If the time of the significant weather changes which constitute a special coincides with the time of the record observation, the two reports are combined—hence the name record special. If this happens, the letter S remains in the report to attract attention to the fact that something special has happened since the last record observation was sent. The date-time group is omitted. The sea-level pressure, temperature, and dewpoint are encoded.

Local Observations (L)

Local observations may be taken at any weather observing station. The elements normally included in a local are ceiling and sky

Table 7-1.—Sky cover height values

Feet	Reportable values (coded in hundreds of feet)	Encoded
5,000 or less	To nearest 100 ft	1,10,50, etc.
5,001 to 10,000	To nearest 500 ft	55,75,100 etc.
Above 10,000	To nearest 1,000 ft	140,180, 200, etc.

condition, prevailing visibility, weather and obstructions to vision, and remarks (as appropriate).

Local observations are taken when changes in ceiling, visibility, weather, or other elements are significant for local aircraft operations. Definitions or standards of significance are developed locally.

Local observations are taken immediately following an aircraft mishap at or near the station except when notification is delayed or there has been an intervening record observation. Such observations consist of all the elements normally included in a record observation except sea-level pressure. Local arrangements are made to ensure that weather service personnel are notified as soon as possible of all aircraft mishaps.

Local observations may also be requested by appropriate personnel when required for purposes other than those listed in the preceding paragraphs.

Sky and Ceiling

Figures preceding the symbols are heights of clouds in hundreds of feet above the surface rounded off to the nearest reportable value as in table 7-1.

The letter "V" following the cloud height indicates the height is variable. This is a condition in which the value rapidly increases and decreases by one or more reportable values during the period of observation. It is reported only for ceilings less than 3,000 feet. The average of all values secured is used as the cloud height.

Note: Variable ceiling heights at or above 3,000 feet may be reported as variable if considered operationally significant.

Sky cover symbols indicate the amount of sky cover. These symbols are listed on the report in ascending order if more than one layer of clouds or obscuration exists. Figure 7-2 lists the sky cover symbols, their meaning, contraction, and explanation.

A ceiling is either:

1. The height ascribed to the lowest reported opaque broken or overcast layer of clouds or obscuring phenomena aloft, or;

2. The vertical visibility in a surface-based phenomena associated with an obscured sky.

3. "Unlimited" when neither of the preceding conditions in 1 or 2 are present.

The letter preceding the height of a ceiling layer of sky cover indicates how the ceiling height was obtained. Specific symbols are employed to denote ceilings obtained by various methods. (See table 7-2)

A brief explanation of the methods utilized in obtaining the height of ceilings as listed in table 7-2 follows:

1. Measured ceiling—Identifies a ceiling height for a layer aloft determined by a ceiling light, ceilometer, cloud-height detection radar, or based on the known height of objects in contact with the ceiling layer and within 1 1/2 nautical miles of the airport.

2. Estimated ceiling—Obscuring phenomena aloft shall be classified as estimated when they are determined by the following methods:

a. Height of a ceiling reported by a pilot within 1 1/2 nautical miles of a runway and within 15 minutes of the actual time of an observation for non-cirriform cloud layers.

Aircraft reports may also be utilized for cirriform layers if they are received during the past hour preceding the actual time of an observation and the distance does not exceed 50 nautical miles.

b. A ceiling height determined by timing the ascent of a ceiling or pilot balloon until entry into the base of the cloud layer is observed.

c. From the known heights of unobscured portions of natural landmarks or objects more than 1 1/2 nautical miles from any runway of the airport.

d. On the basis of observational experience, provided the sky is not completely hidden by surface-based obscuring phenomena.

Summation Amount of Sky Cover in Tenths		Symbol	Contraction When Symbols Not Used	Remarks
1/10 to less than 10/10 surface-based obscuring phenomena		-X	PTLY OBSCD	No height assigned this condition. Vertical visibility is not completely restricted.
10/10 surface-based obscuring phenomena		X	OBSCD	Always preceded by a vertical visibility value.
Less than 1/10		○	CLR	This symbol is not used in combination with others.
1/10 thru 5/10 half or more thin	Only used to report layers aloft.	-⦶	THN SCTD	Height values preceding these symbols are never designated as ceiling layers.
1/10 thru 5/10 more than half opaque		⦶	SCTD	
6/10 thru 9/10 half or more thin		-⦷	THN BKN	
6/10 thru 9/10 more than half opaque		⦷	BKN	Height value preceding this symbol prefixed with a ceiling layer designator provided a lower ceiling layer is not present.
10/10 half or more thin		-⊕	THN OVC	Height value preceding this symbol is never prefixed with a ceiling layer designator.
10/10 more than half opaque		⊕	OVC	This symbol is used in combination with lower overcast layers only when such layers are classified as thin. Height value preceding this symbol is prefixed with a ceiling layer designator provided a lower broken ceiling layer is not present.

201.250

Figure 7-2.—Sky cover symbols.

e. By ceilometer or ceiling light and the penetration of the light beam is in excess of normal for the particular height and type of layer presented.

3. Indefinite ceiling—Ceiling values are classified as "indefinite" when the vertical visibility in a surface-based obscuring phenomenon is:

a. The distance that an observer at the ground can see upward into an obscuring phenomenon completely concealing the sky.

b. Based on the visible portions of nearby objects on the airport complex.

c. Based on the maximum vertical height above the ground within 1 1/2 nautical miles of a runway of the airport and within 15 minutes of the actual time of an observation from which a pilot in a surface-based obscuration (obscured sky condition) can discern the ground. These pilot report values need not be used if, in the judgment of the observer, they are not representative of the conditions at the airport.

Table 7-2.—Ceiling symbols

Symbol	Meaning
E	Identifies a ceiling height for a layer aloft determined by any other method not specified as "M".
W	Identifies the ceiling height as being the vertical visibility into a surface-based obscuring phenomena.
M	Identifies a ceiling height for a layer aloft determined by a ceiling light, ceilometer, cloud-height detection radar, or based on the known height of objects in contact with the ceiling layer and within 1 1/2 nautical miles of the airport.

Visibility

CONTROL TOWER OBSERVATIONS.—Unless otherwise exempted, certified tower personnel shall report prevailing visibility when the prevailing visibility at the usual point of observation or at the tower level is less than 4 miles. These control tower visibility observations may be used immediately for aircraft operations; but they shall be recorded and forwarded to the weather station as soon as practicable. During this condition, control tower personnel shall notify the weather station as soon as possible when they observe the prevailing visibility at the tower level has decreased to less than 4 miles, and has changed by one or more reportable values (See table 7-3). When the tower visibility is reported as variable, subsequent actual observed values within the limits of the reported variability need not be transmitted to the weather station.

In addition, tower personnel shall also record on graphic transcription equipment, MF1-10, or a separate tabulation sheet, the following information for each control tower visibility observation:

1. Time of observation.
2. Prevailing visibility at the tower level.
3. Remarks (such as visibility in different sectors).
4. Observer's initials.

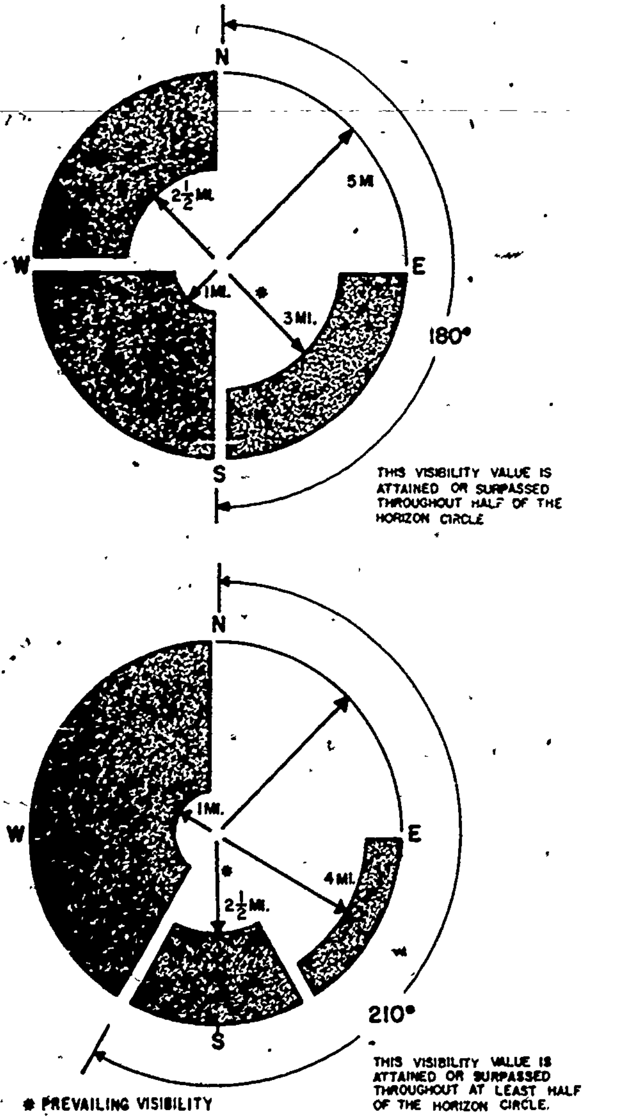
Visibility is reported in statute miles (nautical miles onboard ships) and fractions thereof to 3 miles, the nearest whole mile to 15 miles, and the nearest 5 miles beyond 15 miles. (See table 7-3)

If visibilities of less than 3 miles rapidly increase or decrease by one or more reportable values, the visibility is followed by the letter "V" for variable and the variable amount is entered in the REMARKS section of the report.

PREVAILING VISIBILITY.—Prevailing visibility is the greatest visibility which is attained or surpassed throughout at least half of the horizon circle not necessarily continuous. In uniform weather conditions, determination of visibility is relatively simple since it is the

Table 7-3.—Reportable visibility values

Increments of separation (Miles)							
1/16	1/8		1/4	1/2	1		5
0	3/8	1 1/4	2	2 1/2	3	10	15
1/16	1/2	1 3/8	2 1/4	3	4	11	20
1/8	5/8	1 1/2	2 1/2		5	12	25
3/16	3/4	1 5/8			6	13	30
1/4	7/8	1 3/4			7	14	35
5/16	1	1 7/8			8	15	40
3/8	1 1/8	2			9		etc.



201.69

Figure 7-3.—Prevailing visibility.

same in all directions. In non-uniform weather conditions one aid in determining prevailing visibility is to divide the horizon circle into several sectors, each of which has substantially uniform visibility. (See fig. 7-3) The prevailing visibility is the visibility entered on the hourly aviation weather report under such conditions.

SECTOR VISIBILITY.—Sector visibility is the visibility within a specified sector of the horizon circle having essentially uniform visibility. Sector visibility is encoded in the remarks section of the hourly aviation weather report when it is different from the prevailing visibility and is less than 3 miles, or when it is considered operationally significant.

Such remarks include the direction from the station of the sector in which the visibility is different.

Weather Element Symbols

The following symbols are used to indicate weather elements:

T+	Severe thunderstorm
T	Thunderstorm
R	Rain
RW	Rain showers
L	Drizzle
ZR	Freezing rain
ZL	Freezing drizzle
IP	Ice pellets
IPW.	Ice pellet showers
S	Snow
SW	Snow showers
SP	Snow pellets
SG	Snow grains
IC	Ice crystals
A	Hail

Suffix "+" to precipitation symbols to indicate heavy intensity, "-" for light intensity. The absence of an intensity symbol indicates "moderate." No intensity is assigned to tornadoes, waterspouts, funnel clouds, hail or ice crystals, and only moderate or severe is reported for thunderstorms.

Tornadoes, waterspouts, and funnel clouds are always spelled out in full and are followed by letters showing the direction they are bearing from the station and direction toward which they are moving. An example would be: TORNADO NW MOVG E.

Precipitation is divided into three classes: liquid, freezing, and frozen. If two different classes of precipitation are present, they are encoded in the above order. If more than one type of precipitation of the same class are present (heavy snow, ice pellets), the one with the greatest intensity is encoded first (S +IP).

Obstructions to Vision Symbols

Hydrometeors (other than precipitation) and lithometeors are called obstructions to vision and are encoded by means of letter symbols if conditions reduce the prevailing visibility to less than 7 miles and the obstruction to vision is occurring at the station. If the visibility is reduced to less than 7 miles by an obstruction at a distance from the station, the phenomena is described in remarks.

The order of encoding, if more than one obstruction is present at the time of the observation, is in order of decreasing predominance. The various symbols follow:

Hydrometeors
(water based)

F	Fog
GF	Ground fog
IF	Ice fog
BS	Blowing snow
BY	Blowing spray

Lithometeors
(Solid based)

D	Dust
BD	Blowing dust (duststorm)
BN	Blowing sand
K	Smoke
H	Haze

Obstructions to vision symbols always follow the weather element symbols. Obstruction to vision symbols are NEVER modified with a plus or minus sign to show their intensity. The visibility indicates their intensity.

Sea Level Pressure

Sea level pressure is the reporting station's barometric pressure in millibars. It is encoded in three figures representing tens, units, and tenths of millibars. The initial one or two digits are omitted in the encoding, as is the decimal point. Examples are 1025.1 millibars encoded 251 and 999.0 millibars encoded 990. An easy way to remember decoding is: If the first encoded number is less than 5, prefix 10 to the encoded number and point off one decimal place. If the first number is more than 5, prefix 9 to the encoded number and point off one decimal place. Examples are 132 decoded as 1013.2 millibars, and 894 decoded as 989.4 millibars.

Temperature and Dewpoint

The temperature and dewpoint are encoded to the nearest whole degree Fahrenheit using one, two, or three digits. If either is below zero, it is prefixed with a minus (-) sign. Examples are 100, 78, or -5, -19, etc.

Wind

Wind direction is encoded in tens of degrees from true north omitting the last zero. Wind speed is encoded in knots. Both are included in a four-figure group.

EXAMPLES: 3627 indicates direction 360 degrees and speed 27 knots; 0115 indicates direction 010 degrees and speed 15 knots. 0000 indicates calm.

The letters "G" or "Q" following the wind speed indicate gusts or squalls and the figures following "G" or "Q" indicate the peak speed of the gusts or squalls.

A gust is defined as rapid fluctuations in the wind speed with a variation of 10 knots or more between peaks and lulls.

Squalls are classified as such when there is a sudden increase in the wind speed of at least 15 knots and sustained at 20 knots or more for at least 1 minute.

EXAMPLE: 3627G40 indicates wind direction 360 degrees, speed 27 knots, gusty, and peak speed in gusts 40 knots.

Wind is considered to be light when the speed is 6 knots or less. Variable wind direction is when it fluctuates by 60° or more during the period of observation.

Altimeter Setting

The altimeter setting is encoded in three figures. The initial digit is omitted, as is the decimal point. For instance, 002 is decoded as 30.02 and 998 is decoded as 29.98. An easy way to remember how to decode the altimeter setting is to prefix a three (3) and point off two decimal places if the first number of the encoded group is zero. If the first number is NOT zero, prefix a two (2) and point off two decimal places.

Runway Visibility Values and
Runway Visual Range

Runway Visibility Values (RVV) are determined by a transmissometer which is a photoelectric device calibrated to indicate values statistically comparable to those which would be observed by a human observer using dark objects against the horizon during the day or moderate intensity lights at night as visibility markers. RVV is reported in miles and in fractions thereof. RVV is encoded for a given runway as R16VV 1/4 to indicate that runway 16 visibility is 1/4 mile. RVV is included in Navy hourly aviation weather reports when it is less than 2 miles along the appropriate runway, and the prevailing visibility is less than the highest instrument minimum for the appropriate runway.

Runway Visual Range (RVR) is gradually replacing RVV as equipment becomes available. RVR is an instrumentally derived value that represents the horizontal distance a pilot will see down the runway from the approach end. RVR is based on what a pilot of a moving aircraft should see looking down the runway. RVR is reported in hundreds of feet. Selected stations which have the equipment provide tower controllers with continuous RVR observations on automatic readout equipment through a computerized system. RVR is encoded for a given runway as R04VR3 to indicate that runway 04 visual range is 300 feet. RVR is included in a Weather Service station's hourly aviation weather report when the prevailing visibility is one mile or less and/or RVR is 6,000 feet or less.

If RVV or RVR is not available when visibility conditions are such that require they be included in the report, the contraction RVVNO or RVRNO would appear in place of the normal reading in the hourly aviation weather report.

Coded PIREPs

Pilot reports of heights of bases or tops of sky cover within 20 miles (50 miles for cirriform layers) of the reporting station which are not visible from the station are included in the hourly weather report. These heights are above mean sea level (MSL) as read from the aircraft's altimeter. Figures indicating height preceding the sky cover symbol are the bases of the higher layer not visible from the station. Figures indicating height following the sky cover symbol are the tops of the layer.

EXAMPLE: 36⦷66—meaning that the pilot encountered broken clouds between 3,600 and 6,600 feet. (Bases 3,600 feet, tops 6,600 feet.)

Remarks

Remarks may be word contractions, symbols, and/or plain language where authorized symbols or contractions do not apply. They are used to amplify or explain elements of the report.

Some examples of symbols used in the remarks sections are as follows:

REMARKS	EXPLANATION
K1Ø⦶	Scattered smoke layer aloft, base 1,000 feet.
BINOVC	Breaks in overcast. Followed by direction if not overhead.
HIR CLDS VSB	Higher clouds visible.
TCU SW	Towering cumulus to the southwest.
CB ALL QUADS	Cumulonimbus all quadrants.
OCNL LTG	Occasional lightning.
RWB45	Rain showers began at 45 minutes past the hour.
AE16 HLSTO 1/4	Hail ended 16 minutes past the hour. Largest hailstone 1/4 inch.
LTCGC	Lightning, cloud to ground.
LTGIC	Lightning, in clouds.
ICGIC	Icing in clouds.
PRESFR	Pressure falling rapidly.
PRESRR	Pressure rising rapidly.
F INCRG	Fog increasing.
ICGIP	Icing in precipitation.
⦷V⦶	Broken layer in the report is occasionally scattered.
CIG 15V2Ø	Ceiling is varying between 1,500 and 2,000 feet.
VSBY 1V2	Visibility is varying between 1 and 2 miles.
VSBY N1S4	Visibility north 1 mile, south 4 miles.
T OVHD MOVG SE	Thunderstorm overhead moving southeast.

Runway surface conditions are also included in the remarks section of the hourly weather report. This is an extremely important item which can affect the safety of aircraft, particularly during the landing phase.

The runway surface condition is encoded by use of the following words:

CONDITION REPORTED	ENCODED
WET RUNWAY	WR
SLUSH ON RUNWAY	SLR
LOOSE SNOW ON RUNWAY	LSR
PACKED SNOW ON RUNWAY	PSR
ICE ON RUNWAY	IR

Included with the surface condition is the runway condition reading (braking action); this is a decelerometer reading which is determined by a vehicle used in obtaining the runway braking conditions.

This decelerometer reading is a two-digit number between 02 and 26 which is entered in the report following the surface condition.

Any remarks such as ice or snow patches (encoded as "P") or "SANDED" are included as appropriate.

Some examples of runway surface conditions are as follows:

Packed snow on runway, decelerometer reading 18—PSR18.

Patchy ice on runway, decelerometer reading 7—IR07P.

Ice on runway, decelerometer reading 5, condition patchy, runway sanded—IR05P SANDED.

In the remarks section, items extracted from Notice to Airmen (NOTAMs, chapter 5) may be included on FAA Service A hourly aviation weather reports.

All possible contraction for remarks cannot be listed here. For possible changes and additional information, refer to FAA Contractions Handbook 7340.1 Series.

In certain hourly aviation weather reports, additive data is included in remarks such as pressure tendencies, maximum and minimum temperature, cloud groups, etc., intended primarily for use of weather service personnel in preparation of forecast maps.

EXAMPLES OF DECODING HOURLY AVIATION WEATHER REPORTS

1. NCQ -XM3⌽5⊕1 1/2F 1Ø3/63/61/ØØØØ/985/F1. NAS Atlanta, sky partially obscured, measured ceiling 300 broken, 500 overcast, visibility one and one-half fog, barometric pressure 1010.3 millibars, temperature 63 degrees, dewpoint 61 degrees, wind calm, altimeter 29.85, fog one-tenth.

2. NHZ E46⊕4GFH 1Ø6/55/5Ø/362Ø/983. NAS Brunswick, Maine, estimated ceiling 4600 overcast, visibility 4 ground fog and haze, barometric pressure 1010.6 millibars, temperature 55 degrees, dewpoint 50 degrees, wind 360 degrees at 20 knots, altimeter 29.83.

3. NMM-X5-⌽3/16GF 623/39/39/Ø1Ø4/ØØ1/R02VV 1/4/F3. NAS Meridian, sky partially obscured, five hundred thin broken, visibility three-sixteenths ground fog, barometric pressure 962.3 millibars, temperature 39 degrees, dewpoint 39 degrees, wind 010 degrees at 4 knots, altimeter 30.01, runway 2 visibility 1/4 mile, ground fog three tenths.

4. NHK M5⌽2R-F 796/62/59/Ø9Ø3/Ø13/F4CIG⌽V⌽. NAS Patuxent, measured ceiling 500 broken, visibility 2, light rain, fog, barometric pressure 979.6 millibars, temperature 62 degrees, dewpoint 59 degrees, wind 090 degrees at 3 knots, altimeter 30.13, fog four tenths, ceiling broken variable scattered.

PILOT REPORTS (PIREPs)

Pilot reports of meteorological phenomena encountered in flight are called PIREPs. These reports are an extremely valuable source of weather information often not available otherwise. PIREPs are reports of the weather along the actual routes the pilots are flying. Reports concerning such things as cloud tops, icing levels, etc., are extremely valuable in planning and executing flights. All Air Controlmen are expected to cooperate to the fullest extent possible in securing and disseminating PIREPs. In order to do this, it is necessary to learn what information is included in the PIREPs and learn their encoding and decoding.

PIREPs are encoded and disseminated locally and on weather communications networks. These PIREPs are in addition to the Pilot Reports of bases and tops of clouds included in the remarks section of the hourly aviation weather report.

PIREP FORMAT

Arrangement of the elements of a PIREP is as follows:

1. Station identification.
2. Message identifier UA.

3. Location or extent of phenomena relative to an observing station or other nationally known point.

4. Time (GMT) of pilot's observation, if known.

5. Phenomena reported.

6. Altitude of phenomena in hundreds of feet above mean sea level (MSL).

7. Type of aircraft in reports of turbulence, condensation trails, electrical discharge, and icing only; if unknown, the contraction ACFT UNKN would be inserted.

EXAMPLES OF PIREPs

The pilot of a P3 between Richmond, Va., and Washington, D.C., reports to Washington that at 1620 EST his aircraft experienced an electrical discharge 20 miles south of Washington at an altitude of 5,000 MSL. This would be encoded as follows:

DCA UA 20 S
DCA 212Ø DISCHARGE 5Ø P3

The contraction TURBC preceded by an indication of the intensity is used to encode turbulence as follows:

LGT TURBC . . . . Light turbulence
MDT TURBC . . . . Moderate turbulence
SVR TURBC . . . . Severe turbulence
EXTRM TURBC . . Extreme turbulence

When clear air turbulence is reported, the contraction CAT is used in place of TURBC.

A pilot reports to Atlanta, Ga., that his C-130 encountered extreme turbulence at 2330 CST, 10 miles northeast of Knoxville, Tenn., at 6,000 MSL. This would be encoded as follows:

ATL UA 10 NE TYS
053Ø EXTRM TURBC 6Ø C130

At 1215 CST, the pilot of a P3 reports to Madison, Wis., a 72-knot wind from 240 degrees, 20 miles southeast of the station, at 8,500 MSL. This would be encoded as follows:

MSN UA 2Ø SE MSN
1815 WND 24Ø/72 85

The contraction ICG preceded by an indication of its intensity and type, (if known), is used to encode icing conditions as follows:

TRACE ICG . . . . Slow rate of accumulation not hazardous unless encountered for extended periods.

LGT RIME ICG . . . . Rate of accumulation may become a problem with prolonged encounter. Usually not a problem if deicing equipment used.

MDT ICG . . . . Rate of accumulation is such that brief encounters may become hazardous and use of deicing equipment or diversion necessary.

SVR ICG . . . . Rate of accumulation is such that deicing equipment fails to control the hazard and immediate diversion is necessary.

AT 0925Z the pilot of an F-4 reports to Burbank radio an encounter of severe clear icing between 10,000 and 11,500 feet over mountains north of Burbank. This would be encoded as follows:

BUR UA MTNS N BUR
Ø925 SVR CLR ICG 1ØØ-115 F4

Pilots' reports of tornadoes, funnel clouds or waterspouts, severe or extreme turbulence, hail, and severe icing must be given immediate local dissemination.

WEATHER ADVISORIES

FLIGHT ADVISORIES

Flight Advisories are prepared by Weather Service Forecast Offices (WSFO) and contain information of weather developments in their areas of responsibility that are considered to be potentially hazardous to aircraft in flight. The advisories are issued in two categories, SIGMETs (Significant Meteorological Information), and AIRMETs (Airman's Meteorological Information).

Significant Meteorological Information

A SIGMET advisory will be issued concerning weather of such severity as to be potentially hazardous to all categories of aircraft specifically:

1. Tornadoes.
2. Lines of thunderstorms (squall lines).

3. Embedded thunderstorms.
4. Hail, 3/4 inch or more in diameter.
5. Severe and extreme turbulence.
6. Severe icing.
7. Widespread dust storms/sand storms lowering visibility to less than 2 miles.

Airmen's Meteorological Information

AIRMET advisories will be issued concerning weather of such a degree as to be potentially hazardous to single engine and light weight aircraft and in some cases, to all aircraft as well, specifically:

1. Moderate icing.
2. Moderate turbulence.
3. Extensive areas of visibility less than 2 miles with ceilings less than 1,000 feet, including mountain ridges and passes.
4. Winds of 40 knots or more within 2,000 feet of the surface.

Flight advisories are transmitted on Service A.

HURRICANE ADVISORIES (WH)

Whenever a hurricane is considered to be a threat to the area within 300 miles of the U.S. coast during the next 24 hours, the National Weather Service issues detailed advisory reports concerning the location of the storm center, anticipated movement, intensity, and the area that is expected to be affected.

These reports are transmitted over circuit A with dissemination as deemed necessary.

In addition to these detailed forecasts, abbreviated advisories are also issued and transmitted four times daily.

The abbreviated advisory will consist of a statement concerning the storm's position, expected movement, and wind conditions.

SEVERE WEATHER WATCH BULLETIN (WW)

A severe weather forecast (WW), commonly referred to as a Severe Weather Warning or "WW" is prepared by the National Severe Storms Forecast Center (NSSFC) at Kansas City, Missouri.

These forecasts or bulletins are transmitted over circuit A as the situation warrants; they provide advance warning to the aviation community as well as the general public, that severe weather conditions can be anticipated within a particular geographical area.

The report will contain the nature of the weather to be expected, i.e., thunderstorm, etc., severity, area to be affected, and the duration of the alert period for the area noted.

SEVERE WEATHER OUTLOOK NARRATIVE

Another function of the National Severe Storm Forecast Center (NSSFC) is the reporting of present and anticipated surface and upper air criteria that are conducive to generating severe local storms.

This report is designated the "Severe Weather Outlook Narrative" and is generally a forecast of severe weather conditions to be expected for the next 24 hours.

PHRASEOLOGY FOR WEATHER REPORT ITEMS

ACs are continuously required to transmit weather information to pilots via radio; for example, to departing or arriving aircraft or in response to special pilot requests. The following list includes examples of phraseology which coincide with FAA voice procedure for broadcasting aviation weather reports to which pilots listen frequently. Its purpose is to enhance standardization of transmitting weather information.

1. State the height and character of sky coverage data as follows:

a. In the same order of ascending height in which they appear in the weather report.

b. Do not say the word "clouds."

c. Announce ceiling height designators as follows:

CODED	SPOKEN
E	ESTIMATED CEILING
M	MEASURED CEILING
W	INDEFINITE CEILING

d. State heights in hundreds and/or thousands of feet.

CODED	SPOKEN
3	THREE HUNDRED
18	ONE THOUSAND EIGHT HUNDRED
2ØØ	TWO ZERO THOUSAND

e. Announce cloud symbols as follows:

CODED	SPOKEN
○	CLEAR
⦶	SCATTERED
◑	BROKEN
⊕	OVERCAST

f. When a dash precedes a cloud symbol, say the word THIN.

CODED	SPOKEN
7 – ◑	SEVEN HUNDRED THIN BROKEN

g. Announce a ceiling height indicated by the figure "0" as ZERO.

h. Announce a condition indicated by "X" or "–X" as:

CODED	SPOKEN
X	SKY OBSCURED
-X	SKY PARTIALLY OBSCURED

i. Announce sky and ceiling conditions (not all possible combinations of phenomena are included) in accordance with the following:

CODED	SPOKEN
-XM1Ø◑5Ø◑	SKY PARTIALLY OBSCURED, MEASURED CEILING ONE THOUSAND BROKEN, FIVE THOUSAND BROKEN.
20⦶E30◑ 250◑	TWO THOUSAND SCATTERED, ESTIMATED CEILING THREE THOUSAND BROKEN, TWO FIVE THOUSAND BROKEN.
M1Ø◑5Ø◑ 3ØØ⊕	MEASURED CEILING ONE THOUSAND BROKEN, FIVE THOUSAND BROKEN, THREE ZERO THOUSAND OVERCAST.
1Ø⦶5Ø⦶	ONE THOUSAND SCATTERED, FIVE THOUSAND SCATTERED.
5⦶W15X	FIVE HUNDRED SCATTERED, INDEFINITE CEILING ONE THOUSAND FIVE HUNDRED, SKY OBSCURED.
-XM5⊕	SKY PARTIALLY OBSCURED, MEASURED CEILING FIVE HUNDRED OVERCAST.
-X5-◑1Ø-◑ 5Ø-⊕	SKY PARTIALLY OBSCURED, FIVE HUNDRED THIN BROKEN, ONE THOUSAND THIN BROKEN, FIVE THOUSAND THIN OVERCAST.
1Ø-⦶E2Ø◑ 45Ø⊕	ONE THOUSAND THIN SCATTERED, ESTIMATED CEILING TWO THOUSAND BROKEN, FOUR FIVE THOUSAND OVERCAST.

2. Announce prevailing visibility immediately following sky conditions. This element is reported in statute miles at land stations and in nautical miles on ships and ocean station vessels (OSV).

NOTE: When visibility is less than 3 miles and variable, this information is reported in remarks.

Announce prevailing visibility in accordance with the following examples:

CODED	SPOKEN
1/16	VISIBILITY ONE-SIXTEENTH
1/8	VISIBILITY ONE-EIGHTH
3/4	VISIBILITY THREE-QUARTERS
1 1/2V	VISIBILITY ONE AND ONE-HALF VARIABLE
6	VISIBILITY SIX
15+	VISIBILITY MORE THAN ONE FIVE

3. If atmospheric phenomena and obstructions to vision appear in a weather report,

announce these conditions following the prevailing visibility, as follows:

a. Atmospheric phenomena:

CODED	SPOKEN
T	THUNDERSTORM
R	RAIN
RW	RAIN SHOWERS
ZR	FREEZING RAIN
L	DRIZZLE
ZL	FREEZING DRIZZLE
IP	ICE PELLETS
IPW	ICE PELLET SHOWERS
S	SNOW
SW	SNOW SHOWERS
SP	SNOW PELLETS
SG	SNOW GRAINS
IC	ICE CRYSTALS
A	HAIL

b. Announce HEAVY, MODERATE, or LIGHT when a plus sign (+), no sign, or one dash(-), respectively, are suffixed to the precipitation symbol, except announce "T" as THUNDERSTORM and "T+" as SEVERE THUNDERSTORM. No suffix is attached to hail or ice crystals regardless of the intensity.

c. Obstructions to vision:

CODED	SPOKEN
F	FOG
GF	GROUND FOG
IF	ICE FOG
BD	BLOWING DUST
BN	BLOWING SAND
BS	BLOWING SNOW
BY	BLOWING SPRAY
H	HAZE
K	SMOKE
D	DUST

4. Omit sea-level pressure from the broadcast. Give sea-level pressure in millibars only in response to a specific request from a pilot.

5. Announce temperature and dewpoint in accordance with the following:

a. In two or three figures in degrees Fahrenheit.

b. Below zero Fahrenheit values by prefixing the temperature with the word MINUS.

CODED	SPOKEN
37/36	TEMPERATURE THREE SEVEN, DEWPOINT THREE SIX
1Ø4/99	TEMPERATURE ONE ZERO FOUR, DEWPOINT NINER NINER
-2/-3	TEMPERATURE MINUS TWO, DEWPOINT MINUS THREE

6. Announce current local wind direction and speed as determined from the instruments in the console as follows:

a. State wind direction in tens of degrees (in terms of the magnetic compass), using three digits.

b. Omit the words MAGNETIC, TRUE, or KNOTS.

c. Announce a north wind as THREE SIX ZERO.

d. Read other than local wind direction as it appears in the report; i.e., TRUE rather than MAGNETIC.

CODED	SPOKEN
3514	WIND THREE FIVE ZERO DEGREES AT ONE FOUR

e. Announce wind speed in knots. If it is estimated, state: WIND (direction), ESTIMATED (speed).

7. Announce each of the four digits of the altimeter setting by adding as the first digit the figure "2" or "3," as appropriate, and using values obtained from altimeter setting indicator instruments, where available.

CODED	SPOKEN
996	ALTIMETER TWO NINER NINER SIX
Ø1Ø	ALTIMETER THREE ZERO ONE ZERO

8. Announce RVV and RVR as follows:

a. State runway visibility (RVV) in the same manner as prevailing visibility.

CODED	SPOKEN
R04VV1/4V1. . .	RUNWAY FOUR VISIBILITY VARIABLE BETWEEN ONE QUARTER AND ONE
R36VV1 1/2+. .	RUNWAY THREE SIX VISIBILITY MORE THAN ONE AND ONE-HALF
RVVNO.	RUNWAY VISIBILITY NOT AVAILABLE

b. Announce runway visual range (RVR) at the location of origin only, in hundreds or thousands of feet. When the readout reports 1,000 —, announce LESS THAN ONE THOUSAND FEET.

CODED	SPOKEN
R18VR4Ø.	RUNWAY ONE EIGHT VISUAL RANGE FOUR THOUSAND FEET
R16VR1Ø.	RUNWAY ONE SIX VISUAL RANGE LESS THAN ONE THOUSAND FEET
RVRNO.	RUNWAY VISUAL RANGE NOT AVAILABLE

9. Announce remarks and NOTAMs included in weather reports when of interest to pilots. Do not include additive data intended primarily for the preparation of forecast maps. Announce as follows:

CODED	SPOKEN
VSBY 1V2. . . .	VISIBILITY VARIABLE BETWEEN ONE AND TWO
VSBY NE3 SE2 1/2 SW2	VISIBILITY NORTHEAST THREE, SOUTHEAST TWO AND ONE-HALF, SOUTHWEST TWO

10. Announce remarks in accordance with the following:

CODED	SPOKEN
PTCHS GF W N E	PATCHES OF GROUND FOG WEST, NORTH, AND EAST
TWR VSBY5 GF DEP 3Ø . .	TOWER VISIBILITY FIVE, GROUND FOG THREE ZERO FEET DEEP
22Ø⦶28Ø FEW AC OVR RDG SW. . . .	BROKEN CLOUDS REPORTED AT TWO TWO THOUSAND, TOPS AT TWO EIGHT THOUSAND, FEW ALTOCUMULUS OVER RIDGE SOUTHWEST
⦶V⦶.	SCATTERED LAYER VARIABLE BROKEN
TCU NW	TOWERING CUMULUS NORTHWEST
K1Ø⦶.	SMOKE LAYER ONE THOUSAND
RWU E	RAIN SHOWERS OF UNKNOWN INTENSITY EAST
SN0INCR5.	SNOW INCREASED FIVE INCHES DURING PAST HOUR
S-OCNLY S+. . .	LIGHT SNOW, OCCASIONALLY HEAVY.

Detailed information concerning reporting techniques, observations, etc., may be found in the Federal Meteorological Handbook No. 1 (FMH #1). This publication is prepared by an interagency group which represents the National Weather Service, Department of Defense (Navy and Air Force Weather Services) and the Department of Transportation (FAA).

Procedures contained in FMH 1 apply equally to observing functions in both U.S. civil and military agencies.

In addition to becoming familiar with the forenamed manual, you should visit the Naval Weather Service office located at your base and observe first hand the techniques and equipment utilized in observing and forecasting the weather.

CHAPTER 8

AIDS TO AIR NAVIGATION

Various types of air navigation aids are in use today, each serving a special purpose in our system of air navigation.

The FAA has been assigned the authority to establish, operate, and maintain a common system of air navigation facilities. In addition, the FAA also prescribes standards of operation of these air navaids which are utilized by both civil and military aircraft for instrument flight within federally controlled airspace.

This common system is referred to as the National Airspace System (NAS).

Knowledge of the basic radio principles applicable to both communications and navigation equipment will increase your understanding of their use and limitations.

BASIC RADIO THEORY

To understand how communication by radio propagation is possible, a brief consideration of the electrical nature of all matter is helpful.

All matter consists of a great number of tiny units called molecules. Each molecule consists of one or more atoms. An atom is composed principally of subatomic particles called electrons, protons, and neutrons. Protons and neutrons are a closely packed group called the nucleus of the atom. Electrons revolve at high speed around the nucleus at relatively great distances from it. An atom can be visualized as a miniature solar system in which the electrons revolve around the nucleus much the same as planets revolve around the sun.

A gravitational force exists between the proton and electron of an atom. An electrical force also exists. A gravitational force always attracts, but an electrical force can either attract or repel. This electrical force is explained by ascribing an electrical property called charge to protons and electrons. A proton is arbitrarily said to have one unit of positive (+) charge, and an electron one unit of equal but opposite negative (-) charge. During a state of rest, protons repel other protons, electrons repel other electrons, but a proton attracts and is attracted by an electron. Hence, the rule that like charges repel, and unlike charges attract each other. Neutrons, as the name implies, are electrically neutral, having no charge, and are neither attracted nor repelled by a proton or electron.

In addition to the electrical forces between charged particles at rest, other forces exist which depend upon the relative motion of the particles. These are called magnetic forces, and always accompany moving electrical charges. Thus, electricity and magnetism are not separate phenomena; both arise from the properties of electrical charges.

A conductor is material containing charges which are free to move under the influence of an electric field. If the electric field is maintained within the conducting circuit, the motion of the free charges is continuous. This motion is called current. If the field is always in the same direction, the resulting current is called direct current. If the field periodically reverses direction, the current also reverses and is called an alternating current.

Figure 8-1 shows two metal plates which are connected by a wire broken by a switch S. The air between the two plates acts as an insulator. Suppose the two plates receive from an external source a concentration of positive and negative charges. An electric field then exists in the air between the plates. The charges are isolated on the plates by the absence of a conducting path; hence, this arrangement, known as a capacitor, provides a convenient storage of electric charges. If the switch is closed, a current flows in the wire in the direction shown until the electric field is exhausted and the charges on the plates are equalized.

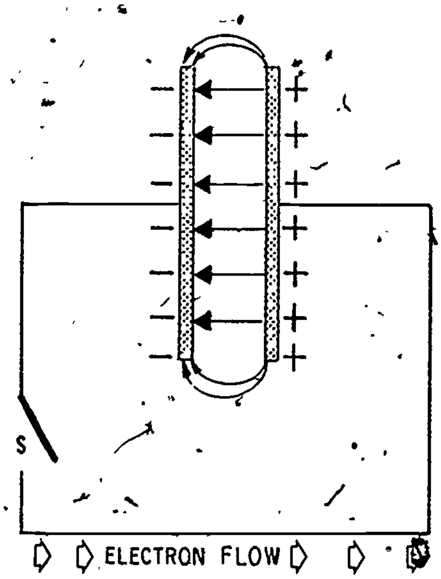


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Figure 8-1.—Capacitance.

When electric charges are in motion, as when a current is flowing in a conductor, a magnetic field forms around the conductor. Once formed, the magnetic field surrounding all portions of the conductor is constant in direction and intensity if the generating current is also constant. If the current-carrying wire is wound into a coil, called an inductor (fig. 8-2), the resulting magnetic field is intensified in proportion to the number of turns. The greater the inductance, the stronger the magnetic field for a given current.

Suppose that a circuit contains both capacitance and inductance, or a combination of circuits as in figures 8-1 and 8-2. When the switches are closed, the energy in the electrical field at the capacitor causes a current to flow in the inductor, thereby creating a magnetic field. This continues until the capacitor is completely discharged. All the energy now resides in the magnetic field. When the current ceases, there is nothing to sustain the magnetic field, which promptly collapses, returning the energy to the circuit. This recharges the capacitor, and the energy of the circuit has now been transferred from the magnetic field back to the electric field. This type of circuit is known as an oscillating circuit and the sequence repeats itself indefinitely. The oscillating circuit lies at the heart of the radio because it provides a source of alternating electric and magnetic fields and a means of controlling the frequency of oscillations known as tuning.

Most of the energy stored in the electric field of a capacitor or the magnetic field of an inductor is restored to the circuit when the capacitor has become discharged or when current ceases to flow in the inductor. These fields expand and contract at nearly the speed of light, which is approximately 186,000 miles per second. At very low frequencies there is ample time for the restoration of energy to take place. However, as frequency increases, the recurring cycles become faster. When the time needed for the field to expand and collapse is more than about one-half cycle, some of the energy becomes detached and continues to radiate into space at approximately the speed of light. Such radiating energy, called electromagnetic radiation, is the link between a radio transmitter and receiver.

RADIO THEORY

Radiated electromagnetic energy suitable for radio communication is called a hertzian wave. The wave is named for an early German

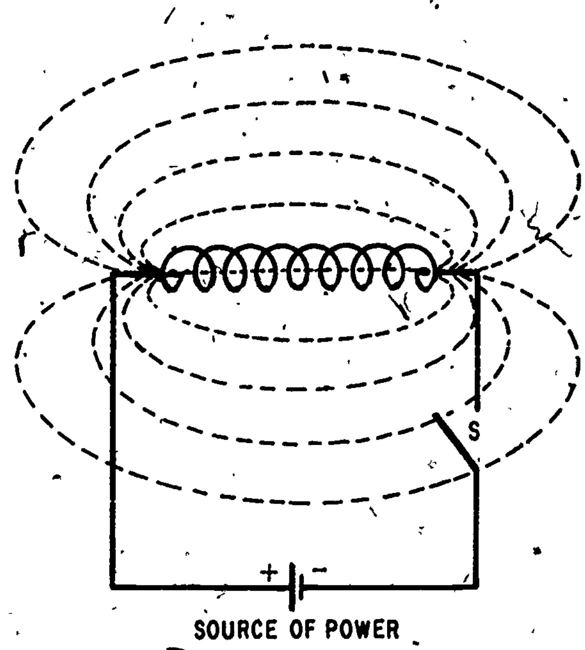

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Figure 8-2.—Inductance.

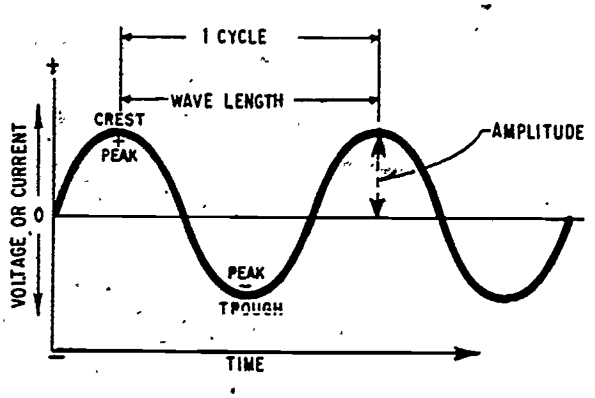

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Figure 8-3.—Hertzian wave nomenclature.

physicist and mathematician named Hertz, who introduced the theory of the kinetic energy of an electrical current. Hertz's discoveries, along with many other discoveries, laid the basis for the development of radio telegraphy.

The hertzian wave can be represented by a sine curve as shown in figure 8-3. The top of the wave represents the maximum positive value, and the bottom represents the maximum negative value. Either maximum may be called a peak. Wave length is the distance between corresponding points on consecutive waves as shown in figure 8-3. It is the distance a wave travels during one cycle. Frequency is the number of cycles that occur per second, stated in terms of hertz, abbreviated Hz; thousands of cycles per second stated in terms of kilohertz, abbreviated kHz; or millions of cycles per second stated in terms of megahertz, abbreviated MHz. The range of frequencies involved, called the radio spectrum, extends from approximately 10 kHz to 300,000 GHz as shown in table 8-1.

A hertzian wave, as previously indicated, is an oscillating electromagnetic field. A continuous series of such waves of like characteristics is called a continuous wave (CW). (See fig. 8-4(A).) Such a wave can be used in Morse code transmissions, being keyed so that the signal is interrupted when desired. (See fig. 8-4(B).) A continuous wave may be modified in accordance with some characteristics of an audio frequency signal, such as that produced by the human voice. When thus used, it is called a carrier wave. The process of modifying the carrier wave in this manner is called modulation. After this has taken place, the carrier wave may be called a modulated carrier wave. (See fig. 8-4(C).) When this form of radio transmission is used, the transmitting station generates the carrier wave and modulates it by the message to be conveyed. The receiver demodulates the incoming signal by removing the modulating signal and converting it to its original form.

There are four principal kinds of modulation. In amplitude modulation (AM) the amplitude (fig. 8-3) of the carrier wave is altered. This is the most widely used form of modulation. In frequency modulation (FM) the

Table 8-1.—Radio spectrum

Frequency range	Name of the range	Symbol
Below 30 kHz	Very low frequency	VLF
30-300 kHz	Low frequency	LF
300-3,000 kHz	Medium frequency	MF
3-30 MHz	High frequency	HF
30-300 MHz	Very high frequency	VHF
300-3,000 MHz	Ultrahigh frequency	UHF
3,000-30,000 MHz	Superhigh frequency	SHF
30,000-300,000 GHz*	Extremely high frequency	EHF

* Gigahertz

frequency of the carrier wave is altered. This is used in some voice communications and commercial broadcasting and has an advantage of being nearly static free. In phase modulation the phase (amount by which the beginning of a cycle is displaced from a reference origin) is altered. This is similar to FM and has some engineering advantages. In pulse modulation (PM) very short bursts of carrier wave signals are transmitted, followed by relatively long periods during which no signal is transmitted. PM is used in RADAR, DME, and radio teletype.

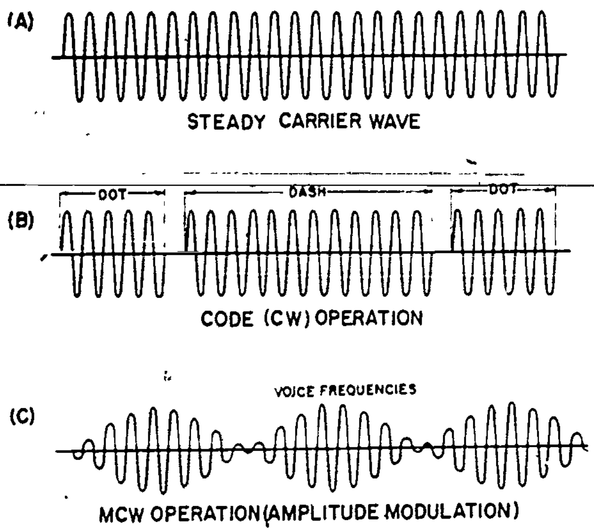

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Figure 8-4. — Types of radio waves.

With amplitude modulation, two sidebands are radiated, the frequencies of which are the sum and difference, respectively, of the carrier and modulating frequencies. The intelligence is carried only on the sidebands. In single sideband (SSB) transmission the carrier and one of the sidebands are suppressed, producing narrow bandwidth transmission. Bandwidth is the amount of radio spectrum required for transmission, including the carrier wave and both sidebands when present. SSB transmission is desirable in that it effects economy in the use of limited frequency bands and in power.

Radio Transmitter

A radio transmitter consists essentially of a power supply to furnish direct current; an oscillator to convert direct current into radio frequency oscillations (the carrier wave); an amplifier to increase the output of the oscillator; a device for controlling the frequency of the generated signal; and, for most transmitters, a modulator to produce modulation of the carrier wave. (See fig. 8-5.) In addition, an antenna is needed to project the electromagnetic radiation into space.

ANTENNA

An antenna can be defined as a conductor or system of conductors used either for radiating

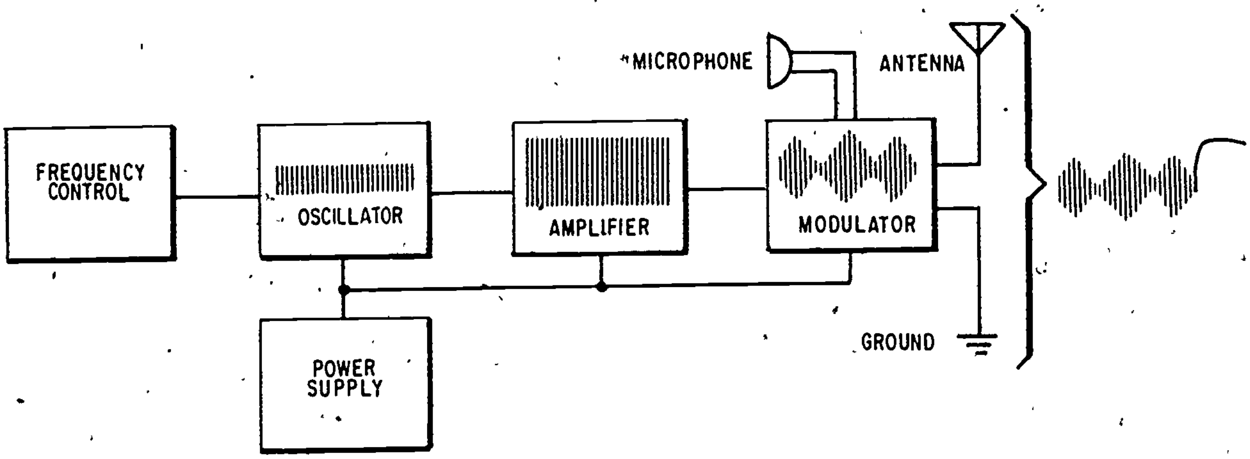

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Figure 8-5. — Radio transmitter.

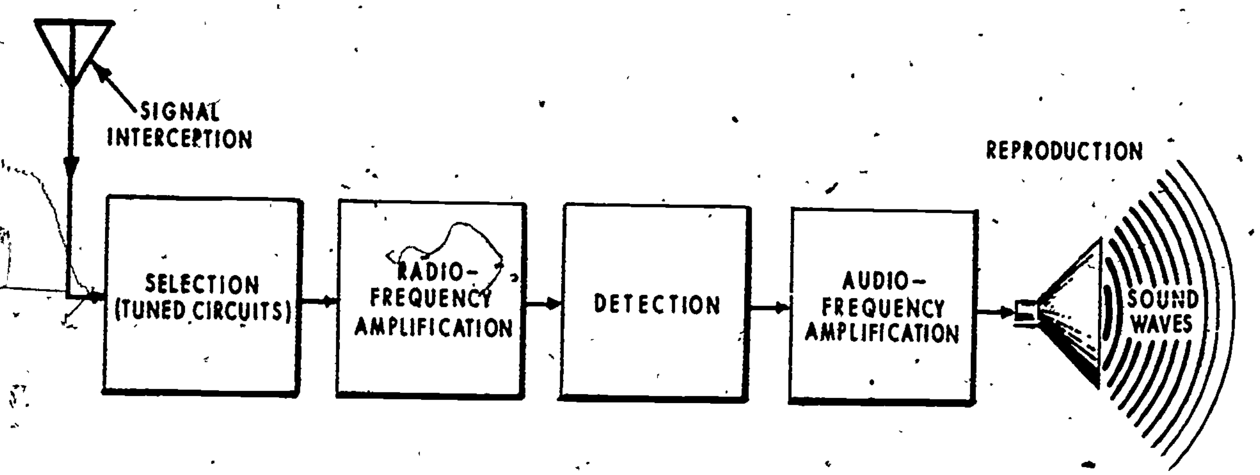

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Figure 8-6.—Radio receiver.

electromagnetic energy into space or for collecting electromagnetic energy from space.

In effect, electrical energy from the transmitter is converted into electromagnetic energy by the antenna and radiated into space; on the reception end, the opposite transpires, and this electrical energy is fed into the receiver via the antenna.

Fortunately, separate antennas seldom are required for transmission and reception of radio energy. An antenna transfers energy from space to its input receiver terminals with the same efficiency it transfers energy from the output transmitter terminals into space, assuming, of course, that the same frequency is used in both cases.

This property of interchangeability of the same antenna for transmitting and receiving operations is known as antenna reciprocity.

Antenna reciprocity is possible mainly because antenna characteristics are essentially the same regardless of whether an antenna is sending or receiving electromagnetic energy. An antenna may be nondirectional or directional depending upon the design or arrangement of antennas, called an array. Reflectors are also used to reflect some of the radiated energy in a desired direction.

RADIO RECEIVER

When an electromagnetic field passes a conductor such as an antenna, a current is induced in the conductor, which thereby becomes a generator of radio frequency power. A radio receiver is a device which accepts the power thus generated by an antenna, and transforms it into usable form. The output of receivers most used by ACs is presented aurally via earphones or a loud speaker, or visually on a cathode ray tube as in RADAR or DF.

A radio receiver consists essentially of electrical components capable of doing four things as follows:

1. Selecting a signal of a single frequency from among the thousands existing together in the receiving antenna.

2. Amplifying the selected signal without distortion until it is sufficiently powerful to actuate succeeding devices within the receiver.

3. Demodulating any modulated signal so as to produce a new signal of audible or other usable frequency.

4. Amplifying that signal still further until, at the output of the receiver, it can operate the devices which present the signal in usable form. (See fig. 8-6.)

NOTE: For a more detailed study of communications theory and other related data you, as an Air Controlman striker or rated AC, should refer to Basic Electronics, Volume 1, NAVEDTRA 10087-C.

VHF/UHF OMNIDIRECTIONAL RANGES

The omnidirectional facility derives its name from the Latin word omnis, meaning all. Hence the omni facilities produce directional guidance in all directions. Theoretically speaking, an infinite number of courses are produced by these facilities, but in actual practice only 360 are usable under optimum conditions. Courses produced by omni facilities radiate from the station like spokes from the hub of a wheel and are called RADIALS. It is important to remember that the radials are always FROM the station.

PRINCIPLE OF OPERATION

The principle of the omnidirectional facility is based on the comparison of the phase difference between two radiated audio frequency signals, the difference in phase varying with change in azimuth. One of the two signals is nondirectional. It has a constant phase throughout 360 degrees of azimuth and is called the reference phase. The other signal rotates at a speed of 1,800 rpm, varies in phase with azimuth, and is called the VARIABLE phase.

The rotating signal is initially set so that at magnetic north both the reference and the variable signals are exactly in phase. In all other directions, the positive maximum of the variable signal will occur at some time later than the maximum of the reference signal. The fraction of the cycle which elapses between the occurrence of the two maximums at any point in azimuth identifies the azimuth angle of that point. (See fig. 8-7.)

For an analogy to help visualize the method of determining bearing from the transmitter let us use, as an example, a rotating light beacon. Suppose that an additional light flashes each time the light beam sweeps past magnetic north and the beacon rotates clockwise at 6 rpm (one revolution each 10 seconds or 36 degrees per second).

To determine our direction from the beacon, we could use a stopwatch, starting the watch at the instant we see the start of the flash and stopping it when the rotating beam sweeps past our position. Then, by multiplying the number of seconds shown on the stopwatch by 36, we can obtain our magnetic bearing from the beacon. Suppose that exactly 5 seconds elapse from the start of the flash until the rotating beam flashes past us: 5 x 36 = 180. From this we determine that bearing from the beacon is 180 degrees.

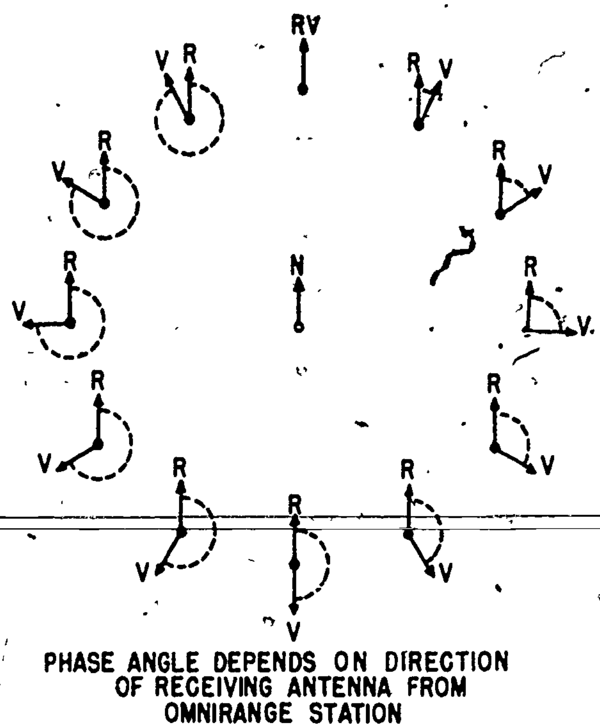

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Figure 8-7. — Comparison of reference and variable phase.

If we move our position to the right (counterclockwise), the elapsed time interval would be shorter; hence, our bearing would be something less than 180 degrees. The reverse would be true if we moved our position to the left (clockwise). In effect, the reference and variable voltages of the omni facility provide the same information electronically that the flasher and the beacon supply visually in this example.

RECEIVING EQUIPMENT

The basic function of the airborne receiving equipment is to measure the phase angle between the reference voltage and the variable voltage. As described previously, each point or degree of azimuth radially from the ground transmitter has a definite, fixed phase difference between the reference and the variable signals. Therefore, if our receiving equipment can translate and provide in readily usable readings on the instrument panel the phase difference existing at the receiving position, a bearing from the transmitter is obtained. Likewise, if our equipment can be adjusted to any desired bearing (or phase difference), and indicate when the aircraft has reached that bearing, we may preset courses, then fly to and continue along them. That is exactly what the receiving system is designed to do, and a great deal of information is available to the pilot taking advantage of all its possibilities.

DISTANCE MEASURING EQUIPMENT (DME)

Distance and direction from a known ground point are two items of information necessary to establish position in air navigation and assist the air traffic controller to effectively maintain separation. Until the advent of equipment for measuring distance, a pilot could find his bearing toward a selected navaid; but in order to determine his actual position (bearing and distance), it was necessary to tune to another facility and determine his position by cross-reference methods. This was time consuming. By use of the present-day distance measuring equipment the pilot has both the bearing and distance from the station displayed on the indicators.

Principles of Operation

Distance measuring capability requires special equipment in the aircraft and on the ground. The airborne equipment is known as the INTERROGATOR and the ground equipment is called the TRANSPONDER. In the operation of distance measuring equipment, paired pulses at a specific spacing are sent out from the aircraft (this is interrogation) and are received at the ground station. The ground station (transponder) then transmits paired pulses back to the aircraft at a different pulse spacing and on a different frequency. The time required for the round trip of this signal exchange is measured in the airborne unit and is translated into distance (nautical miles) from the aircraft to the ground station.

Operating in the UHF band on the line-of-sight principle, distance measuring equipment furnishes distance information with a very high degree of accuracy. DME measures slant distance rather than horizontal distance over the ground. Except in the immediate vicinity of the transponder and at a relatively high altitude, the navigation error introduced by the slant measurement is minor and usually may be ignored.

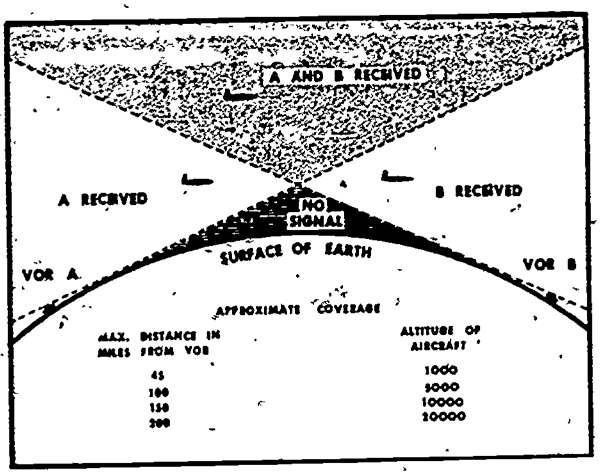
TYPES OF OMNIRANGES

Several types or combinations of VHF/UHF omni facilities are in operation today; therefore, careful use of terminology referring to these facilities is necessary. The omni facilities and their operating frequencies are as follows:

1. VOR. VHF omnidirectional radio range which provides bearing (direction) information. VOR facilities operate on frequencies between 108.0 MHz and 118.0 MHz.
2. VOR/DME. VHF azimuth information and UHF distance information furnished from co-located components. Frequency pairing allows the use of a single receiver tuning selector capable of simultaneously selecting a paired VOR and DME receiver frequency.
3. TACAN. (Tactical Air Navigation) UHF omnidirectional radio range which provides direction and distance information. TACAN facilities operate on frequencies between 960 MHz and 1,215 MHz. VOR receivers are unable to receive navigational signals from TACAN facilities.
4. VORTAC. A combination of VOR and TACAN. This facility provides azimuth navigational information on VHF (108-118 MHz) and azimuth and distance navigational information on UHF (960-1,215 MHz). Aircraft having complete TACAN airborne equipment can receive both distance and azimuth information from the TACAN portion. Aircraft equipped with VOR receivers use the azimuth information from the VOR and must obtain distance information from the TACAN portion. This is accomplished through single receiver tuning selection of paired frequencies as with VOR/DME.

RECEPTION DISTANCE

Like all VHF/UHF transmissions, omni facility signals follow and approximate line-of-sight course. (See fig. 8-8.) Therefore,



201.111
Figure 8-8.—Line-of-sight transmission characteristics.

reception distance increases with an increase in the altitude of an aircraft. Since the reliable operating range is about 40 miles at minimum en route altitude (1,000 feet above terrain), omni facilities are spaced approximately 90 miles apart to assure navigation coverage over an airway. Due to the operational band of the omni facilities, they are relatively free of atmospheric and precipitation static.

CLASSIFICATION

VOR, VORTAC, and TACAN navaids are classed according to their operational use. There are three classes as follows:

T . . . . . . Terminal
L . . . . . . Low altitude
H . . . . . . High altitude

Table 8-2 shows the normally anticipated altitude and interference-free distance service. It is apparent from the table that this is not maximum range of the facility. Use of these facilities beyond the prescribed limitations is not intended, and may therefore result in undependable or inadequate indications in the aircraft.

IDENTIFICATION

VORs are identified by two methods consisting of the ground facility transmitting one of the following:

1. A 3-letter identifier in Morse code.
2. A recorded automatic voice identification announcing the name of the facility followed by the word "VOR."

Identification of VOR facilities is transmitted continuously except when interrupted by an actual voice transmission on the voice feature of the navaid, or during periods of maintenance, in which case the identification of the facility is removed.

TACANs are identified by ground facility transmission of a 3-letter identifier in Morse code at regular intervals of 37.5 seconds.

VORTAC identification requires identification of both the VOR and TACAN portions of the facility. The procedure is basically the same as for individual facilities except they are interlocked; i.e., the VOR identification is continuous except at regular intervals of every 37.5 seconds when the TACAN is identified. Where the recorded automatic voice identification is used for the VOR portion, it consists of the name of the facility followed by the word VORTAC.

VOR RECEIVER CHECKS

Federal Air Regulations, Part 91 provides for certain VOR equipment accuracy checks prior to flight under instrument flight rules (IFR). The FAA has provided the following means of checking VOR receiver accuracy:

1. VOR test facility (VOT).
2. Certified airborne checkpoints.

Table 8-2.—Altitude and radius distances

Class	Altitudes	Distance (miles)
T	12,000' and below	25
L	Below 18,000'	40
H	Below 18,000'	40
H	14,500' -- 17,999'	100*
H	18,000' -- FL 450	130
H	Above FL 450	100

*Applicable only within the contiguous 48 states.

3. Certified checkpoints on the airport surface.

The VOR test facility (VOT) transmits a test signal for VOR receivers which provides a convenient and accurate means to determine the operational status of their receivers.

Airborne and ground checks consist of certified radials that should be received at specific points on the airport surface, or over specific landmarks while airborne in the immediate vicinity of the airport.

Should an error in excess of plus or minus 4 degrees be indicated through the use of the ground check, or plus or minus 6 degrees using the airborne check, IFR should not be attempted without first correcting the error.

In addition to the above procedure, the Navy has established checkpoints on taxiways, usually in close proximity to the warmup area, or those used just prior to taxiing on the runway in use. These checkpoints consist of a position on the taxiway, marked by a 20' circle painted on the surface, and a painted sign adjacent to the taxiway that indicates the distance and bearing to the TACAN/VOR from a position directly over the circle. (See chapter 10.)

CAPABILITIES AND LIMITATIONS

The VOR and TACAN characteristics are similar with the exception of VOR providing bearing information only and operating in the VHF frequency band. Since TACAN is widely used throughout the Navy as a primary navaid, no reference is made to VOR in this section.

The TACAN system employs 126 two-way operating channels of 2 MHz spacing within the frequency range of 960 to 1215 MHz. Bearing information is available to an unlimited number of aircraft within range (line of sight) of the facility. Distance information is also limited to line of sight and normally extends from 0 to 195 miles. Newer equipment may provide distance information to 300 miles. A ground facility will reply to as many as 120 interrogations for distance information simultaneously. Thus it can be said that each of the 126 TACAN channels available will provide full service (bearing and distance) to as many as 120 aircraft simultaneously.

NOTE: In addition to servicing 120 aircraft, two distance signals are generated, processed, and utilized by the monitoring equipment. This ensures ground-station reliability.

TACAN bearing accuracy is plus or minus 3/4 of 1 degree. The distance accuracy is about plus or minus 600 feet plus 2 percent of the distance measured.

Atmospheric conditions above 50,000 feet are such that the high voltages within the equipment are sufficient to cause arcing. Therefore, TACAN operation is limited to altitudes up to 50,000 feet.

On later models of airborne TACAN equipment, air-to-air ranging has been added which provides distance information between airborne TACAN radio sets. To accomplish this function, pilots of the aircraft concerned must agree upon selection of two different TACAN channels which are separated by exactly 63 MHz. If such a capability exists, an airborne TACAN radio set can transmit distance reply signals to interrogations from as many as five other sets simultaneously. At the same time, the set will receive replies to its own interrogations from all five other sets. However, only the distance to one other set can be displayed on the aircraft's distance indicator. No bearing information is available between aircraft when the air-to-air ranging feature of the equipment is selected. Also, ground-to-air information is not available when the air-to-air feature is selected. Figure 8-9 is an example of the visual display provided the pilot when the air-to-air feature is selected.

AIRCRAFT INSTRUMENTATION

The purpose of this section is to provide the Air Controlman with an idea of the practical use of TACAN and the basic aircraft instruments involved. There are several types of instruments, or modifications thereof, available, and new ones are being produced continuously to provide Navy pilots with the best possible navigation assistance. The instruments depicted here are not to be considered as standard in Navy aircraft. VOR is not referred to due to similarity of operation with the exception that VOR provides bearing information only and operates within the VHF frequency band instead of the UHF band as does TACAN.

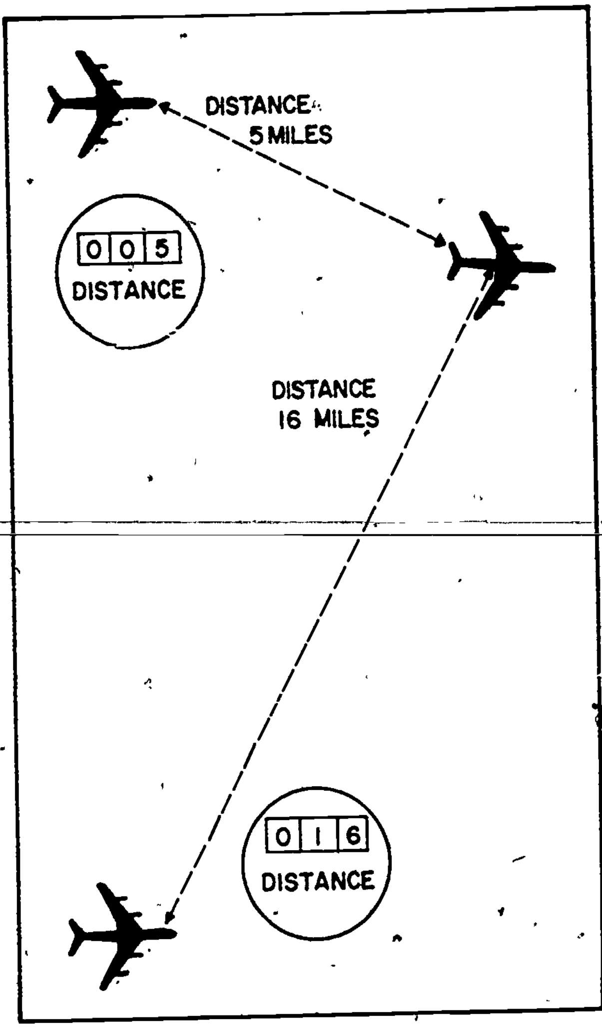


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Figure 8-9.—Air-to-air ranging.

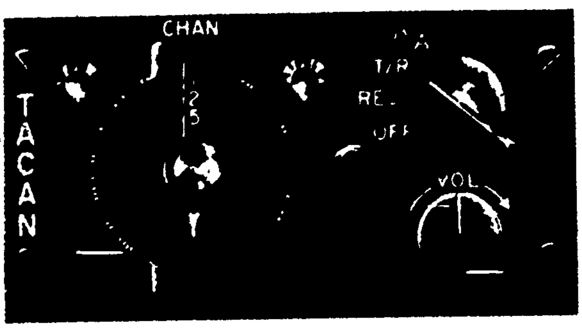

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Figure 8-10.—TACAN control box.

Figure 8-10 shows a TACAN control box and the various switches. The control system labeled CHAN allows a pilot to select one of the 126 operating TACAN channels available. The switch at the upper right hand side of the control box allows a pilot to turn the TACAN set off, receive only (REC) which provides bearing information only, transmit/receive (T/R) which provides both bearing and distance information, or air-to-air ranging (A/A) which provides distance information between airborne TACAN radio sets. The volume control selects the desired volume level of the identification of the TACAN channel selected. This identification is the 3-letter Morse code identification of the TACAN and is heard in the pilot's radio headset.

Figure 8-11 shows three basic instruments used for TACAN air navigation. They are as follows:

1. The range indicator, which displays distance in nautical miles to the TACAN station selected by the channel selector.

2. The course indicator, which displays the following:

a. The relative position of the course selected (the window labeled course) to the aircraft (vertical bar).

b. Whether the selected course will take the aircraft TO or FROM (TO-FROM indicator on the left side of the instrument) the station.

c. The relationship of the aircraft's heading (vertical needle) to the course selected.

3. The radio magnetic indicator (RMI), which displays the following:

a. The magnetic heading of the aircraft (rotating compass card).

b. The relative bearing of the TACAN station from the aircraft (large needle with the number 2 on it).

NOTE: There is another small needle used on the RMI for Automatic Direction Finding (ADF), which is discussed later in this chapter, but is not shown in figure 8-11.

Figure 8-12 is an example of maintaining flight along a specified TACAN radial by correcting for wind drift.

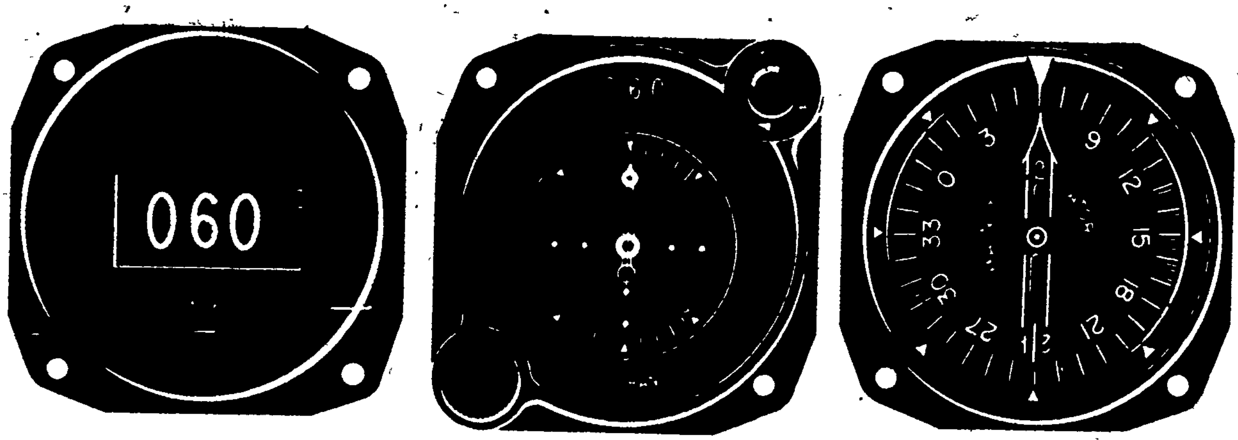

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Figure 8-11.—Range indicator, course indicator, and radio magnetic indicator.

Figure 8-11 is the actual instrument display of the aircraft's position No. 1 in figure 8-12 as follows:

1. The range indicator shows that the aircraft is 60 miles from the TACAN station.

2. The course indicator shows that the aircraft is on the selected course (060) which will take it TO the station.

3. The radio magnetic indicator (RMI) shows that the aircraft's magnetic heading is 060 and the TACAN is directly ahead of the aircraft.

At position No. 2 of figure 8-12 wind has blown the aircraft off the radial. The instruments indicate this as follows:

1. The range indicator shows that the aircraft is now 50 miles from the TACAN station.

2. The course indicator shows:

a. The selected course (060) which will take the aircraft TO the station is left of the aircraft's position (vertical bar).

b. The aircraft's heading is parallel to the selected course (vertical needle).

3. The RMI shows that the aircraft's heading is still 060 magnetic, but the TACAN station now bears left of the aircraft's nose.

The pilot must apply corrections to return the aircraft to the desired radial. Position No. 3 shows the instrument display after the corrections have been made as follows:

1. The range indicator shows the aircraft is now 40 miles from the TACAN station.

2. The course indicator shows that the selected radial (060) is still left of the aircraft's position (vertical bar), and the heading of the aircraft will intercept or is toward the selected course (vertical needle).

3. The RMI shows that the pilot has changed the magnetic heading to 030 and the TACAN station now bears to the right of the aircraft's nose.

Position No. 4 shows the aircraft back on course with a corrected heading to maintain such course as follows:

1. The range indicator shows the aircraft is now 10 miles from the TACAN station.

2. The course indicator shows the following:

a. The aircraft is back on the selected radial (vertical bar) which will take it TO the station.

b. The aircraft's heading is left of the course selected to compensate for the wind (vertical needle).

3. The RMI shows the aircraft's magnetic heading is 050 and the TACAN station bears right of the aircraft's nose.

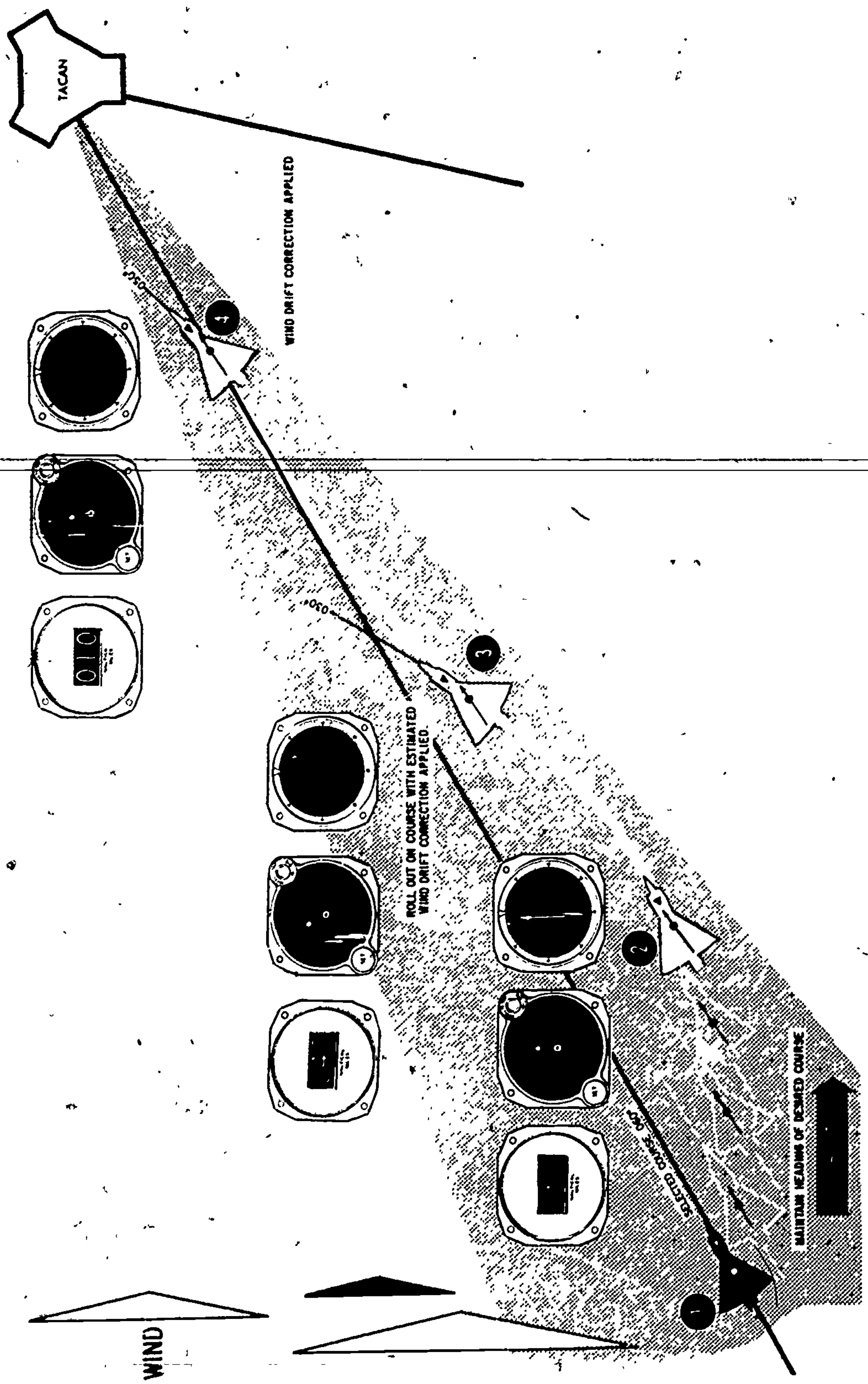

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Figure 8-12.—Flying a TACAN radial.

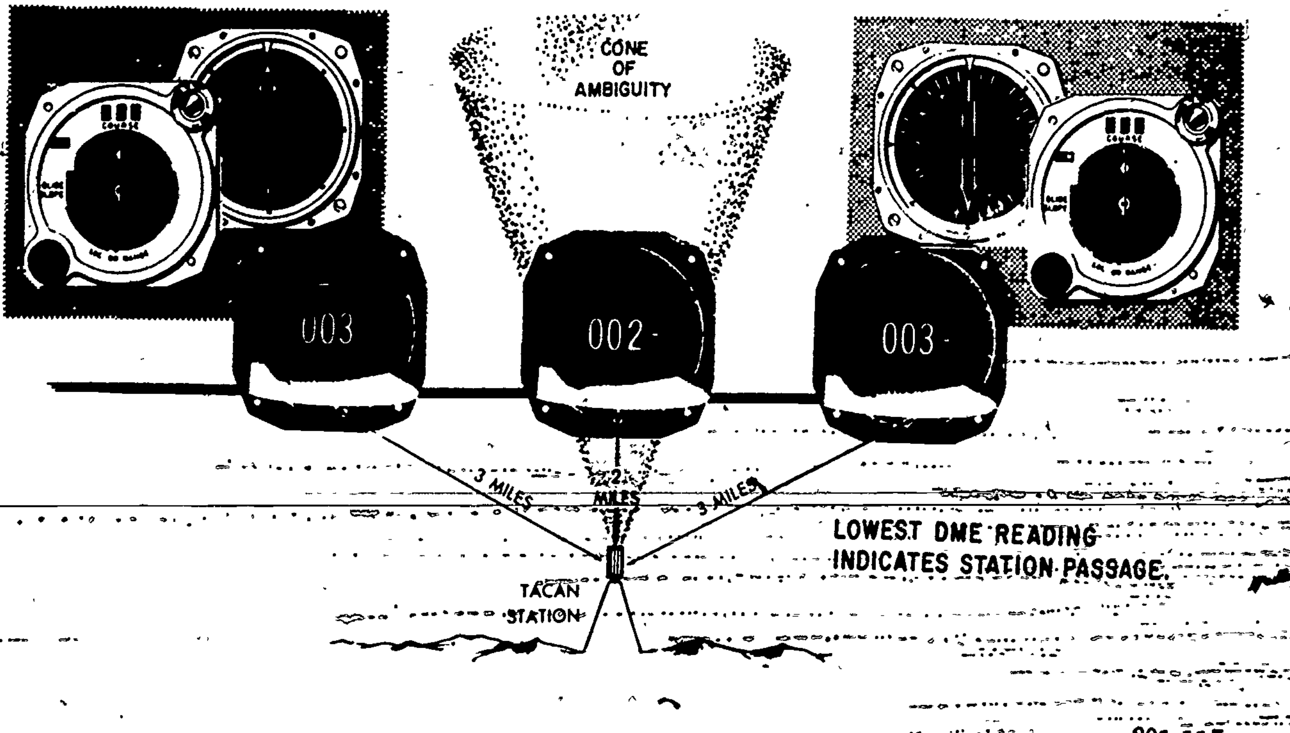

Figure 8-13.—TACAN station passage.

When the aircraft passes over the station, distance on the range indicator will commence to increase, the vertical bar on the course indicator will fluctuate from side to side momentarily, the TO-FROM indication on the course indicator will change to FROM, and the needle on the RMI will rotate aimlessly, then stabilize 180 degrees from the bearing approaching the station, or point aft of the aircraft to the TACAN station. The reason for the course indicator and RMI TACAN needle fluctuation is a large cone of ambiguity directly over all TACAN stations in which no bearing information is received. This cone of ambiguity is 100 degrees. Therefore, the instruments which use bearing information will not settle down until an aircraft has passed through the cone. However, distance information is constant; and since it is slant range, there will be a reading of distance directly over the TACAN station which indicates the vertical distance or altitude of the aircraft. (See fig. 8-13.)

TACAN may also be used to maintain a constant distance, called ARC, from a TACAN station. To accomplish this a pilot would, after arriving at the desired distance (ARC), select a magnetic heading on the RMI to cause the RMI TACAN needle to point off the aircraft's wing or 90 degrees relative to the TACAN station. Then the magnetic heading would be altered slightly to maintain a constant distance or fly the ARC, and constant relative bearing to the TACAN station.

RADIO BEACONS

Several types of radio beacons are used as aids to aircraft navigation. The discussion in this chapter includes nondirectional beacons, ADF procedures, and marker beacons.

NONDIRECTIONAL RADIO BEACONS (NDB)

A low- or medium-frequency radio beacon transmits nondirectional signals whereby the pilot of an aircraft equipped with a loop antenna can determine his bearing and "home" on the station. These navaids normally operate in the frequency range of 200 to 415 kHz and transmit a continuous carrier with a continuous keyed identification except during voice transmissions.

When a radio beacon is used in conjunction with the ILS markers, it is called a compass locator. ILS systems are discussed later in this chapter.

All radio beacons except the compass locators transmit a continuous three-letter identification in code. Compass locators transmit a continuous two-letter identification in code.

Voice transmissions are made on radio beacons unless the letter W (without voice) is included in the class designator. Radio beacons are subject to disturbances that result in ADF needle deviations, signal fades, and interference from distant stations during night operations. Table 8-3 shows the classification and normal usable distances of NDBs.

AUTOMATIC DIRECTION FINDING (ADF)

Although many new types of direction finding and homing equipment are coming into widespread use, the radio compass still remains a basic and important piece of equipment for homing, tracking, course interception, time/distance checks, and similar purposes. Therefore, a brief description of the basic method utilized in an ADF orientation is included so that the Air Controlman may visualize the "pilot's position" during an ADF orientation.

When the pilot is flying ADF, the problem of orientation is solved automatically. The 0-180 degree axis of the radio compass indicator is aligned with the longitudinal axis of the aircraft. Thus, you can think of 0 degrees on the radio compass dial as representing the nose of the aircraft, while 180 degrees on the radio compass dial represents the tail of the aircraft. The radio compass needle always points toward the station. This means that when the radio compass indication is between 0 and 090 degrees, the station is ahead and to the right of the aircraft. When the radio compass points to a reading between 090 and 180 degrees, the station is behind and to the right. A reading between 180 and 270 degrees shows that the station is behind and to the left, while a reading of between 270 and 360 degrees shows that the station is ahead and to the left. The radio compass needle points to the number of degrees the pilot must turn in a clockwise direction to head directly toward the station. This is called relative bearing of the station.

Table 8-3.—Service range of NDB facilities

Class	Power (watts)	Distance (miles)
Compass Locator	Under 25	15
MH	Under 50	25
H	50 - 1999	50
HH	2000 or more	75

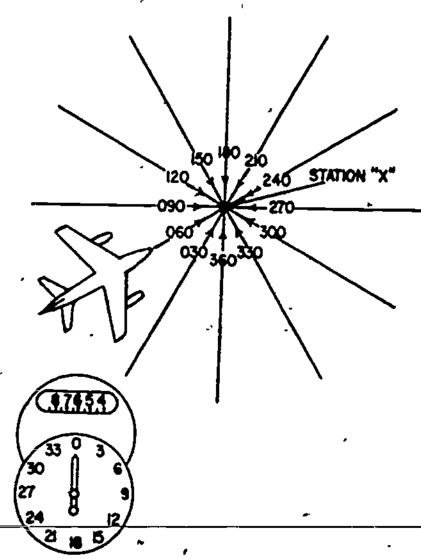

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Figure 8-14.—Inbound bearing to station X.

By adding the relative bearing of the station and the magnetic heading of the aircraft, the pilot can determine the magnetic bearing of the station. This establishes a line of position from the aircraft to the station. By looking at figure 8-14 you can see that the aircraft is approaching the station from the southwest. The magnetic bearing of the station is 060 degrees. For the sake of simplicity, we will assume that there is no wind drift, so a magnetic heading of 060 degrees is holding the aircraft on this bearing. The radio compass indicates the relative bearing of the station—the angle measured clockwise from the nose of the aircraft to the station. In this case, the relative bearing is 0 degrees.

MARKER BEACONS

Marker beacons serve to identify a particular location in space along an airway or on the approach to an instrument runway. This is done by means of a 75-MHz transmitter which transmits a directional signal to be received by aircraft flying overhead. Four classes of markers are now in general use—FM, LFM, and ILS marker beacons, and Station Location or Z-Markers.

The class FM fanmarkers are used to provide a positive identification of positions at definite points along the airways. The transmitters have a power output of approximately 100 watts. Two types of antenna array are used with class FM fanmarkers. The first type used, and generally referred to as the standard type, produces an elliptical-shaped pattern, which at an elevation of 1,000 feet above the station is about 4 miles wide and 12 miles long. At 10,000 feet the pattern widens to about 12 miles wide and 35 miles long. (The long axis lies across the airway.)

The second array produces a dumbell or bone-shaped pattern, which at the "handle" is about 3 miles wide at 1,000 feet. The bone-shaped marker is preferred at approach control locations because the narrow pattern provides a more accurate position.

The class LFM or low-powered fanmarkers have a rated power output of 5 watts and are usually located within 5 miles of the station with which they are associated. The antenna array produces a circular pattern which appears elongated at right angles to the airway due to the directional characteristics of the aircraft receiving antenna.

ILS marker beacon information is included under the heading "Instrument Landing System" in this chapter.

The Station Location, or Z-Marker, was developed to meet the need for a positive position indicator for aircraft operating under instrument flying conditions, to show the pilot when he was passing directly over a Low Frequency Radio Range Station. The marker consists of a 5-watt transmitter and a directional antenna array which is located on the range plot between the towers or the loop antennas.

At certain installations where the fanmarker is located off the airways and the radio beacon is installed at the fanmarker site, is the FMHW. The FMHW is a combination of two facilities, for the specific purpose of allowing aircraft to proceed directly to the marker by means of the radio compass. The FMHW consists of the following:

1. FM—A fanmarker, bone or eliptical, 100 watts.
2. MH—A low-powered radio beacon, less than 50 watts.
3. W—Designates with a voice facility.

INSTRUMENT LANDING SYSTEM

One of the most important problems in the achievement of all-weather flight reliability has been the development of a system for landing aircraft by instruments. This development has gradually evolved into the present Instrument Landing System, commonly known as ILS.

The ILS system may be divided functionally into three parts:

1. Guidance information—localizer, glide slope
2. Range information—marker beacons
3. Visual information—approach lights, touchdown and centerline lights, and runway lights.

While these three elements are being improved, there are several supplementary elements being incorporated to further increase the utility and safety of the system. Compass locator stations have been added to assist in holding procedures and in tracking the localizer course. PAR is another added feature which is used to monitor the actual flightpath of aircraft using ILS.

To utilize the localizer associated with the ILS, an aircraft, to receive one of the 20 ILS channels available, must be equipped with a VHF receiver capable of receiving frequencies in the 108- to 112-MHz band. The aircraft must also be equipped with a course indicator to display the information received.

The structure housing the localizer unit of the ILS is located on the extended centerline of the instrument runway of an airport. It is located far enough from the end of the runway to prevent it from being classed as a hazard.

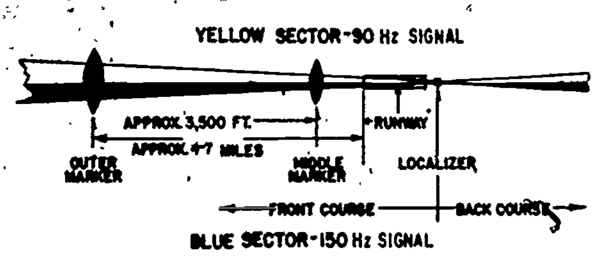

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Figure 8-15.—ILS localizer installation.

This unit radiates a field pattern directly down the centerline of the runway toward the fanmarkers. It also directs another field pattern in the opposite direction. These patterns are called the front and back courses, respectively. (See fig. 8-15.)

Utilizing the front course for an ILS approach is desirable since glidepath information is displayed only on this course. The back course may also be used, but since no glidepath information is available, the approach minimums will be considerably higher.

The localizer has a power output of 100 watts. This is sufficient to provide course guidance to the runway from a distance of 18 nautical miles, provided the aircraft is not lower than 1,000 feet above the surface or not higher than 4,500 feet above the elevation of the antenna site. To produce the oncourse signal, the radiated field pattern is modulated at two different frequencies. The right side, looking from the outer marker toward the transmitter, is modulated at 150 Hz. This is identified as the blue sector on maps or charts. The left side is modulated at 90 Hz and is identified as the yellow sector. The oncourse is the point of equisignal strength between the radiated pattern.

Each localizer is identified by a 3-letter code group preceded by an "I" designator; for instance, I-MIA or I-DAL. Most ILS installations include a voice facility on the localizer frequency. This voice facility is used for the transmission of approach control instructions from the airport control tower.

The glidepath unit is housed in a building located between 750 and 1,250 feet from the approach end of the runway (down the runway) and offset 400-600 feet from the runway centerline.

The beam projected by the glidepath transmitter is essentially the same as would be the localizer beam operating on its side. The upper side of the beam is modulated at 90 Hz and the lower side at 150 Hz.

The glidepath projection angle is normally adjusted to 3 degrees above the horizontal so that it intersects the middle marker at about 200 feet and the outer marker at about 1,400 feet above the runway elevation.

In addition to the desired course, all glidepath facilities inherently produce additional courses at higher vertical angles. However, provided pilots are properly indoctrinated in glidepath instrumentation and follow procedures correctly, these high angles will not be encountered and will cause no difficulty in glidepath navigation. (See fig. 8-16.)

The glidepath transmitter operates in a frequency band of 329.3 to 335.0 MHz, with a reception range of 18 nautical miles and a power output of 5 watts.

Every localizer frequency has a corresponding glidepath frequency. The frequency selector control is designed to switch the glidepath receiver to the corresponding frequency automatically when the pilot selects the proper localizer frequency, provided the aircraft is equipped with a glidepath receiver. This process is known as PAIRED FREQUENCIES.

The markers used with the ILS are low-powered fanmarkers of 3 watts or less output, operating on the fanmarker frequency of 75 mc and radiating the same vertical elliptical-shaped pattern.

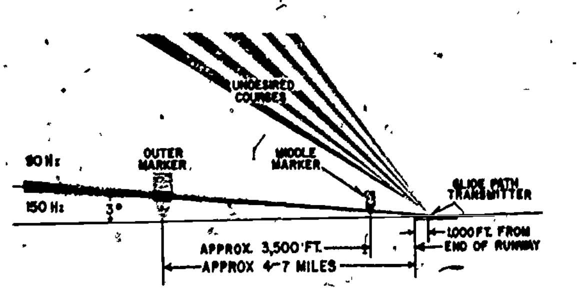

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Figure 8-16.—ILS glidepath and marker installation.

The outer marker is located approximately 4 to 7 miles from the instrument runway and is aligned on the front course of the ILS.

The middle marker is located approximately 3,500 feet from the approach end of the runway, between the runway and the outer marker.

Certain civil and military aircraft are equipped with ILS marker receivers which are used in connection with ILS facilities. They are usually equipped with purple and amber lights mounted on the instrument panel of the aircraft. Although all ILS markers are on the same frequency, the different lights are designed to operate independently, depending on the modulation frequency (tone) of the signal being received. A 400-Hz band-pass filter is included in the purple light hookup and a 1,300-Hz filter, for the amber light. These filters are intended to pass only the particular modulation frequency for which they are designed. Thus, when the aircraft is over an outer marker (400-Hz tone), the purple light will flash two dashes per second. When the aircraft is over a middle marker (1,300-Hz tone), the amber light will flash alternate dots and dashes.

The modulated tone signal is heard in the headset, and at the same time the visual signal is displayed by the marker beacon light.

Compass locators have a power output of less than 25 watts, a range of at least 15 miles, and operate between 200 and 415 kHz. It is employed as an aid in the following:

1. Transition from en route to ILS, flying a homing path direct to the outer marker from the designated radio fix or facility.

2. Flying a holding pattern by keeping the pilot advised at all times of his position relative to the outer marker.

3. "Tying down" and tracking the localizer course.

4. Determining when the markers are passed. This is particularly useful in case of failure of the fanmarker equipment.

A 2-letter identifier is used for the identification of the compass locator (LOM and LMM). The two letters are derived from the 3-letter location identifier.

The first and second letters of the 3-letter location identifier are assigned to the front course outer marker compass locator (LOM), and the second and third letters are assigned to the front course middle marker compass locator (LMM).

Example: Oklahoma City, Okla.—OKC LOM—OK LMM—KC.

When used in conjunction with ILS, compass locators are installed at the outer and/or middle marker location. They are designed for use with automatic direction finding (ADF) equipment in the aircraft.

At some locations, higher-powered radio beacons, up to 400 watts, are used as outer marker compass locators. These generally carry transcribed weather broadcast information.

CHAPTER 9

CONTROL TOWER EQUIPMENT

The purpose of this chapter is to introduce the Air Controlman to the various types and pieces of equipment found in control towers throughout the Navy. Great strides have been taken in the past decade to standardize and modernize both the control towers and the equipment therein. Through constant research and development the Air Controlman may expect to see even more development in equipment in the future. This is necessary to keep pace with the rapid progress being made in the field of aviation.

The equipment and methods of operation discussed in this chapter are considered to be most widely in use at this time. As new methods and equipment are installed at duty stations, it behooves every Air Controlman to study diligently, not only the method of operation, but the capabilities and limitations of the equipment and the techniques utilized.

JOINT ELECTRONICS TYPE DESIGNATION SYSTEM

The Joint Electronics Type Designation System (JETDS), formerly known as the AN nomenclature system, was developed to standardize, within the DOD, identification of electronic material and associated equipment.

This system of type designations applies to developmental, preproduction, and production models of systems, groups, components, and subassemblies of electronic equipment for military use. Once assigned, a type designation will never be duplicated. In the JETDS, nomenclature consists of a name followed by a type designation, which is composed of indicator letters and an assigned number. The type designation will always apply to one specific article or any subsequent improvements that may be made on that article.

A type designation assignment for a complete system, or set, consists of an AN (which is used to identify major items of electronic equipment), a slant bar, a series of three letters, a hyphen, and a number. The meanings of the three letters following the slant bar may be found in the table included in this manual as appendix II.

An example of a type designator would be Radar Set AN/SPS-10, which is a surface search radar set designed for installation aboard ship.

COMMUNICATIONS CONSOLES

Radio is the primary means of communications with aircraft, both in the air and on the ground. Different radio frequencies are established for a particular type of operation. For example, most Navy towers have 340.2, 360.2, 142.74, and 126.2 assigned specifically for airport traffic control purposes. Additional frequencies may be established by appropriate authority at some facilities depending upon operational requirements. Different operating positions within the same facility may have to share the same frequency for a single aircraft operation. For example, single piloted IFR aircraft should be provided a single frequency approach to the maximum extent that communications and traffic conditions permit. Therefore, approach control, radar facility, and the control tower may find it necessary to use the same frequency sometime during such an operation. Additionally, interfacility communications may be necessary for coordination between the different operating positions where physical contact between controllers is not possible. To provide controllers with this capability, communications consoles are provided which allow selection of various frequencies and intercommunications between operating positions.

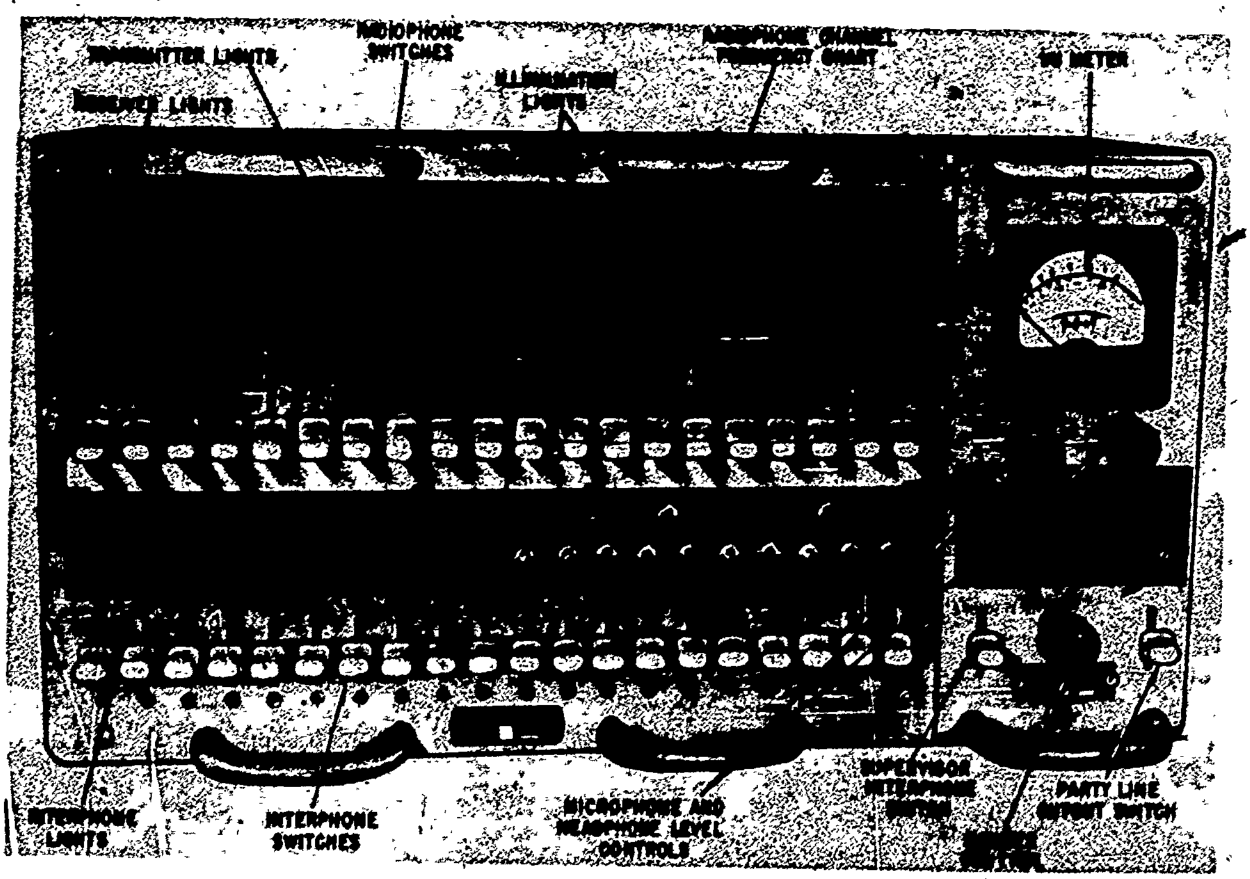

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Figure 9-1.—AN/FSA-17 communications console.

AN/FSA-17 COMMUNICATIONS CONSOLE

The AN/FSA-17 communications console (fig. 9-1) is a communications control system for air traffic control centers at naval air stations and other facilities where several operators must exercise control over multichannel radio communications while at the same time maintaining interphone communications with each other.

The system provides control of as many as 20 transmitters with a lockout feature that denies the use of a transmitter to any other operator once selected. It also monitors as many as 20 radio receivers at any one time. An operator can talk to one or more operators on the interphone feature. The interphone feature allows private line or party line intercommunication.

The operation of the console is simple, once the confusion of the multiplicity of controls is overcome. (See fig. 9-1.) Located on the right side of the console is a microphone level indicating meter, level controls for the microphone and headphone, and a dimmer control for illuminations, as well as lights and switches. The 3-position radiophone switches control the receivers and transmitters. These switches are OFF in the down position. To monitor a frequency, the switch is moved to the middle position. To select a transmitter, while monitoring the frequency, the switch is moved to the top position. The radiophone frequency chart is a removable strip of translucent plastic placed below the radiophone switches. The frequency controlled by each switch may be written on this chart for ready reference. Above each switch is an amber light which glows when a radio call is

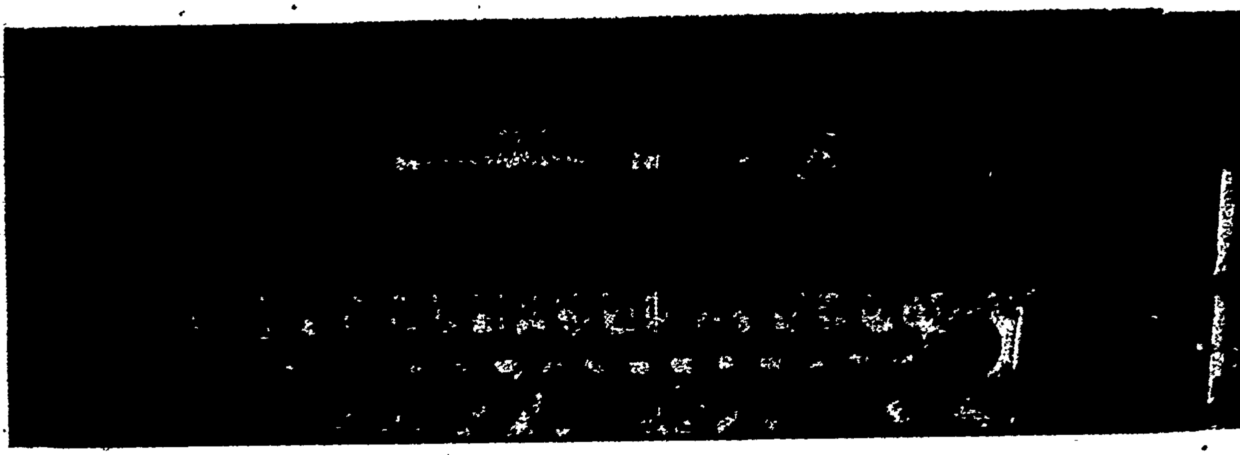

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Figure 9-2.—Speaker amplifier control.

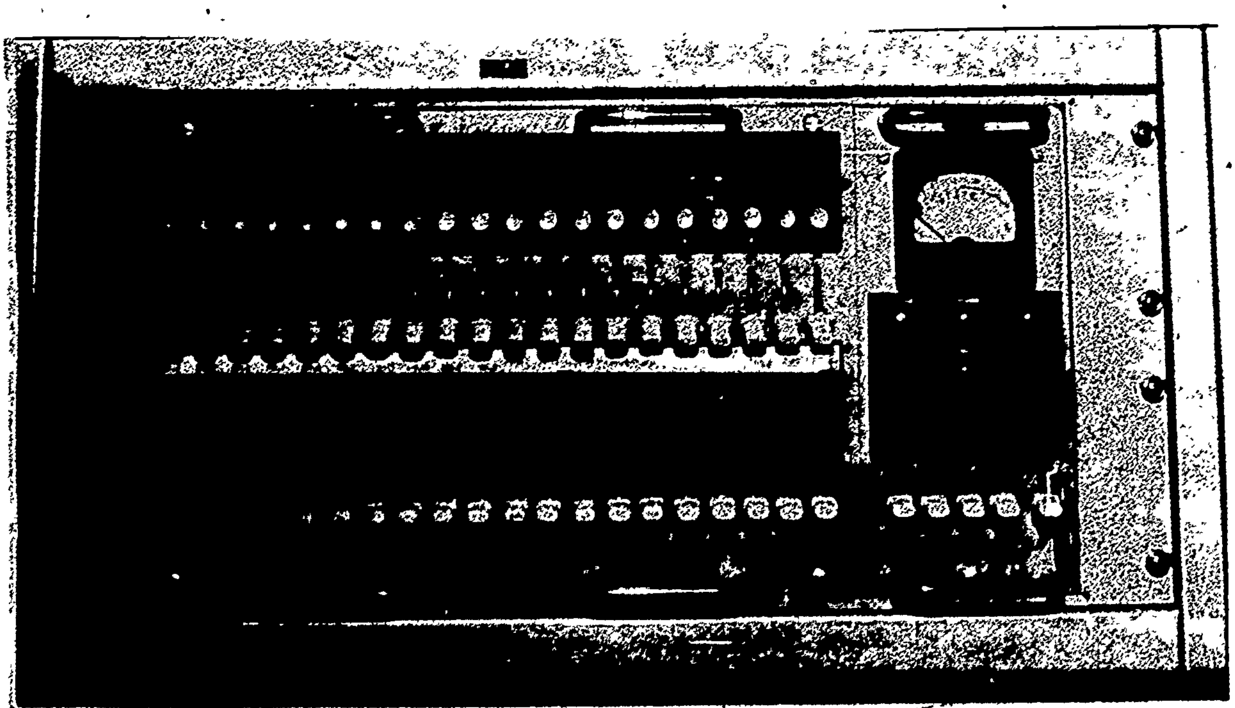

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Figure 9-3.—AN/FSA-52 communications console.

received, regardless of the position of the switch. A green light immediately above each amber light will glow when a transmitter is selected by a corresponding switch.

The 20 interphone switches on the bottom of the console control the 20 private line interphone circuits. The switches are OFF in the down (middle) position. To call and talk to another operator, the switch corresponding to the desired operator is moved to the upper position. Above each interphone switch is a red light which will glow when the position is called by another operator (the one corresponding to the number under the light). The supervisor interphone switch provides a private line interphone circuit to the supervisor's console in the same manner as the other interphone switches.

The party line cutout enables a controller to disconnect from a party line (programed into the system) by moving the switch up.

A speaker amplifier control is supplementary equipment added to the control tower operator's console. (See fig. 9-2.) This unit is usually installed directly above the basic FSA-17 with corresponding frequencies. Placing any one of the 20 receiver switches on the speaker amplifier control removes that particular receiver from the operator's headphone circuit and feeds it to an associated speaker. The speaker level control provides for control of speaker volume. The dimmer control is used to adjust panel illumination intensity. The speaker muting system prevents acoustical feedback through a microphone. To achieve headphone operation on all frequencies, the operator needs merely to raise the muting switch.

AN/FSA-52 COMMUNICATIONS CONSOLE

The AN/FSA-52 communications console is similar in design and basically the same in operation as the AN/FSA-17. It allows for additional frequencies, intercommunications, and possible operating positions. It may also be programed for the use of several direct telephone lines through the console. (See fig. 9-3.)

A speaker amplifier control unit is shown directly below the AN/FSA-52 console in figure 9-4. Other auxiliary equipment, such as a speaker, jackbox, and boom-type headset necessary for controller operation, are shown in figure 9-4.

In addition, equipment discussed later in this chapter is shown on top of the panel in front of the controller such as, a digital-type altimeter setting indicator, wind direction and speed indicator, and digital time indicator showing hours, minutes, and quarter minutes. Also shown is a flight progress strip holder. (Flight progress strips are described and illustrated in chapter 5.)

Figure 9-5 is an overall view of a typical control tower layout showing the various types of equipment used by the control tower operators. A floor-mounted microphone keying foot switch used with the three communications systems described in this chapter is illustrated in figure 9-5.

AN/FSA-58 COMMUNICATIONS CONSOLE

The AN/FSA-58 (fig. 9-6) is a newer type of equipment which possesses many new and desirable features. The modular characteristics of this system permit a virtually unlimited expansion of the basic equipment without undue installation of large amounts of additional units.

Some of the features incorporated in this communications equipment are as follows:

1. Console mounting may be accomplished by arranging the modules in either a vertical or horizontal manner.

2. No limitations as to the number of transmit or receive circuits for radiophone channels.

3. Interphone circuits available between controllers and between the supervisor and controllers.

4. The supervisor's console contains a power and fault alarm system that indicates both visually and aurally when trouble occurs within the system.

5. Backup power supply that automatically shifts to batteries or standby power source in the event of primary power failure.

6. Individual speaker and volume control at each control position.

7. Override feature on the supervisor's console.

8. Landline circuits may be patched into the modules.

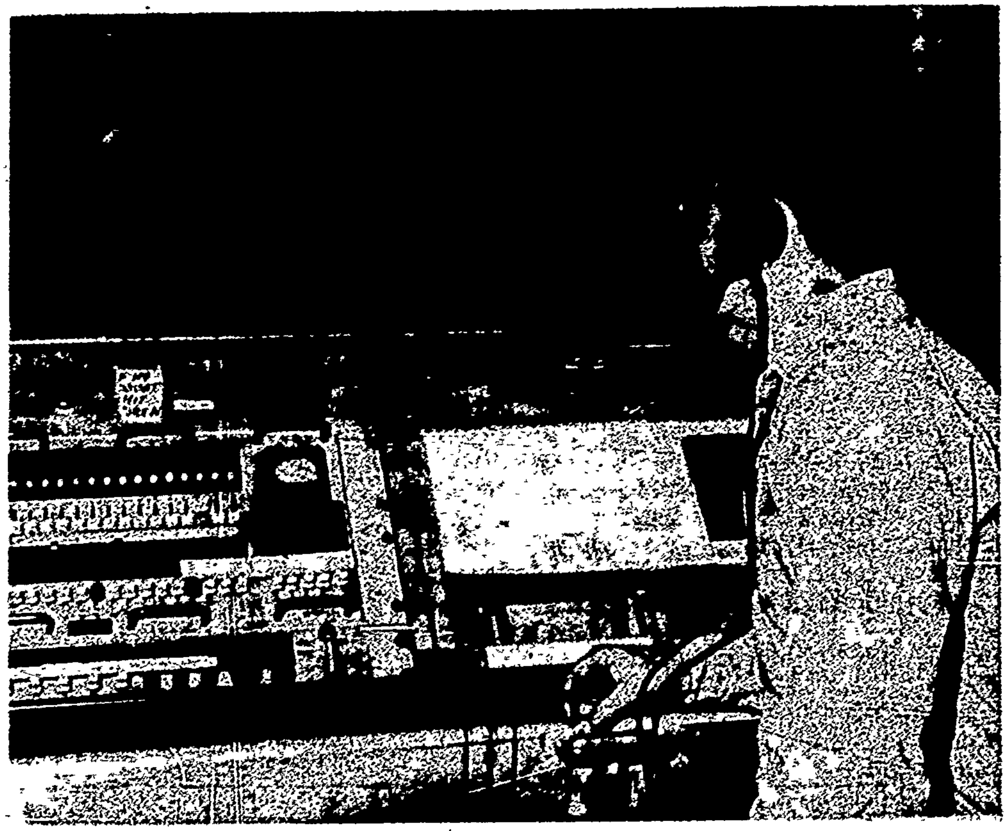

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Figure 9-4.—AN/FSA-52 installation and auxiliary equipment.

As can be seen, this particular piece of equipment is extremely adaptable for use in either the control tower or a radar control room.

A controller's position would normally consist of a minimum of four modules: a speaker amplifier, console amplifier, radiophone switch (TX/RX), and interphone switch with additional radiophone (TX/RX) modules installed as required.

All pushbuttons are the lighted transparent colored lens type with provisions for identifying frequency, channel number, position, etc. The console amplifier contains a dimmer switch to control the intensity of these lights. (See fig. 9-6.)

To operate, select the desired frequency and depress the appropriate XMTR SEL button (green) on the radiophone module. This light will then glow a steady bright. If the desired frequency button glows at half brilliance before being depressed, this indicates that it is in use by another controller or the supervisor; if depressed, a busy signal is heard in the headset and the light will flash brightly.

Receiver audio will be heard in the headset when the HEADSET/SPRK button (white) is not depressed; to transfer the receiver to the speaker merely depress this button and adjust the speaker level control for the loudness desired.

If it is desired only to monitor a particular frequency, simply depress the RCVR/MON button (yellow). With the button pushed in the light will glow at half brilliance.

Operation of the interphone system (fig. 9-6) is equally as simple; to call another controller or the supervisor, depress the CALL button (red) for the station desired and the lamp will light. The HEADSET/SPKR button operates in the same manner as previously described for the radiophone section.

The monitor button (red) has a momentary push button feature which allows the controller to listen to incoming calls. This light is illuminated when another station is calling.

Adjustment of headphone volume and microphone level is accomplished by utilization of the controls located on the console amplifier.

In addition to the controls listed on the controller's console, the supervisor has the ability to ascertain which controller is utilizing a particular frequency, what channels the controller has been programed for, and a provision to call all controllers simultaneously on the interphone.

The jackbox (fig. 9-7) is used in conjunction with the AN/FSA-52 and AN/FSA-58 communications equipment. It provides two jacks for the headset, one marked RADIO ONLY and the other marked RADIO-TELCO. For operation without landlines installed in the system, the headset would be plugged into the RADIO ONLY jack. When landlines are wired into the console and a controller requires access to them in addition to the normal radiophone channels, he would plug his headset into the RADIO-TELCO jack. The jackbox is equipped with a switch which allows the controller to change between radiophone and landline circuits. A green light

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Figure 9-5.—Control tower layout.

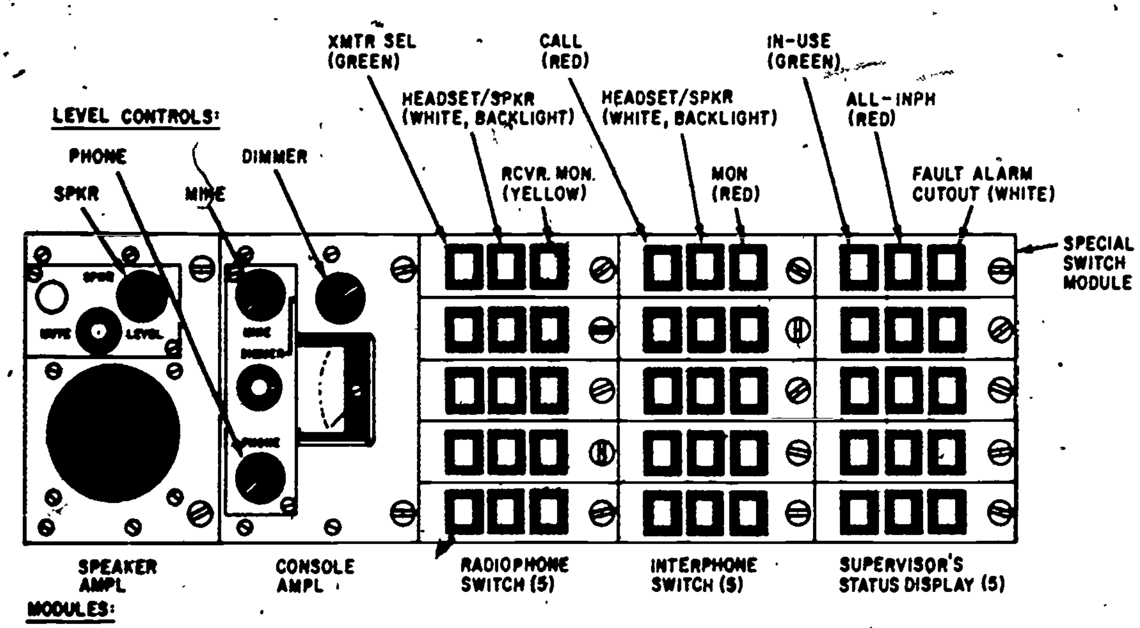

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Figure 9-6.—AN/FSA-58 controller's communication console.

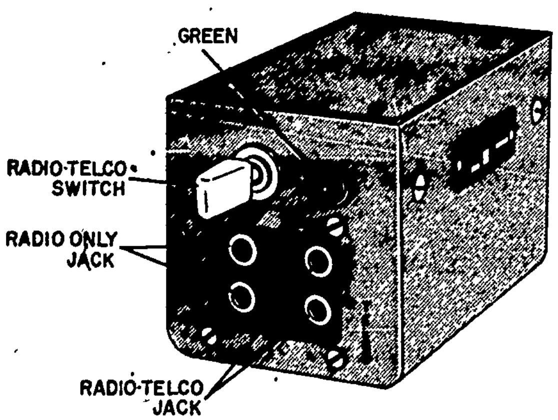

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Figure 9-7.—AN/FSA-52 and AN/FSA-58 communications jackbox.

located on the jackbox unit will glow when the switch is in the TELCO position. With the switch in the RADIO position any received audio will be heard in the headset while it will be transferred to the speaker when the switch is placed in the TELCO position.

Standard-type headsets and a foot-operated switch (figs. 9-4 and 9-5) are utilized with the AN/FSA-58 communications equipment.

MICROPHONES

A microphone is essentially an energy converter that changes sound energy into corresponding electrical energy. When one speaks into a microphone, the audio pressure waves strike the diaphragm of the microphone and cause it to move in and out in accordance with the instantaneous pressure delivered to it. The diaphragm is attached to a device that causes current to flow in proportion to the instantaneous pressure applied to the diaphragm.

TYPES

There are two types of microphones in use today by ATC facilities; they are the hand-held type (fig. 9-8) and the headset type (fig. 9-9). Both types should be placed directly in front of the mouth, within one-half inch or almost touching the lips. Most hand-held microphones are relatively inefficient, and the slightest variation of microphone position can drastically reduce the intelligibility of the message being transmitted.

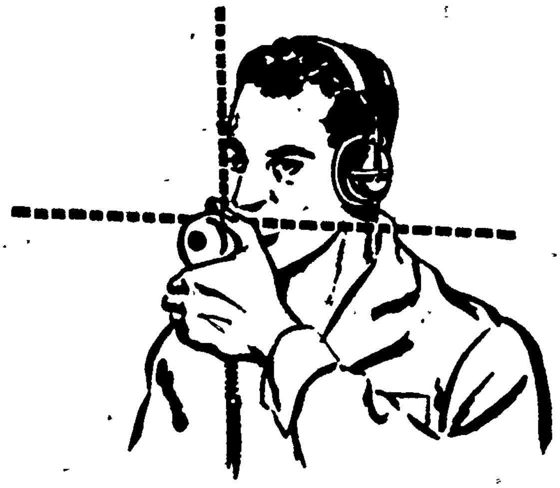

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Figure 9-8.—Hand-held microphone.

A newer style headset is being incorporated in ATC facilities as the older, but still reliable, telephone operator style needs replacing. It is very light in weight and construction and fits comfortably behind the ear. (See fig. 9-10.)

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Figure 9-9.—Headset microphone.

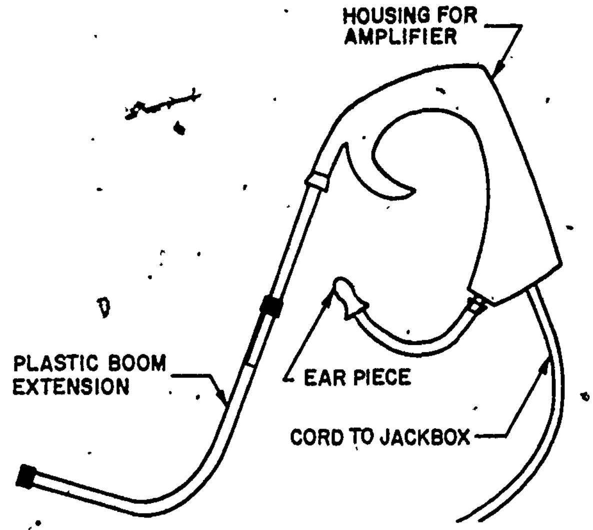

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Figure 9-10.—Lightweight headset microphone.

TECHNIQUES

Proper microphone technique is important in radiotelephone communications. Transmissions should be concise and in a normal conversational tone. Consider the following suggestions for proper technique: Speak clearly and distinctly; avoid extremes of voice pitch; be natural; use standard phraseologies to the maximum extent practicable, but do not be afraid to use plain language where no precedence has been set; shield your mike from outside noises; keep your mike a sufficient distance from an associated speaker to avoid acoustical feedback.

In radiotelephone communications, the operator of the equipment becomes part of the system. The manner in which the message is delivered determines the effectiveness of the transmitted signal as well as the power and efficiency of the equipment. Figure 9-8 and 9-9 illustrate correct technique for hand-held and boom or headset-type microphones, respectively.

VOICE RECORDERS AND REPRODUCERS

The purpose of recorders in air traffic control facilities is to record conversations

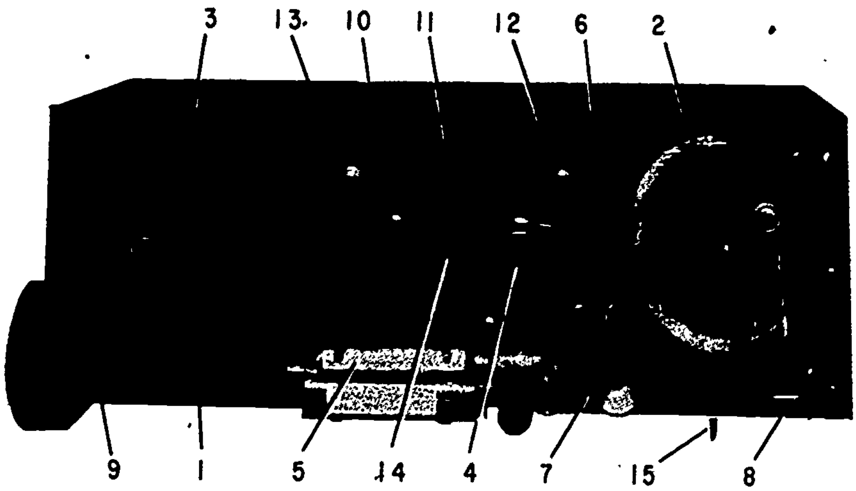

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Figure 9-11.—RD-217/UNH front panel controls.

between controllers and aircraft. These recordings of control instructions become a record of the many conversations that take place between pilot and controllers and between pilots of separate aircraft.

They are used for aircraft accident analysis; checks on circuit discipline; analyzing adequacy and accuracy of air traffic control instructions; immediate playback for assistance in search and rescue; and for voice training of air traffic control personnel.

All radio circuits used for the control of air traffic shall be recorded continuously during hours of operation. Operator position recording is normally employed; however, the following frequencies shall be recorded independently:

1. UHF Emergency
2. VHF Emergency
3. UHF Primary (local VFR control)
4. UHF Primary (approach control)

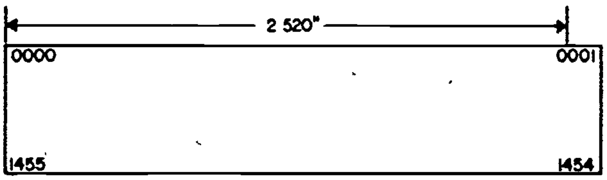
VOICE RECORDER-REPRODUCER RD-217/UNH

The RD-217/UNH (Sound-Scriber Model S-124) Single Channel Recorder/Reproducer (fig. 9-11) is being replaced by the RD-379(V)/UNH ten-channel recorder-reproducer (discussed later in this chapter) as monies become available. Because of this, only a brief orientation on the operation and control of the RD-217/UNH will be given in the Rate Training Manual.

Operation and Control

Supplement this description by studying the Sound-Scriber Service Manual sent with the recorder in order to familiarize yourself with the capabilities and limitations of the recorder.

The RD-217/UNH Single Channel Magnetic Tape Recorder-Reproducer has been engineered and designed to perform the specific task of



201.25
Figure 9-12.—Portion of magnetic tape.

continuously recording any desired communication signal over any period of time up to 24 hours without tape change. In addition, the time in minutes from 0000 to 1455 (24 hours, plus a 15-minute overtime allowance) has been precision-printed on the visible side of the tape as it moves past the recording head.

All the controls of the magnetic tape recorder (except the automatic volume control switch) are conveniently located on the front panel. (See fig. 9-11.) Study the service manual for complete procedures as to the proper methods to follow when tapes are to be changed or when playback is desired.

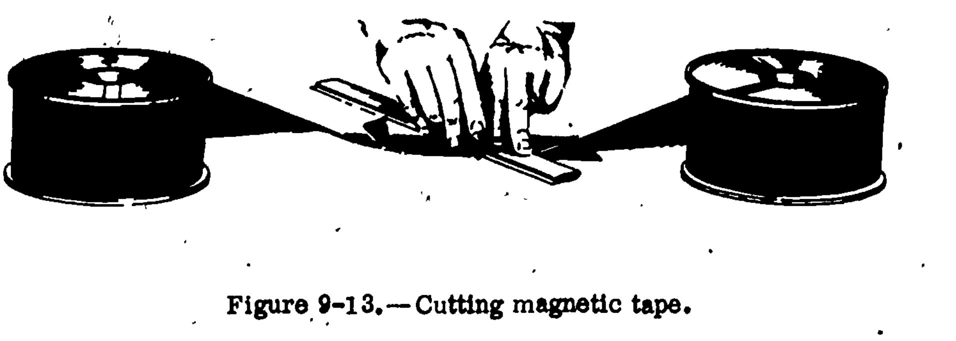
The recording medium is a brown magnetic tape wound on a 3 3/4-inch diameter plastic reel with the coated side wound toward the inside. Each tape is 2 inches wide and approximately 312 feet long.

There are two time scales on each reel of tape. To permit easy location of recorded material, the uncoated side is stamped in minutes to provide a time scale. This scale starts at 0000 minutes at one end of the tape and is stamped, along its length, a total of 1,455 minutes. (See fig. 9-12.) The time scale that is right side up as the operator faces the recorder is the one being used. In order to locate a specific portion of the recording, it is necessary to convert the number to time. If the number is 0200, it indicates that 200 minutes have elapsed since the tape was actuated. The conversion formulas are:. If you have the number, divide by 60; if you have the time in hours, multiply by 60 and add the minutes.

Recorded material can be stored under normal conditions for an indefinite period of time without magnetic deterioration. The ideal site for both the recorder and the spare tapes is a room where dust and dirt are at a minimum, the temperature ranges between 60° to 75°F, and the relative humidity is 60 percent or less. The tapes can be used over and over for recording by erasing the recorded material. To erase the recorded material, a demagnetizer is used.

The Chief of Naval Operations requires all air traffic control facilities to keep their recorded reels on file for a period of 10 days before erasing. However, in some instances a length of recorded material needs to be kept longer than the required time. In this case, the desired portion of the tape can be removed and another piece of tape the same length spliced in its place.

Each air traffic control facility has a maintenance kit supplied with each recorder. Within this kit are two reels of splicing tape. To splice the tape, place the ends of the tape that are to be spliced together, cut the tape at a 60-degree angle using a straightedge and razor blade or similar device and make sure that the cutting device is not magnetized. (See fig. 9-13.) Align both ends of the tape with the uncoated side of the tape up and cover the aligned ends of the tape with the splicing tape. The splicing tape should be allowed to protrude over the edges of the tape and should not be stretched, as stretching will cause it to curl. Apply pressure to the splicing tape with the thumbnail or a smooth object, then remove the excess tape with nonmagnetic scissors.



201.26
Figure 9-13.—Cutting magnetic tape.

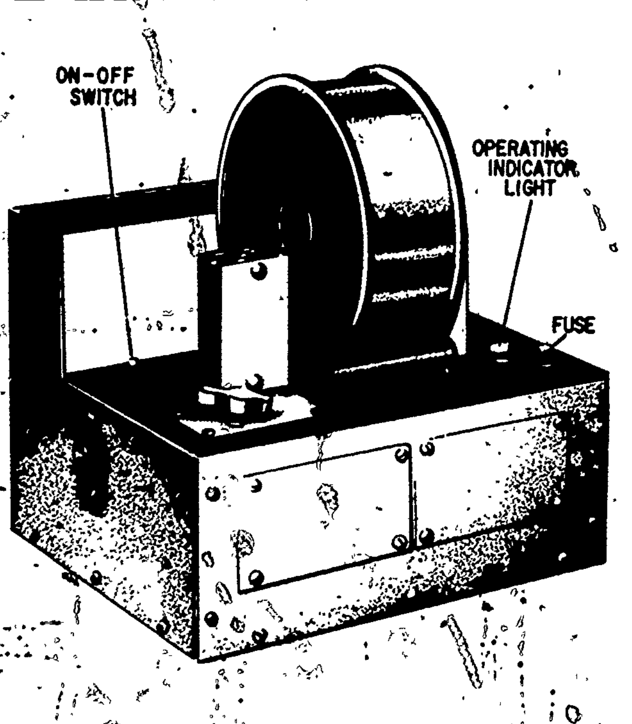


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Figure 9-14.—Demagnetizer.

DEMAGNETIZER

The demagnetizer is a portable unit contained in an aluminum cabinet. The demagnetizer is designed to erase the recorded material from a complete reel of tape. (See fig. 9-14 for an illustration and controls of the demagnetizer.)

To demagnetize a reel of tape, hold the power switch of the demagnetizer in the ON position until the neon light becomes bright, then place the reel of tape on the rollers. After the reel is placed on the rollers, rotate the reel three complete turns. After the turns are complete, slowly remove the reel from the demagnetizer and release the power switch. Be sure that the power switch is NOT released before removing the reel. If this is not done properly, a loud swishing background noise will be heard when this reel is played back after it has been used for recording again. To complete this procedure of erasing, the tape should remain in the demagnetizer approximately 10 seconds, but in no case should it be left in the demagnetizer in excess of 15 seconds.

SAFETY PRECAUTIONS

Both the recorder and the demagnetizer employ voltages which are extremely dangerous if contacted by operating personnel. Operating personnel must at all times observe applicable safety regulations when using or working with this equipment. If the magnetic tape recorder is to be permanently located in one spot, ground the chassis of the machine to a good earth connection. Because of the high voltage generated by the demagnetizer, it must be grounded. NEVER operate the demagnetizer without a proper ground. A very strong magnetic field is created by the two poles of the demagnetizer. Be careful not to place any delicate instrument close to this field.

VOICE RECORDER-REPRODUCER RD-379(V)/UNH

The magnetic tape recorder-reproducer, (fig. 9-15), referred to hereafter as the unit, is an audio-frequency, solid-state, magnetic-tape recording system which can make simultaneous recordings of up to ten channels of audio information. Information stored on the tape may be played back through the reproducer head at the recording site, or the tape may be removed and played back on the separate reproducer RP-214(V)/UN. (See fig. 9-16.)

The unit contains two identical tape transport assemblies, one of which is always kept in a standby condition. A fail-safe control tone is continuously recorded and reproduced at a level well below that of the desired voice recording. If the reproduce head fails to pick up this signal (such as, when the tape breaks), recording is automatically switched from the operating transport to the standby transport. When this happens, a loud audio alarm activates at the recording site. This alarm can be extinguished only at the recording site, thus allowing the cause of the alarm to be corrected immediately.

A shorting tap generates a control signal when most of the tape has been used and this signal switches the recording from the used-up transport to the standby transport.

New tapes may easily be loaded on the transports; whenever the recorded information is no longer required (normally ten days), the tape will automatically be erased as it is used for making a new recording. Any one of the ten channels can be individually monitored on either of the two transports. A rotary switch allows the operator to monitor either the

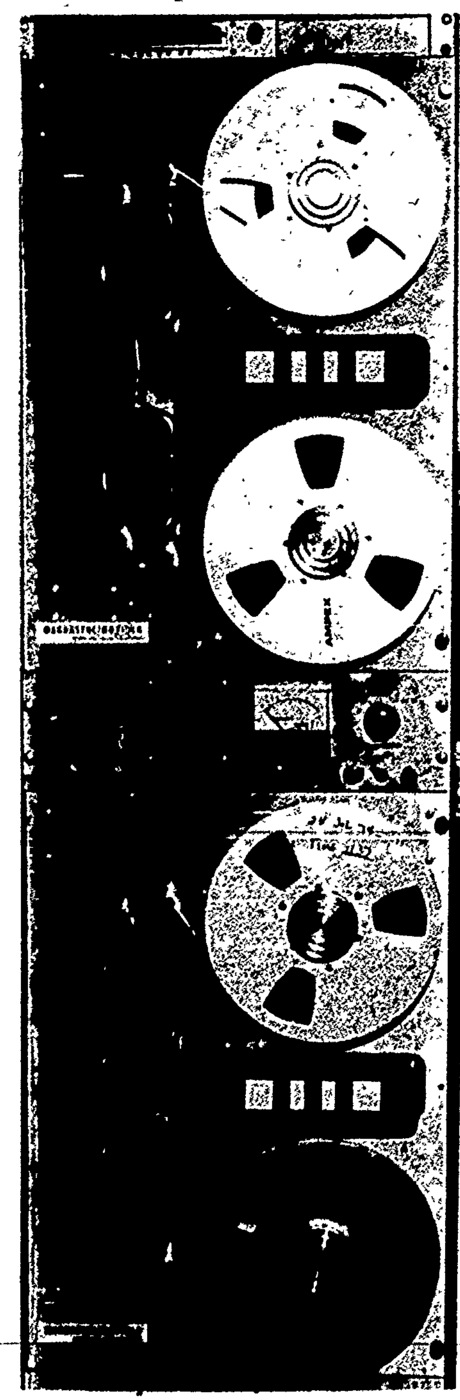

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Figure 9-15.—Voice recorder-reproducer RD-379(V)/UNH.

incoming signal or the reproduced signal (which occurs approximately four seconds after the recording is made).

As previously stated, up to ten channels of data may be recorded. It is normal practice to use one of these channels to record an audio time announcement. This recorded time signal is displayed in DAYS-HOURS-MINUTES-SECONDS.

For complete operating instructions in tape handling and loading procedures, consult section three of the RD-379(V)/UNH technical manual.

VOICE REPRODUCER RP-214(V)/UN

The magnetic tape reproducer is a portable, audio-frequency, solid-state, magnetic tape reproducing machine with a 10-channel capability. This unit (see fig. 9-16) is able to reproduce any three channels simultaneously and monitor them on a loudspeaker or electrical headset. Normal playback speed is 15/32 ips. Fast-forward and rewind speed of 150 ips (minimum) enables cueing and searching for specific parts of the recorded tape. Searching for a portion of recorded information is extremely easy. All you need to know is the time that the incident happened and search for it by using the recorded time announcement displayed in the window located at the top of the reproducer. All controls are located on two panels facing the operator.

For complete operating instructions on tape handling and loading procedures, consult section three of RP-214(V)/UN technical manual.

WIND INDICATOR

Wind direction and wind velocity indicators are mounted in the control tower to provide controllers with first-hand wind information in order to select the proper runway to use during specified wind conditions. They provide a method for prompt issuance of wind directions and velocities to pilots by controllers. Also, the controller may note a marked increase in velocity, gustiness, or a wind shift that, if relayed immediately to the weather service personnel, may be significant of impending or approaching weather changes. These instruments are of several sizes and mounted in various ways in the tower.

Normally the meteorological instruments located in the tower are "slaves" to the equipment

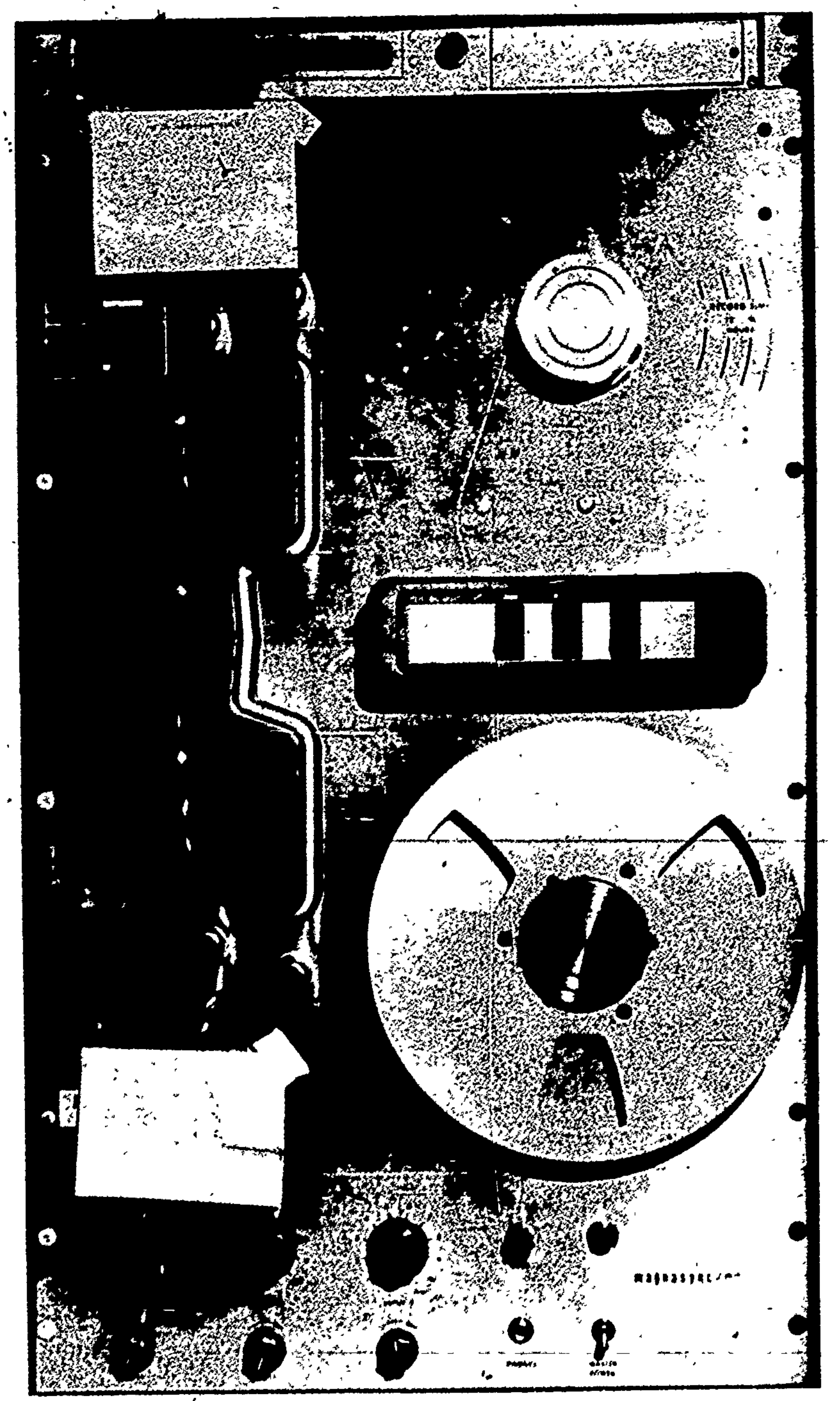

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Figure 9-16.— Voice reproducer RP-214(V)/UN.

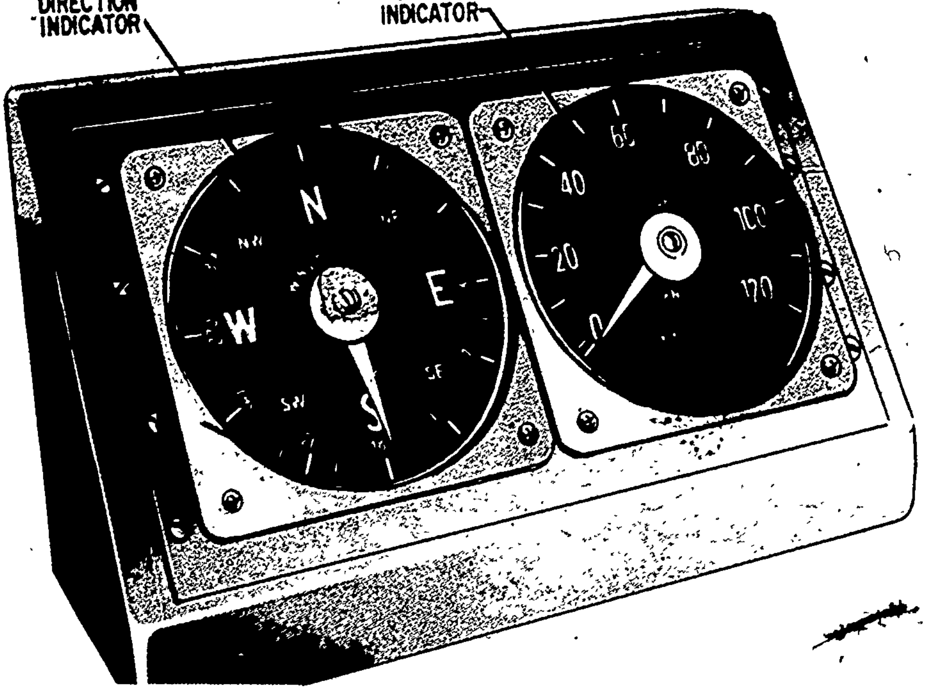

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Figure 9-17.—ID-586/UMQ-5 wind direction and speed indicator.

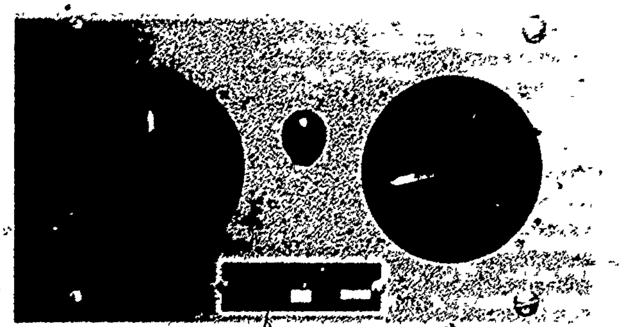

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Figure 9-18.—ID-1649/UM wind direction and speed indicator.

in the meteorological office. The wind direction received in the weather office on the "master set" is "true" direction. On the other hand, the directional instruments in the tower must be compensated for magnetic variation so that the controller reads "magnetic wind," which is what he relays to the pilot.

Figure 9-17 illustrates the ID-586/UMQ-5 wind direction and speed indicator which is installed in many Navy control towers.

The wind indicator readings in the control tower must be compared with weather service readings at the beginning of each working day, keeping in mind that weather service direction is true and variation must be applied to obtain a correct reading. If the wind indicator is in error plus or minus 5 degrees in direction or 5 knots in speed, weather service maintenance personnel must be notified so that corrective action can be taken. If the instrument is in error over 10 degrees or 10 knots, it is considered inoperative.

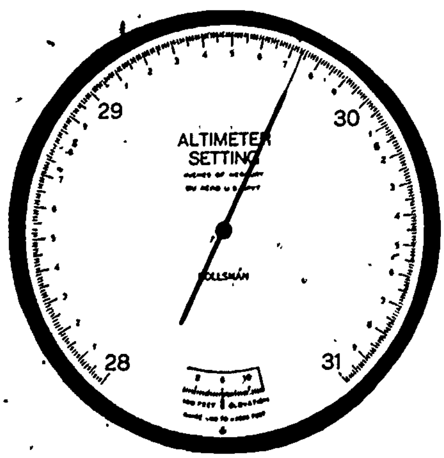
Figure 9-18 shows the ID-1649/UM wind direction and speed indicator which is utilized in Navy control towers as well as in many naval radar control facilities.

ALTIMETER SETTING INDICATOR

The altimeter setting indicator is a special form of aneroid barometer so designed that after installation and proper adjustment, the altimeter setting may be read directly from the scale of the instrument. (See fig. 9-19.) The instrument is designed to indicate the altimeter setting when the elevation scale is set to the actual elevation of the instrument above sea level. The mechanism is enclosed in a sealed case with provision for the connection of a venting tube leading to the outside free air.

The altimeter setting indicator is the primary means of obtaining altimeter settings at terminal facilities. The altimeter setting indicator reading must be compared with the official altimeter setting of the weather service between 0800 and 0900 (local time) each day. If there is an error in the instrument of 0.02 but less than 0.04 inch, the correction factor is written on the face of the instrument for application to readings issued until weather service maintenance personnel can check the instrument. If the error exceeds .04 inch, the instrument is considered inoperative. In both cases, maintenance personnel must be advised immediately. If the average windspeed is in excess of 40 knots at the time a correction factor is determined, the previously determined correction factor must be used until the average windspeed is less than 40 knots.

Figure 9-20 is a digital-type altimeter setting indicator that displays the current altimeter setting in 4 digits and is illuminated for ease of viewing.



201.29
Figure 9-19.—Altimeter setting indicator.

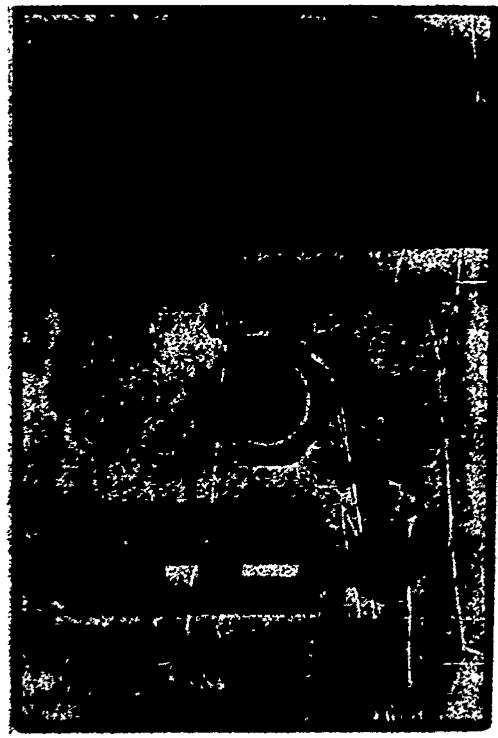


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Figure 9-20.—Digital altimeter setting indicator.

Initially the altimeter setting is obtained from a direct reading indicator (fig. 9-19) which may be located in a remote location such as a radar control room or the weather service office. This altimeter setting is then set into the master altimeter setting control panel (fig. 9-21) by adjusting the control knobs to the appropriate setting.

With this data set on the master control panel, display to all of the digital-type altimeter setting indicators is automatically accomplished. (See fig. 9-20.)

PORTABLE TRAFFIC LIGHT

The portable traffic light is used to control the movement of personnel and vehicles on the landing area and the landings and takeoffs of aircraft not equipped with radio. It is a directive light which emits an intense, narrow beam. Signals from the light are readily discernible to the pilot of any aircraft visible to the tower operator.

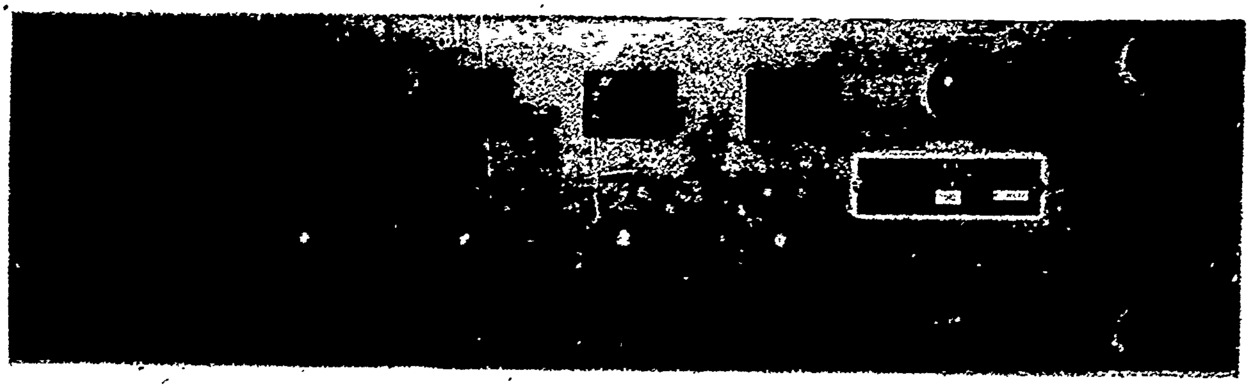

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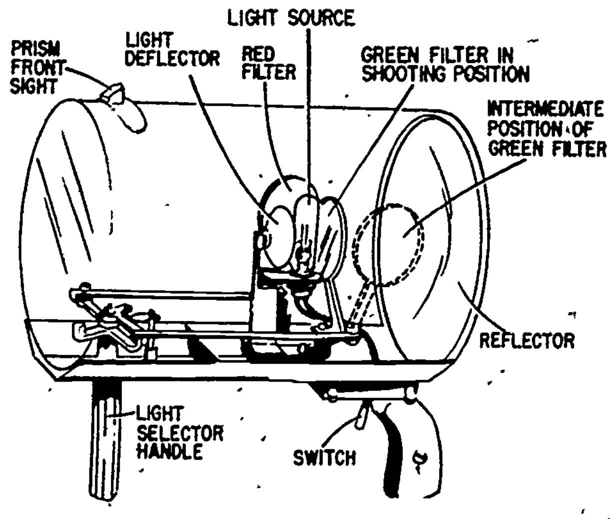
Figure 9-21.—Altimeter setting control panel.

The portable traffic light most commonly used (fig. 9-22) consists of a mica composition case, a reflector mounted inside at the back, a mechanism for controlling a choice of three different colored lights, and a socket for a light bulb. The light selector mechanism consists of two filters, one red and one green, mounted vertically on two arms that extend into a horizontal position from the front to the back. These arms are connected to the light selector handle underneath the case, thus enabling the operator to select the appropriate color. In addition, the selector handle aids in aiming the light. By turning this handle fully clockwise, the red filter is in place, giving a red light; fully counterclockwise puts the green filter in place.

The intermediate position, in which neither filter is in place (both at the side of the case), produces the clear or white light. The switch that controls the light is in a pistol-type grip located toward the rear of the light underneath the case. The switch is a spring-loaded toggle switch that automatically opens the circuit when released. This feature enables the operator to flash the selected color or to hold the toggle switch down when a steady color is desired. The portable traffic light is normally installed in control towers from overhead by means of a cable on pulleys and counterbalanced by weights. This keeps the light within reach for the controller's [illegible] and in an out-of-the-way position when not in use.

The Air Controlman should be thoroughly familiar with the limitations of the traffic



201.33

Figure 9-22.—Portable traffic control light.

control light, and evaluate its capabilities in connection with its use. The traffic control light has a range of 15 miles at night and 10 miles during daylight hours. It has the following advantages:

1. Requires no radio equipment in the aircraft; therefore, all aircraft can be controlled whether or not they possess a radio.

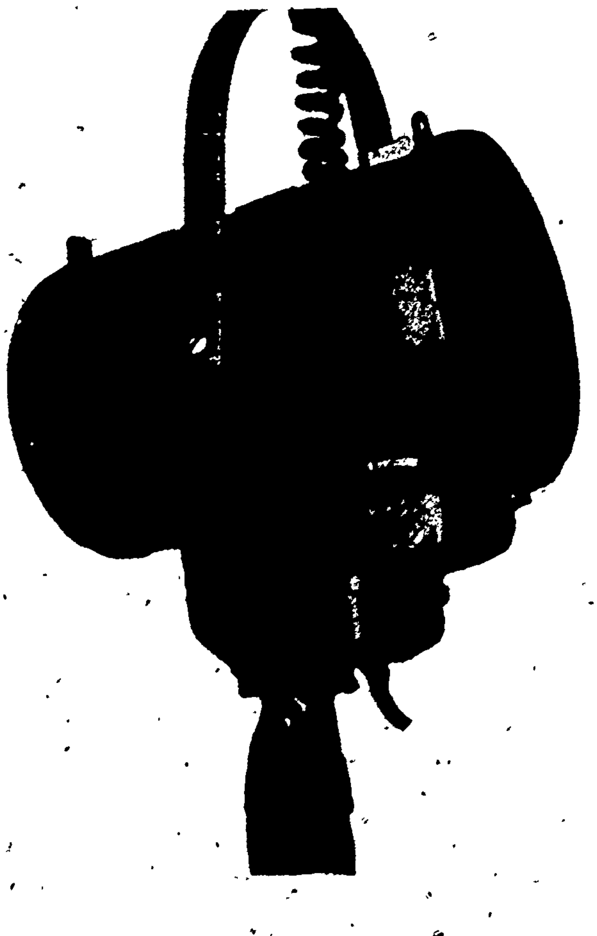
2. Provides an emergency method of control in event of radio failure—either in the tower or the aircraft.

It has the following disadvantages:

1. The pilot may not be looking at the control tower at the time a signal is directed toward him.
2. The information transmitted by a light signal is limited. One may transmit only an approval or disapproval of the pilot's anticipated actions to him since no explanatory or supplementary information can be transmitted.

The traffic control light is flight-checked at a distance of three miles around the airport at the lowest traffic pattern altitude. On the ground it must be clearly visible to the extremities of use.

The meaning of the traffic control light signals are referred to in chapter 11, figure 11-2 and table 11-1.



201.221
Figure 9-23.— Portable signal light gun.

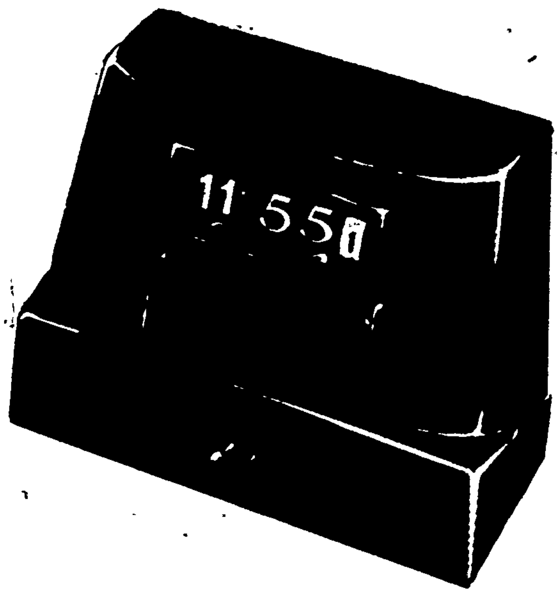


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Figure 9-24.—Direct-reading clock.

Figure 9-23 is an illustration of one of the newer type traffic control lights. Operating principles for this signal light are basically the same as for the one previously described.

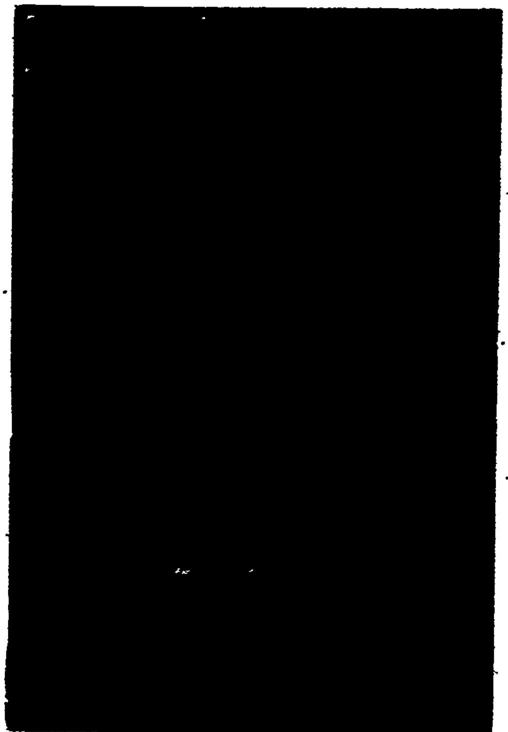
CLOCKS

Two basic types of clocks may be found in the control tower: the large 12-hour wall clock, or the small direct-reading counter-type clock in both the 12-hour and 24-hour version, which also has a quarter-minute drum. (See fig. 9-24.) Some stations have a date-time stamp clock which is most useful for maintaining exact records of the time occurrence of events. Regardless of what type of timing device is utilized, it must be kept accurate at all times.

One of the newer type clock display units is shown in figure 9-25.

This type of time indicator is remotely controlled by receiving an input from a master clock which can be located within the ATC facility building.

The time is displayed on the indicator in hours, minutes, and quarter minutes and is



201.222

Figure 9-25.—Time indicator unit.

illuminated in the same manner as the digital-type altimeter setting indicator.

Time checks are obtained from a reliable source, and corrections to the master clock are made as necessary.

NAVAID MONITORS

A malfunction of navaid equipment could place a pilot in a critical position; therefore, it is necessary that some automatic means be provided for continuously checking a navaid system.

Normally, the control tower is responsible for monitoring navaids at an air station. This is accomplished by electronic navaid monitoring devices located in the tower. Most monitor equipment is similar in that it provides both a light and an aural alarm to indicate that a particular navaid is malfunctioning. Some monitor equipment provides for an automatic change-over to standby navaid equipment when the main system has failed. Other equipment requires that the standby equipment be "dialed" on, which is a method similar to dialing a telephone with certain codes being dialed for certain functions.

When an alarm system of a navaid monitoring device goes off, the Air Controlman on duty in the tower should attempt to get the standby equipment in operation, if not automatic. Then he should notify the technician responsible for maintenance of the navaid equipment to provide for rapid repairs.

If the navaid has to be shut down or is unreliable, control tower personnel should immediately notify the appropriate persons or facilities, which are determined locally. These generally include the duty section leader, the appropriate duty officer, the technician who will repair the equipment, the associated approach control if not located in the tower, and the ARTCC in whose area of responsibility the station is located.

Figure 9-26 is an example of an air traffic control console for monitoring navaids. Basically the AN/GSA-35 in figure 9-26 provides facilities to perform the following functions:

1. Monitor and display the status of TACAN, VOR, and UHF HOMER transmitters at remote locations.
2. Establish voice communications between the console and the remote location.
3. Provide manual control of TACAN, VOR, and UHF HOMER transmitters, using the telephone dial.
4. Provide a visual and aural alarm should failure occur at the transmitter location.
5. Voice modulate the VOR and UHF HOMER transmitters.
6. Shut down or restore to operation any, or all, of the transmitters at the transmitter locations.

The control panel on the AN/GSA-35 is divided into four modular subpanels. Three of the subpanels contain the necessary switches and lamps to control and monitor a particular navaid transmitter. The subpanel on the left of the console is a dial control panel which is used in conjunction with the other subpanels to perform the required functions.

Where an indication of navaid status is required at positions other than the location of the main console, a remote indicator illustrated in figure 9-27 may be installed to provide a

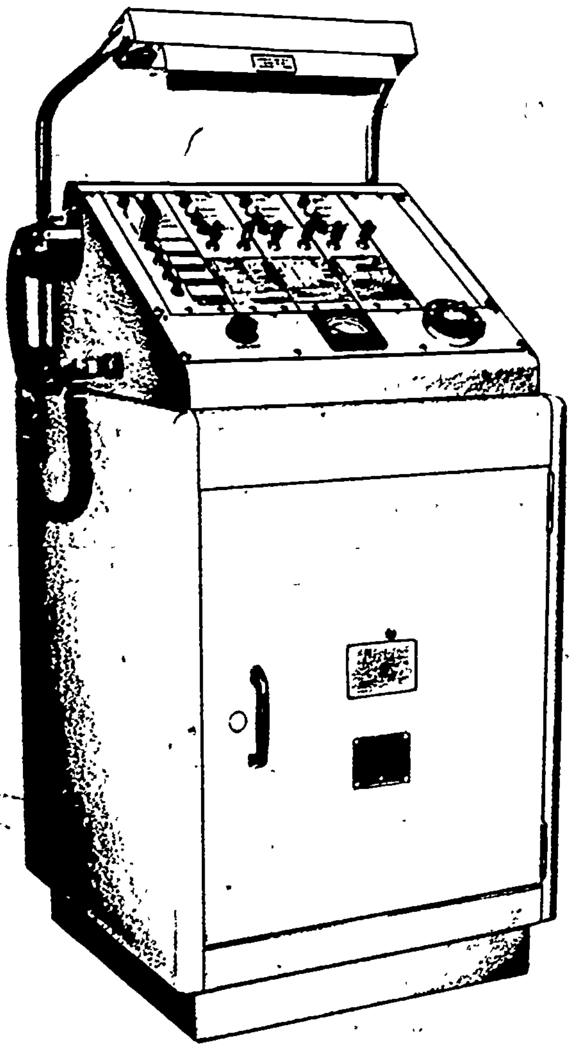


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Figure 9-26.—AN/GSA-35 air traffic control console.

slave indication from the main console. The navaid descriptions on the left side of the remote indicator are lighted continuously, and the adjacent OFF is lighted when that particular navaid goes off the air.

RUNWAY VISUAL RANGE (RVR) INDICATOR

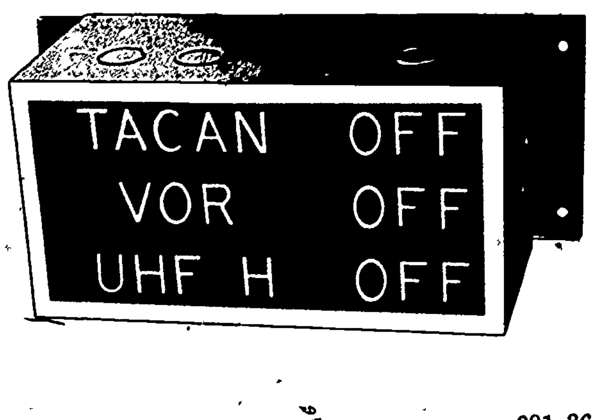
The RVR (transmissometer) system works in conjunction with the operation of the runway lights and is normally set to operate when the tower operator selects step three, four, or five on his runway brightness-control panel. RVR is an instrumentally derived value that represents the horizontal distance a pilot will see down the runway from the approach end. RVR may be used by the tower, in lieu of the reported visibility by the observer, in the approval of straight-in instrument approach procedures, and takeoff minimums.

THEORY OF OPERATION

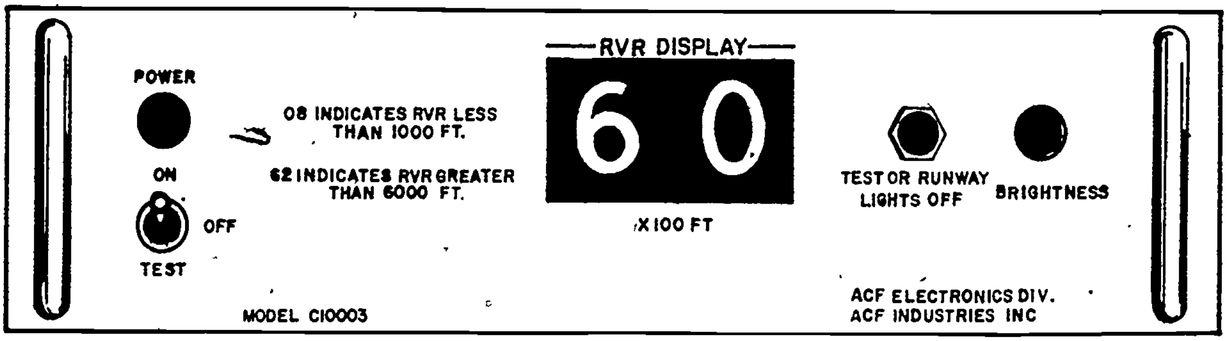
The transmissometer AN/GMQ-10 provides data for the computation of Runway Visual Range (RVR). The transmissometer supplies light transmittance signals in the form of pulse rates. These pulse rates are transmitted to the RVR converter where they are correlated with the empirically obtained RVR data encoded therein. The corresponding RVR value is then displayed by the RVR displays once every minute.

The system is designed to convert the transmittance pulse rates to their corresponding RVR values with a high degree of accuracy. They are based on a 500-foot baseline between the transmissometer projector and receiver.

The RVR values are displayed digitally (see fig. 9-28) in increments of 200 feet ranging from 1,000 to 6,000 feet. Values less than 1,000 and greater than 6,000 feet are displayed as 800 feet and 6,200 feet, respectively. Actually, the RVR values are displayed as two-digit numbers which should be multiplied by a factor of 100 in order to obtain the correct reading. When the equipment is tested or the runway lights are



201.36
Figure 9-27.—Remote navaid status indicator.



201.37

Figure 9-28.—Runway visual range indicator.

OFF, the red light indicator on the display panel is ON. Consequently, the displayed values should not be accepted as true values of RVR.

DIGITAL DISPLAY INDICATOR

The Digital Display Indicator can be rack-mounted or placed on a desk top for convenience of the observer. It is also completely enclosed for protection against foreign objects. All controls are located on the front panel. Interconnection of the converter and display is made in the rear. The front panel controls are shown in figure 9-28 and perform the following functions:

1. ON-OFF-TEST switch. Applies ac power to unit in TEST position or in ON position when RVR Converter is turned on.

2. TEST or RUNWAY LIGHTS OFF Indicator. Illuminated indicator informs operator that equipment is either in a test condition or that no RVR curve for runway lighting has been selected.

3. BRIGHTNESS control. Adjusts the brightness of the RVR display.

Make sure that all cables are connected properly. Turn the BRIGHTNESS knob fully clockwise. The display screen should now be illuminated. The observer should wait 2 minutes before observing the displayed digits.

TOWER BRIGHT RADAR DISPLAY

The Bright RADAR Indicator-Tower Equipment, Model 1 is commonly referred to as BRITE-1, a term derived from the initial letters of the nomenclature and the model number. The BRITE-1 system was designed for use in control towers by the local controller. The volume of traffic in the terminal area has increased to the point where it has become difficult to rely only on visual control of traffic in the vicinity of major airports. Factors which serve as a basis for this problem and contribute directly to the requirement are varying visibility conditions, a wide range of approach speeds, and larger airport landing areas. It is the responsibility of the local controller to accurately sequence arriving VFR traffic with IFR arrivals, provide separation between IFR departures and IFR arrivals and successive IFR departures. He may also be responsible for providing separation between successive IFR arrivals inside the final approach fix. In the interest of efficiency, he must also take full advantage of minimum separation in releasing departing aircraft while maintaining a proper margin of safety. To effectively assist the local controller, a radar display is needed which is suitable in the varying light conditions existing in the tower cab. This display system will operate with inputs from the surveillance radar systems available to the ATC facility.

The BRITE-1 offers sufficient control and adjustment capability to provide complete use of the Air Surveillance Radar (ASR) capability and has the resolution and accuracy so that normal radar separation can be sustained between IFR departures and IFR arrivals, successive IFR departures, and at certain locations for successive arrivals inside the final approach fix. The display system is compact and capable of different mounting arrangements to permit installations in limited space and varied tower configurations. (See fig. 9-29.)

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Figure 9-29.—Bright Radar Indicator.

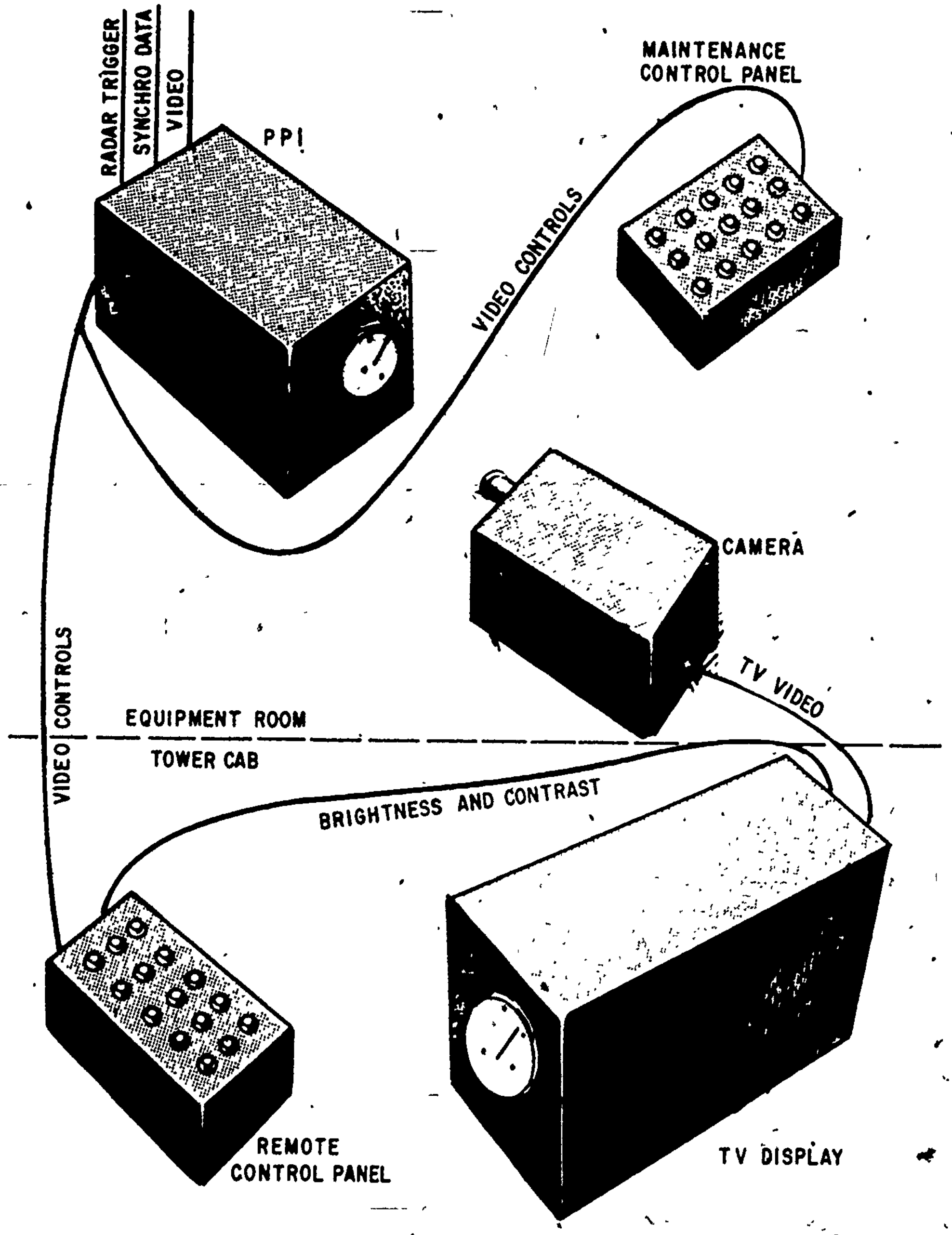

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Figure 9-30.—Isometric view of BRITE-1.

BASIC PRINCIPLES OF OPERATION

Refer to figure 9-30 for the following discussion. The BRITE-1 system is composed of five basic components. These include the TV Display Unit and the Remote Control Panel which are located in the tower cab and the Plan Position Indicator (PPI), TV Camera and Maintenance Control Panel located in the equipment room. The PPI receives radar information from the surveillance radar and presents

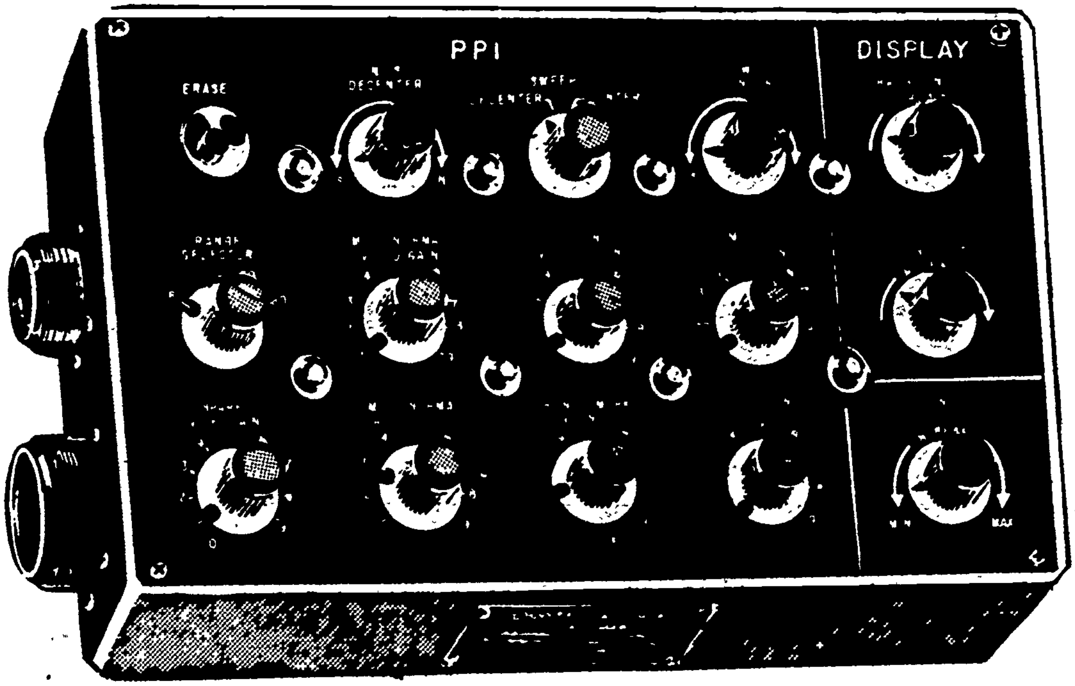

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Figure 9-31.—Remote control panel.

it on a 5-inch Cathode-Ray Tube (CRT) as a PPI presentation similar to the presentation seen on an ASR indicator. The TV camera is positioned at the proper distance to focus the light from the CRT onto the face of a vidicon tube (camera tube) which converts the light into TV video. This TV video is transmitted via coaxial cable to the TV display unit in the tower cab and presented on the 12-inch scope.

TV DISPLAY UNIT

The front of the TV display as shown in figure 9-29 contains the CRT bezel, power on-off switch, FOCUS, BRIGHTNESS, and CONTRAST controls. The rear of the unit contains a switch for local or remote operation, two indicating fuses, and maintenance related connectors. The LOCAL-REMOTE switch on the back of the display unit affects the BRIGHTNESS and CONTRAST controls only. This switch, in the LOCAL position, enables the operator to make adjustments in the brightness and/or contrast levels using the control knobs on the front of the TV display unit. When the switch is placed in the REMOTE position, the adjustments must be made from the operator's remote control panel. (See fig. 9-31.)

The FOCUS control feature also located on the front of the TV display unit cannot be "remoted" to any other location. It can alter the definition of the image being displayed but not beyond that which is established on the PPI and TV camera in the equipment room. Controllers should make no attempt to make focus adjustments since this is a maintenance function.

REMOTE CONTROL PANEL

The remote control is designed to be operated either on a desk top or recessed in a control console. (See fig. 9-31.) The control panel is an edge-lighted plastic panel consisting of a black surface engraved in translucent white letters which are illuminated for night viewing from eight removable recessed panel lamps. Light is transmitted from the panel lamps at the edges of the plastic surrounding the lamps throughout the body of the plastic and to the edges of the engraved lettering. A panel light control is provided to vary the intensity of the illumination of the lettering.

OPERATING INSTRUCTIONS

The operation of the BRITE-1 system is limited to the operation of the remote control panel as shown in figure 9-31. Perform the following procedural steps for the operation of the BRITE-1 system:

1. Adjust display BRIGHTNESS control until the raster (horizontal pattern of scanning lines) is just visible on the CRT.
2. Adjust CONTRAST control until noise is visible on the CRT.
3. Set RANGE SELECTOR switch to the desired range as follows:

RANGE SCALES	RANGE MARKS
6 NM range	2 NM range marks
10 NM range	2 NM range marks
20 NM range	5 NM range marks
30 NM range	5 NM range marks
60 NM range	5 NM range marks

4. Adjust RANGE MARK INTENSITY control until the range marks are just visible, or at the desired level.
5. Adjust MAP VIDEO GAIN control until the video map is just visible, or at the desired level.
6. Adjust Moving Target Indicator (MTI)/NORMAL GATE ADJUST control fully clockwise.
7. Adjust MTI/NORMAL VIDEO GAIN control until target appears and is stored on the display for the desired time.
8. Adjust BACKGROUND VIDEO control until the amount of normal video superimposed on the MTI presentation is the desired level for a background signal.
9. Repeat process in step 7 to adjust BEACON VIDEO GAIN. Also applicable to SPARE VIDEO GAIN control if this channel is in use.
10. Set DECENTER-CENTER switch to DECENTER if an off-centered display is desired.
11. Depress and adjust the N-S and/or E-W DECENTER controls to move the sweep origin to the desired location.
12. Depress ERASE button to clear display of undesired target trail information.
13. Adjust panel light to desired level.

OPERATING MAINTENANCE

The air traffic control tower is a primary link in the air control system. Peak efficiency can only be maintained by ensuring that all electric and electronic equipment is functioning at all times. Outages of power and malfunction of equipment will happen from time to time. Equipment performance checks and constant visual inspections of the tower equipments are necessary.

A good practice to follow is for each section, as it relieves the watch, to utilize some form of checkoff list. These checkoff lists should be completed as soon as possible (traffic conditions permitting) after going on watch. The list can be expanded or shortened as conditions warrant at any locality. Any malfunctions should be immediately brought to the attention of the electronics technicians normally assigned to the tower. Under no circumstances should a tower operator tamper with the adjustments, repair, or maintenance of the control tower equipment.

Another good practice to follow is to make periodic visual inspections of all the tower equipment. This can be accomplished during periods when traffic is light, and can be done in a matter of minutes. Any control tower equipment out of adjustment or otherwise inoperative creates hardships for yourself and your shipmates.

The maintenance, general appearance, and condition of the tower and equipment, including furniture and cleanliness of spaces, reflect directly upon the attitude and spirit of the personnel assigned. Generally, everyone has an area of responsibility under the watch supervisor or section leader. As with any task you are assigned, your actions and attitude toward menial tasks are making impressions on your senior petty officers, and willingness to cooperate and do a good job will not go unnoticed. Most towers require that certain cleaning functions must be completed prior to the change of watches; while details such as window washing are performed less frequently. Remember that towers are filled with valuable electrical and electronic equipment that must be kept clean and free of dust to perform at peak efficiency.

CHAPTER 10

AIRPORT TRAFFIC CONTROL AND AIRFIELD EQUIPMENT

AIRPORT LAYOUT

The Air Controlman must have a thorough knowledge of the airport layout, airfield markings, and airfield lighting equipment to effectively control traffic on and in the vicinity of the airport.

SELECTION OF SITE

Why did the Wright brothers journey from Ohio to Kitty Hawk, North Carolina, to conduct their early tests? They were selecting a site, and for a very good reason. Their primary concern in the selection of a site was the prevailing wind conditions. They knew from earlier experiments that their fragile and somewhat low-powered craft needed the advantage of a steady wind to become airborne. The site at Kitty Hawk offered such an advantage.

In the early days of aviation a smooth field at the edge of town served quite adequately as an airport. Then, as aircraft became heavier and faster, and with the advent of instrument flying, bigger and more elaborate facilities had to be constructed. The airport of today is much more complex than in the past, and many factors must be considered in selecting a site. Some of the major factors are adequate area, accessibility, weather conditions, and terrain.

Adequate Area

The site selected must afford a sufficient and suitable area for the required airport facilities. In the past years of aviation it was extremely difficult to accurately predict the rapid growth of aviation. Higher performance aircraft and the great volume of air traffic that grew so fast caused some airport areas to become inadequate very quickly. To add to the problem, cities and towns grew outward to meet the airport area. In planning the modern airport, careful consideration should be given to possible expansion in the future.

Accessibility

Another aim of site selection is to ensure that adequate supply routes are available either by land, water, or by air. Railroads and surrounding highways naturally simplify the supply problem. When an airport is planned to serve a metropolitan area, it is necessary to locate the airport where it is easily accessible to the city and still does not create a hazard in the congested areas.

Many Navy airports exist for the primary purpose of supporting the fleet. To best serve this need they must be easily accessible. Their easy accessibility contributes not only economically, but to the combat readiness of fleet units.

Weather Conditions

Prevailing weather conditions should also be considered. By checking past National Weather Service records of the area, future weather conditions can be predicted rather accurately. From an operational standpoint, some things to consider are the frequency, severity, and persistence of wind, fog, snow, and rainfall. Additional items to be considered are the need for snow removal equipment, number and type of instrument landing aids, and elaborate drainage construction in areas of heavy rainfall. These factors figure greatly in the cost of construction and maintenance of any airport.

Terrain

A site with favorable topography is one located on high ground with sufficient slope for natural drainage and a reasonably level surface. Rough or hilly terrain can easily become hazardous to low-flying aircraft operating from an airport. In addition, rugged terrain can increase considerably the cost of construction.

The proposed area should be flight-tested for planning approaches to future runways. Special attention should be given to the possibility of shifting wind, downdrafts, and the presence of air eddies that may affect these approaches. From these tests it may even be determined that the proposed site is not a suitable one.

FACILITIES

Throughout the development and construction of airports, facilities have become more standard in the Navy. In keeping with this standardization, further studies of considerable scope and magnitude are presently underway due to progress in the development of aircraft and related installations. The facilities aboard any military airport are many and varied. The Air Controlman must keep abreast of airport advances and the facilities that are available in order that he may properly handle and expedite air traffic.

Runways

A runway is that portion of the landing area, usually paved, upon which aircraft actually land and takeoff. Runway pavement is designed to meet rigid specifications under certain conditions and to resist jet blasts and fuel spillage. The number and orientation of runways are determined from an analysis of wind and other pertinent data.

Many variables must be considered, such as the number of taxiways required, types of instrument approaches available, type of aircraft operations, etc. When more than one runway is considered for an airport, the primary runway is determined by the direction of maximum wind coverage (prevailing wind) to facilitate landings and takeoffs into the wind. The secondary and subsequent runways are oriented to provide the greatest overall wind coverage. This plan is generally the most widely followed. However, adjustments may be required for surrounding developments, local terrain features, excessive construction problems, or alignment of an instrument runway to suit all weather conditions. At airports where the volume of traffic would be restricted by the availability of only one runway, parallel runways may be incorporated either in the original design or added later as necessary.

Factors which determine the length of the primary runway are the elevation of the field, mean maximum temperature, and the principal types of aircraft that will be operated from the field.

Runway length requirements are as follows:

Primary (Prop)	8,000 feet
Primary (Jet)	10,000 feet
Secondary runway	8,000 feet
Test facility	14,000 feet

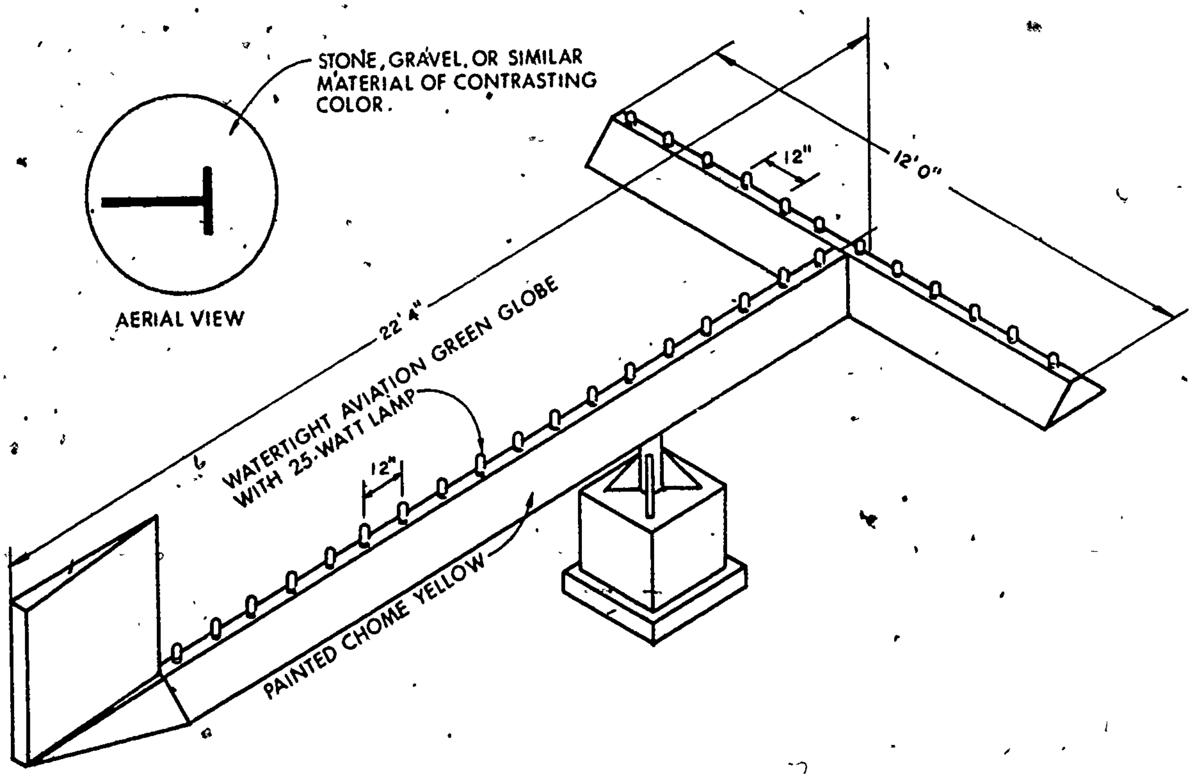
Runway widths are normally 200 feet.

It is realized that some of the Navy's airports do not currently meet the preceding standards, but it is anticipated that future construction and modernization of existing facilities will meet these requirements.

Runway Overrun Areas

These areas are usually unpaved, relatively smooth areas which extend beyond the ends of runways. A portion of this area is constructed of selected materials, compacted and stabilized. This stabilized area is essentially an extension of the runway. The primary purpose of this strip is to provide a reasonably effective deceleration area for aborting or overshooting aircraft. This area may also serve as an emergency all-weather access for firefighting, crash, and rescue equipment. Provisions are made at the upwind end of takeoff runways for a crash strip which is an extension beyond the overrun area. Takeoff runways are those runways whose takeoff usage exceeds 40 percent of total takeoffs. All obstructions are removed, and ditches, gullies, and embankments are leveled off into the general profile of the extended centerline of the runway to minimize damage to aircraft.

Some runways have paved overruns, and the area is marked with yellow chevrons across the area. With this type marking, it becomes a nontouchdown area. At some stations these areas are called blast pavements, used primarily to prevent erosion of runway ends from propeller and jet blast. They are usually made of highway paving material and do not have runway-bearing strength.



201.242

Figure 10-1.—Wind indicator (wind tee).

Taxiways

A taxiway is a specially prepared area, or lane, over which aircraft usually operate under their own power to and from the landing and parking areas. Taxiways are normally constructed to the same specifications as the runways except for dimensions. A warmup area, usually an expanded portion of the taxiway adjacent to the end of the runway, is used for aircraft holding, engine warmups, and checking aircraft instruments and radio equipment. In any event, the warmup area must be of sufficient dimensions to permit aircraft to hold at least 175 feet clear of the runway in use.

Parking Areas

These are hard-surfaced areas located in the vicinity of hangers for the purpose of parking, servicing, and loading aircraft. They are connected to the runways by taxiways, and normally padeyes are sunk into the surface for tying down aircraft during storm conditions.

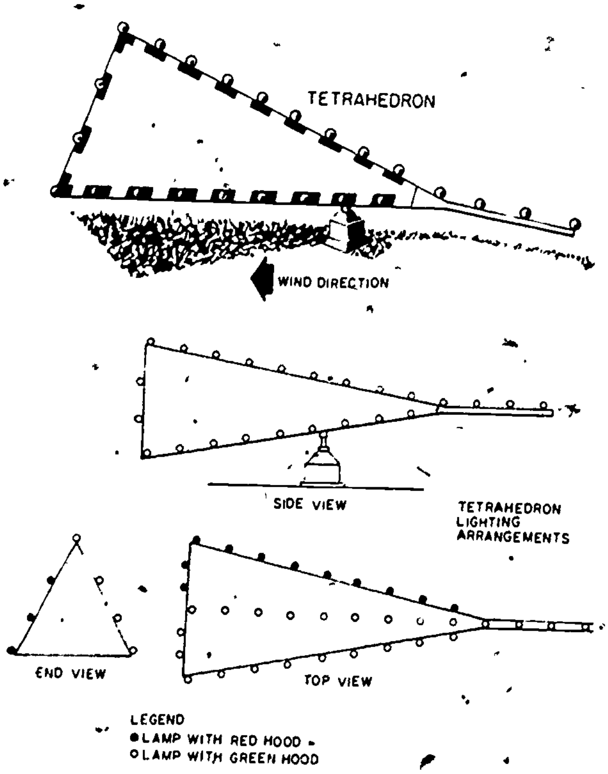
Wind Indicators

Wind tees, tetrahedrons, and wind cones are classified as wind indicators and need not be controllable when so used. The wind tee (fig. 10-1) is used as a navigational aid. It is lighted to provide continuous day and night indication of wind direction. The wind tee is capable of swinging in a 360-degree circle, subject only to the wind. The wind tee is located as near as practicable to the center of the runway layout configuration. It shall be sufficiently remote from large structures to give a true wind direction. Because of its size and weight, the wind tee shall not be located where it will present a possible obstruction hazard to flight operations.

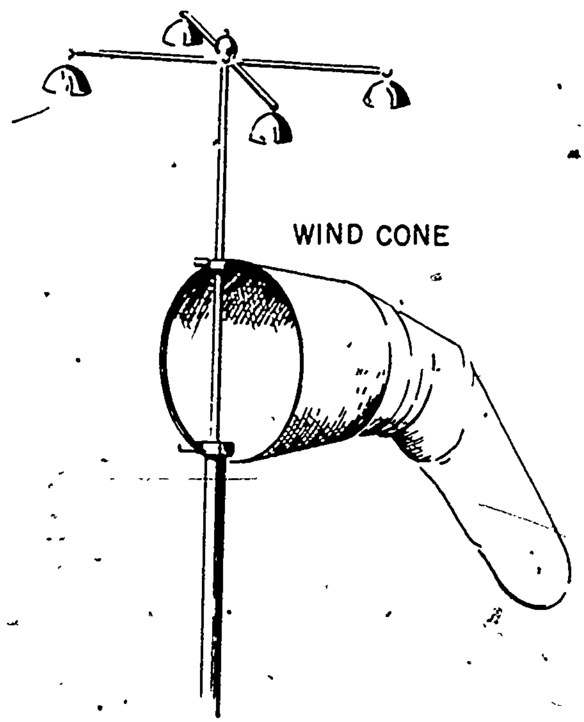
The wind tee is similar in outline to a small aircraft. It is mounted on a pedestal and will weathercock into the wind, thereby indicating the wind direction. This free swinging characteristic affords the pilot a visual presentation of the exact direction from which the wind is blowing. If the tee is not aligned perfectly with the runway being used, the pilot knows that he has to compensate his landing for a crosswind—the amount of compensation being roughly judged from the angle the tee is deviating from the centerline of the landing runway. Also, while taking off it is expedient for the pilot to have this same information.

The wind tee body and base shall be painted solid chrome yellow and lighted with thirty green lights to form a "T" when viewed from the air. A contrasting background (a 100-foot circular background) consisting of crushed stone, gravel, or similar material shall be used to retard the growth of vegetation, and spray-painted to provide a sharp contrast to the wind tee coloring.

The tetrahedron is the largest of the wind indicators. The ideal location for this indicator



201.135
Figure 10-2.—Wind indicator (tetrahedron).



201.136
Figure 10-3.—Wind indicator (wind cone).

is at a site easily visible from the ends of all runways. A 100-foot circular background of contrasting color, under the tetrahedron, increases the visibility of this indicator tremendously.

The tetrahedron is outlined at night by green lights on the starboard side and red lights on the port side, with green lights along the central ridge and spar. (See fig. 10-2.) Tetrahedron lights flashing between sunset and sunrise indicate that the ground visibility is less than 3 miles or the ceiling is less than 1,000 feet, or both. Normally, when this condition exists, VFR operations are suspended and IFR operations placed into effect.

Wind cones are normally installed at the approach end of all runways and provide the pilot with wind data for that particular point on the airport. (See fig. 10-3.)

The wind cone has the appearance of a large stocking minus the foot. It is made of light, durable fabric and is secured to a mast by means of a swivel on the hoop at the large end. Air in motion passing through the wind cone aligns the wind cone with the wind to indicate the direction from which the wind is blowing. The wind cone has an advantage over the wind tee in that besides indicating the direction, it also gives an approximation of wind velocity.

The velocity of the surface wind can be approximated by comparing the angle of the wind cone in its relation to the ground. The wind cone will stand out parallel with the ground when the wind is 15 to 20 knots. (A steady wind greater than 20 knots will give the same indication; hence, caution must be exercised if the wind cone is the only available reference.) A gusty wind is indicated when the windcone alternately rises and falls rapidly. A calm wind is indicated when the wind cone hangs limply at the mast. Gusty, shifting wind is denoted by the wind cone swinging from side to side and rising and falling.

The type of fabric from which the wind cone is constructed determines to a great extent how high it will rise in a given wind velocity. Thus, the fabric should be a standard type for all wind cone construction in order for consistent approximations of wind velocities to be made. The wind cone may be lighted for nighttime use.

Mat Facilities

The mat is a large, hard-surfaced area usually located near the center of the field or at a common intersection of runways. It is often used for the operation of small aircraft and facilitates the taking off and landing of several aircraft at the same time. The mat is especially useful where pilot training is being conducted. Load limits of mat areas are often less than the regular runways; therefore, Air Controlmen assigned to fields which have these facilities should be aware of their load limitations.

Compass Calibration Pad

An aircraft compass calibration pad is a paved area in a magnetically quiet area where the aircraft compass is calibrated. There are two types of calibration pads:

1. Type I is used with the magnetic compass calibration set.

2. Type II includes a compass rose and turntable and may be used either with or without the compass calibration set.

Either pad handles one aircraft at a time. A minimum of one pad is provided at each station; however, additional pads may be required based on local demand. The time required to calibrate one aircraft compass using the magnetic compass calibration set is two hours. When a Type II compass calibration pad is used without the magnetic compass calibration set, the time required is one hour.

The surface is marked every 15 degrees to indicate magnetic bearings beginning with magnetic north. The taxiway to the compass rose is generally placed perpendicular to the taxiway with the least traffic. All metal used in the construction is either brass or bronze because it will not affect magnetic instruments. Other metal objects should be kept clear of the area when the compass rose is in use. In calibrating an aircraft compass, all electrical equipment is turned on and the engines kept running to simulate actual flight conditions.

AIRFIELD PAVEMENT MARKING

Runway Markings

Runway numbers which appear near the approach end of all runways indicate the magnetic heading of the runway. The number assigned to a runway is one-tenth of the magnetic compass reading to the nearest whole number. This means that when a pilot lands toward the South with a compass reading of 168 degrees, he will be landing on runway 17. (If the last figure is 5 or more, select the next higher 10-degree increment.) In this example the nearest whole number is 170 degrees; so, by dropping the zero from 170 degrees the figure 17 is produced. This number will appear on the approach end of the runway.

If the inbound magnetic heading of a runway is less than 100 degrees, such as 070, 080, 090, etc., the first zero and the last zero are dropped, resulting in runways numbered 7, 8, and 9. (See fig. 10-4.)

At airports using multiple parallel runways L indicates left, R indicates right, and C indicates center. All numbers and letters are painted retroreflective white.

The runway centerline marking shall be a broken line with 120-foot dashes and 80-foot blank spaces. The minimum width of the basic runway centerline marking shall be one foot. The minimum width of the instrument runway centerline and the precision approach centerline marking shall be three feet, and the color shall be retroreflective white. (See fig. 10-4.) At intersecting runways, the runway marking of the highest precedence shall be displayed, and the other runway markings shall be interrupted. The following is the order of precedence:

1. All-weather runway
2. Instrument runway
3. Basic runway.

To aid further in takeoff and landing guidance, there are runway side stripes on the precision runway. The painting specifications are the same as the centerline except that the side stripes are solid instead of broken. (See fig. 10-4.) At intersections of two or more runways, the side stripes are continued on one runway only. Precedence for the continuous side strip is given to the primary runway.

RUNWAY THRESHOLD MARKINGS.—Runways 200 feet wide shall have ten stripes, each 12 feet wide by 150 feet long, separated by 3 feet except the middle space, which will be 16 feet between stripes. (See fig. 10-4.) For runways less than 200 feet wide, the threshold markings shall cover the width of the runway less 20 feet on both sides. Runways more than 200 feet wide shall have additional threshold stripes, still allowing 20 feet on both sides of the runway. The color for all threshold markings shall be retroreflective white.

DISPLACED RUNWAY THRESHOLD MARKINGS.—A displaced threshold is a threshold that is not at the beginning of the full strength runway pavement. Special markings are specified as follows. (See fig. 10-5.) Arrows 120 feet long with 80-foot spacing between arrows shall be painted on the unused end of the runway pavement pointing to the displaced threshold markings. The color shall be retroreflective white. Other markings applicable to the type of runway will be placed on the usable side of the threshold markings.

Runway distance markers shall be positioned on each side of the runway to inform pilots of the distance remaining on the runway in thousands of feet. Markers on the side of the runway shall be so located with respect to their companion markers on the opposite side. These markers shall be at right angles to the runway centerline.

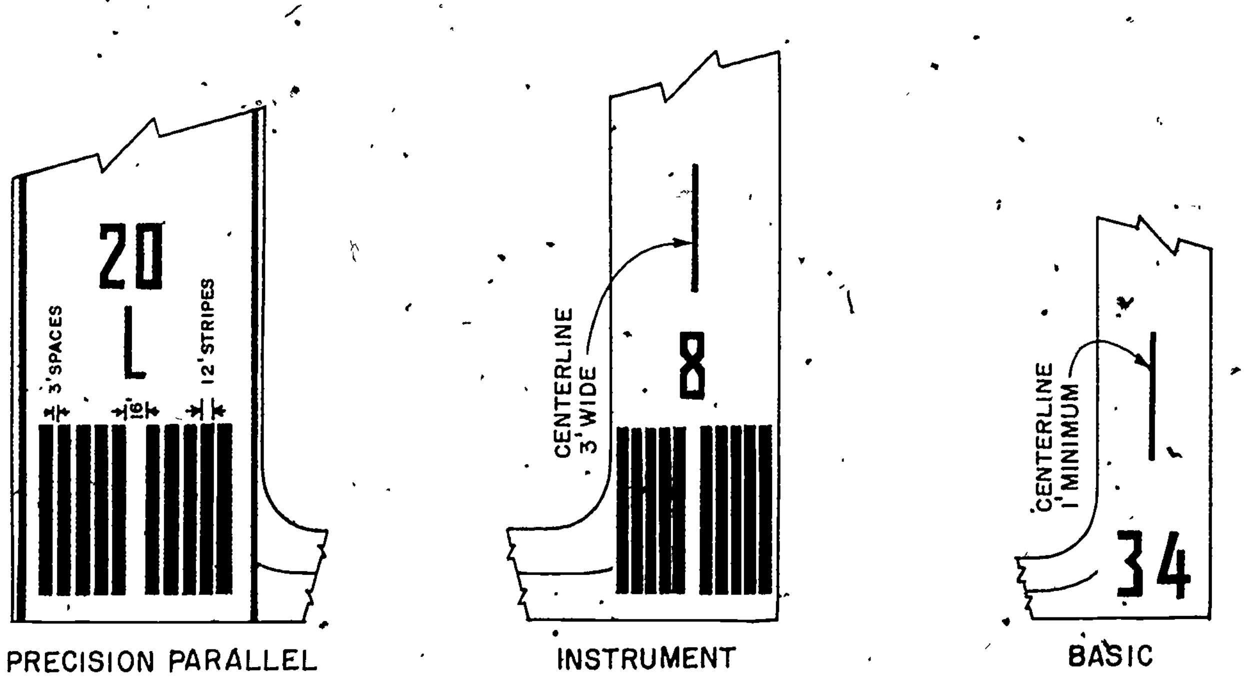
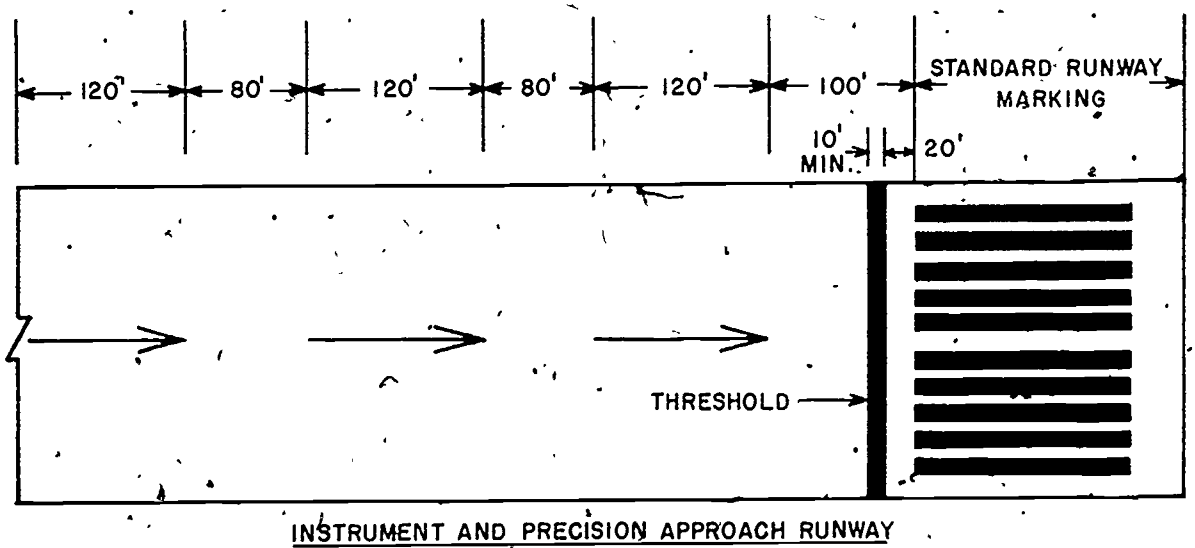


Figure 10-4.—Runway markings.



201.244

Figure 10-5.—Displaced runway threshold markings.

The first markers shall be at 1,000 feet from the ends of the runway with the intervening markers at 1,000-foot intervals toward the midpoint of the runway. If the runway's length is in excess of even thousands of feet, and the distance between the two midpoint markers is less than seven hundred feet, one of the distance markers shall be omitted.

All markers shall be located with the nearest edge 25 feet outboard from the edge of the full strength portion of the runway, and always opposite a runway edge light. Markers which fall within 25 feet of an intersecting runway or taxiway pavement shall be omitted.

At some locations there are markings that are used for a specific purpose. One most common is an area used for field carrier landing practice (FCLP). In this instance an area is painted to simulate an aircraft carrier deck. Stations involved in testing new or modified aircraft sometimes require special markings in the course of conducting various tests. Fields that are used primarily for pilot training may have certain markings arranged to better accomplish this task.

Large signs are installed on both sides of the runway to mark the location of arresting gear (discussed later in this chapter). The signs are large (7'6" long) yellow plexiglass arrows with white letters on a black background. The signs are lighted. (See fig. 10-6.)

201.138

Figure 10-6.—Arresting gear signs.

Taxiway Markings

Taxiway centerline stripes, like runway markings, give visual aid to pilots. A noticeable difference between runway and taxiway markings is that white markings are used on runways, whereas taxiway stripes are indicated with retroreflective yellow paint. Each taxiway is marked by a single centerline stripe 6 inches wide and continues onto the runway to the runway centerline (fig. 10-7) except at runway ends as in figure 10-4.

Holding line markers are also painted retroreflective yellow and consist of two solid lines and two broken lines. They are placed across the taxiway at right angles to the taxiway centerline, (see fig. 10-7) except when the taxiway is associated with a warmup pad; then the holding line may be parallel to the centerline of the runway or taxiway which is intersected. These painted markings are used for holding aircraft 175 feet clear of the nearest runway edge. Ground traffic must not proceed beyond the holding line marker without a control tower clearance.

Another taxiway marking is the VOR/TACAN checkpoint. This location shall be marked by a 20-foot diameter circle painted on the taxiway centerline, as shown in figure 10-8. The circle shall consist of two concentric bands, the outer of white and the inner of chrome yellow paint, each six inches wide. An arrow shall be painted across the diameter of the circle pointing in the direction in which the aircraft is aligned for checking on-board very high frequency omnidirectional and radio range (VOR) equipment. The arrow shall be painted white and chrome yellow in six-inch wide bands. There are usually several on an airport to facilitate ground checks regardless of the taxiway in use. (See fig. 10-8.)

The checkpoint is used in conjunction with a VOR/TACAN check sign. The sign is constructed of lightweight material, utilizing frangible supports, and placed 25 feet from the edge of the taxiway. It is painted with black lettering and has a hooded floodlight for night viewing. (See fig. 10-8.) The hood is provided so that the vision of pilots will not be impaired during night operations. Newer electric signs are being incorporated at air stations and are designed to operate in conjunction with taxiway lights. The information included on the sign is station identification, channel number or frequency, and magnetic bearing and distance to the VOR or TACAN station. The distance and bearing indicated are from the checkpoint, not the sign.

Deceptive, Closed, and Hazardous Area Marking

Where it is determined that an operational requirement exists, there are provisions for marking deceptive, closed, and hazardous areas.

A deceptive area is any surface or area which appears usable but which, due to the nature of its structure, is not intended for normal operational use by aircraft. All deceptive and closed area markings are painted with retroreflective yellow paint, except in the case of a displaced threshold arrow and bar which is painted with retroreflective white paint.

A closed area may be a runway, taxiway, or any other area that was once used but is no longer considered usable. It may be temporary, such as during construction, or permanently closed.

An example of various markings of deceptive, closed, and hazardous areas, both overall and detailed descriptions, are presented in figure 10-9. Study this figure carefully in addition to reading the text.

A hazardous area is an area or any permanent or temporary construction that presents a definite hazard to the operation of aircraft. Some examples are smoke stacks, antenna towers, buildings, and elevated tanks such as water supply tanks. When considered a hazard to flight, they are painted with aviation surface orange and aviation white paint, normally in a checkerboard pattern.

A closed runway is marked with a cross composed of two yellow bands 10 feet wide and 60 feet long. They are placed in the center of the closed runway, with no specified minimum distance between crosses, but they cannot be placed more than 1,000 feet apart. One cross is always placed near each end of the closed runway and adjacent to other runways and taxiways. At night, red lights in the form of a cross are placed at the ends of the runway in sufficient numbers to make certain that the cruciform arrangement is clearly distinguishable.

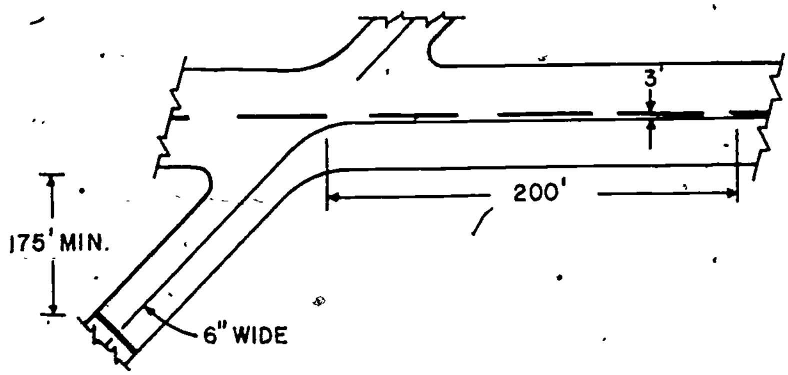


Figure 10-7.—Taxiway/Runway intersection. 201.245

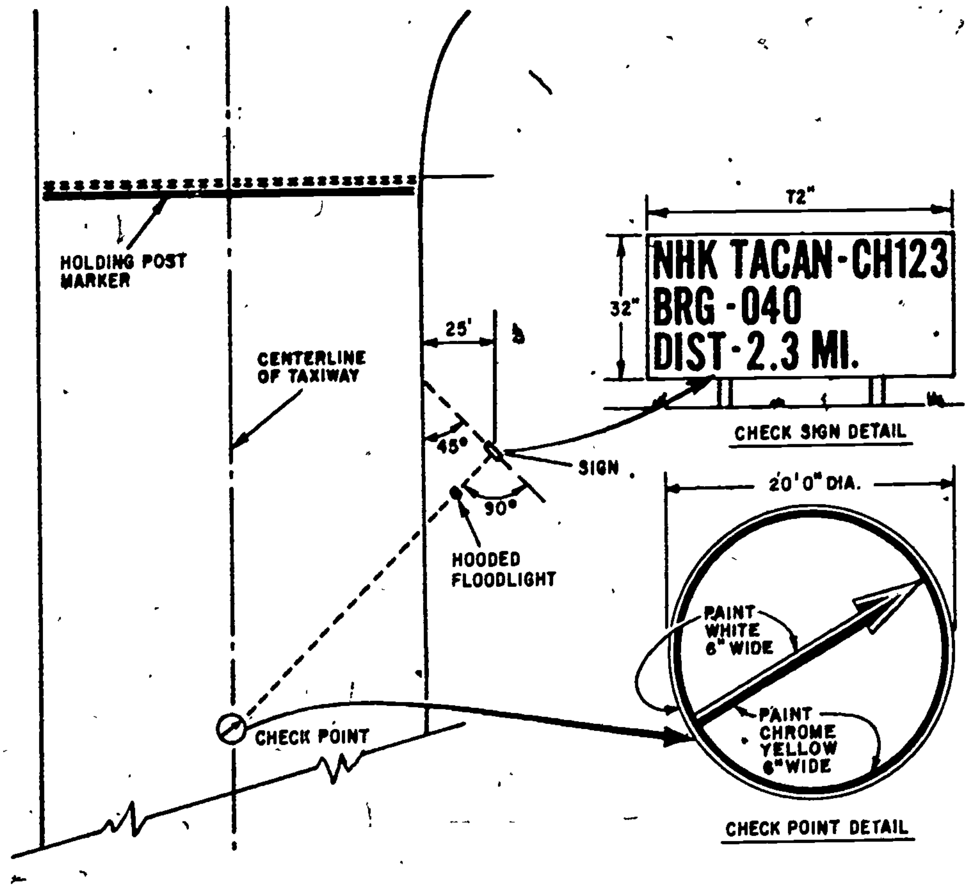
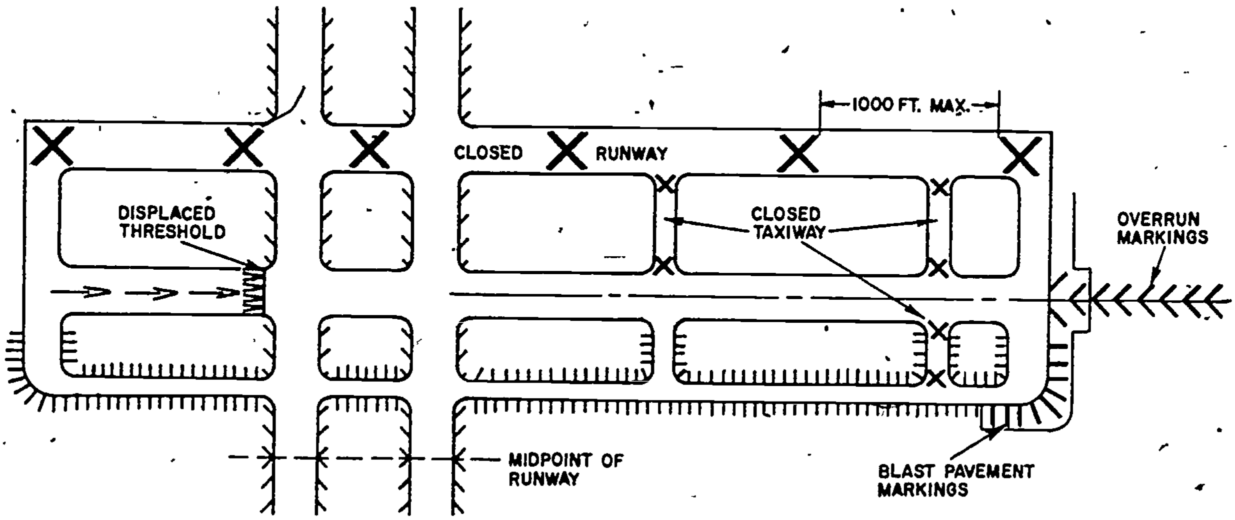


Figure 10-8.—VOR/TACAN checkpoint and check sign. 201.140



201.141

Figure 10-9.—Marking of deceptive, closed, and hazardous areas.

A closed taxiway marking is quite similar to a closed runway marking; however, the cross formed by the yellow bands, or red lights at night measure just half the size of the runway marking. They are always placed at or near the entrance of the closed taxiway. There is no set minimum or maximum distance between the crosses since each one in effect denies the use of the affected area. (See fig. 10-9.)

Small holes, soft spots, etc., on the usable portion of landing fields, are marked by day with yellow flags or yellow pyramids and by night with red lights, to warn incoming pilots that the particular spots so marked are unsafe for landing. When overrun areas are paved they could be easily mistaken for a landing area. When this possibility exists, runway overrun markings are used. These are in the form of chevrons painted retroreflective yellow, and the apex of the chevron points toward the runway. The stripes forming the chevron form a 45-degree angle away from the runway centerline extended and are 3 feet in width. There is no specified minimum size of the chevron, but the overall dimensions cannot exceed 100 feet. They are placed on the paved overrun, along the runway centerline extended, 100 feet apart. (See fig. 10-9.)

Runway, taxiway, and apron shoulder markings have much in common. All of these markings are painted nonretroreflective yellow with a 3-foot wide stripe beginning at the pavement edge, and placed 100 feet apart. Runway markings are placed at a 45-degree angle toward the approach end of the runway beginning at the runway midpoint. Taxiway and apron shoulder markings are perpendicular to the edge of the area. (See fig. 10-9.)

Blast pavement markers are nonreflective yellow stripes 3 feet wide and 50 feet long. They are placed in areas where jet and propeller blasts should be directed when making engine runups at high power settings. Usually these markings are placed near the ends of runways. However, some areas may be established at other points on the airport specifically for maintenance checks. (See fig. 10-9.)

Remember that deceptive, closed, and hazardous area markings are only used when and where they are needed. A particular airport may have all, some, or none of these markings.

For more detailed illustrations and data relative to airport markings at naval airfields, the Air Controlman should refer to the following design manuals: NAVFAC DM-21, NAVFAC DM-23, NAVFAC P-80, and NAVFAC P-272.

FIELD LIGHTING SYSTEMS AND OPERATION

Airport field lighting systems have been standardized by the Air Force, Navy, and the

FAA in order to present a uniform and unmistakable appearance so that flight personnel who are familiar with the adopted standards may readily interpret the lighting aids at any airfield. These standards specify the location, spacing, and color of lighting components in use.

A field lighting system is composed of runway lighting and other lighting aids with necessary controls and power supply. All the lighting aids are considered in this section even though their installation is determined by the mission of the airport. It is necessary that the Air Controlman have a thorough knowledge of these lighting standards as well as the essential function and operating rules of the separate components.

Aeronautical Beacons

The aeronautical beacon is a visual navaid displaying flashes of white and/or colored light, which is used to indicate the location of airports, landmarks, and hazards to air navigation. The principal light used is a rotating beacon of relatively high intensity.

The color or color combination displayed by a particular beacon tells whether the beacon is indicating a landing place, landmark, or hazard.

The rotating airport beacon has a vertical light distribution to make it most effective at angles of one to three degrees above the horizontal from its site; however, it can be seen well above and below this peak spread. Rotation is in clockwise direction when viewed from above. It is always rotated at a constant speed which produces the visual effect of flashes at regular intervals. Those flashes may be of one color or may be of two colors alternately. The flashing rate for airport beacons is 12 to 15 per minute.

Airport rotating beacons are located not closer than 750 feet to the centerline or centerline extended of the nearest runway and not more than 5,000 feet from the nearest point of the usable landing area.

Consideration should be given to ensure that the location of the beacon precludes the possibility of having a "dazzle" effect upon control tower personnel. To prevent this, the beacon shall be located at least 250 feet from the control tower and shall be a minimum of 20 feet above the elevation of the control tower cab floor.

Operation of an airport rotating beacon during the hours of daylight means that the ground visibility in the control zone is less than 3 miles and/or the ceiling is less than 1,000 feet and that a traffic clearance is required for landing, takeoff, and flight in the traffic pattern.

The colors and color combinations of aeronautical light beacons and their meaning are as follows:

1. A rotating beacon displaying alternating white and green flahses indicates that the beacon is at or within 2 miles of a lighted airport or landing field.

2. Military lighted airport rotating beacons display alternating white and green flashes, but the white flash has dual peaked (two quick) flashes to differentiate from civil beacons.

3. Green flashes alone, usually coded, from a code beacon (not a rotating beacon) used by itself, mean that the code beacon is located at or beside a lighted airport. When a rotating white and green beacon is located more than 5,000 feet from an airport or landing field, the green-flashing code beacon is used to show more exactly the location of the landing area.

4. A rotating beacon displaying alternating white and red flashes indicates the location of a landmark or navigational point.

5. A rotating beacon displaying red flashes alone indicates the presence of an obstruction or obstructions hazardous to air navigation.

6. Steady burning red lights are used near airports to mark obstructions, and are also used to supplement flashing lights in marking enroute obstructions.

Runway Edge Lights

Runway edge lights form the outline of the runway for night operations. The runway lights are located along both sides of the runway, extending the entire length. Runway edge lights shall be spaced at even 200-foot intervals from each end toward the midpoint. For runways not evenly divisible by 200 feet, light spacing at the midpoint of the runway shall not be less

Table 10-1.—High intensity runway lights settings

Step	Day visibility	Night visibility
5	Less than 1 mile	When requested
4	1 to 2 miles	Less than 1 mile
3	When requested	1 to 3 miles
2	When requested	Over 3 to 5 miles
1	When requested	More than 5 miles

than 100 feet. Runway edge lights are bidirectional white lights. They are elevated except at intersections where semiflush lights are used to maintain uniform spacing.

Runway edge lights for the duty runway are operated continuously between sunset and sunrise. The intensity setting is normally 1 or 2(as listed in table 10-1). During aircraft operations this setting may be adjusted as the pilot desires.

Category A, B, and C naval airfields have high intensity runway lights (HIRL).

NOTE: For a listing of lighting, navigational, and communication requirements necessary for an airfield to be assigned a specific category refer to the ATC Facilities Manual (OPNAVINST 3721.1 (Series)).

The intensity or brightness of the runway lights can be varied by a selection switch on the lighting control panel in the control tower. There are five settings which may be selected with number 1 being the lowest and number 5 the highest. High intensity settings may be operated as prescribed by local procedures or as requested by a pilot for his operation. Table 10-1 is a guide for determining the appropriate intensity setting.

Threshold Lights

Threshold lights define the ends of the usable runway surface. They are used by the pilot at night to identify the end of the runway. Because of the many variations of the number of lights required on each end of the runway, we will discuss only airfields with VFR or Category "D" IFR capabilities. There are two groups of six lights each, one group on each side of the runway. The first light of each group is on line with the runway edge lights and spaced 5 feet apart. These lights are approximately 2 feet beyond the usable runway. (See fig. 10-10.) They are bidirectional in color with green-showing toward the approach zone and red toward the runway. To determine what is required for your airport, refer to the Design Manual, "Communications, Navigational Aids, and Airfield Lighting" (NAVFAC DM-23).

Runway End Identification Lights (REIL)

These lights have a rotating mechanism which rotates two high-intensity lamps inside a clear glass cover at a constant speed of 40 revolutions per minute. The runway side of these lights is shielded to prevent glare from blinding pilots of approaching aircraft. These lights are installed 50 feet outboard from each side of the runway edge in line with the threshold lights. (See fig. 10-10.)

Runway Centerline Lighting System

Runway centerline lights, where installed, consist of a single row of lights at uniform intervals (25 feet apart) along the centerline of the runway to provide a continuous lighting reference from threshold to threshold. The lights may be installed on a primary and secondary runway. On/off and brightness controls for individual runway centerline lights are provided in the control tower. Runway centerline lights are white lights. The intensity selected should be the same as that selected for the high intensity runway lights.

Taxiway Lighting

Taxiway lights, which are blue in color, have a variable spacing distance, depending upon the length of a straight taxiway segment or radius of curve of a taxiway turn. On a straight segment over 300 feet in length, the space between lights may approach but not exceed 200 feet. On a straight segment of 300 feet or less, the distance between lights may approach but not exceed 50 feet. Taxiway lights marking a curved edge of a taxiway follow the rule that the sharper the radius of curvature, the closer the lights are placed. In no case will there be less than three taxiway lights on any one taxiway.

Two blue lights spaced 5 feet apart and placed on each side of a taxiway entrance into (or exit from) a runway or parking area are called entrance-exit lights. These lights are not installed at intersections of taxiways or at locations that are normally runway entrances or exits.

The control system for taxiway lights is designed to permit the lighting of combinations of individual taxiways necessary to provide any required lighted taxiing path. The taxiway lights are turned on as soon as the pilot of an aircraft is cleared to taxi out and turned off when the aircraft is on the runway or another taxiway. For inbound aircraft, they are turned on as the aircraft approaches the taxiway to be used and turned off when the aircraft is parked.

Approach Lights

Approach lights of varying types, colors, and construction have been specifically developed to meet civil and military requirements. These lights are installed in an area extending outward from the threshold of the instrument runway, and are usually the pilot's first visual contact with the ground under extremely low visibility conditions. Electronic landing aids, such as GCA and ILS, are used to bring the pilot down to the approach minimums. Approach lights are required for final alignment with the runway, and runway lights are required to complete the landing.

High-intensity incandescent lights penetrate somewhat farther through fog, smoke, or rain than neon lights. Several types of high-intensity approach lights have been installed in the United States, taking the place of the neon system.

The current system being installed at Navy facilities is called Centerline Approach Lighting System (U.S. Standard (A)). It consists of a series of crossbars of lights (normally 3,000 feet) with condenser discharge (sequence flashing) centerline lighting that coincides with the runway centerline lighting, and indicates the approach to, and threshold of, the runway. The intensity of

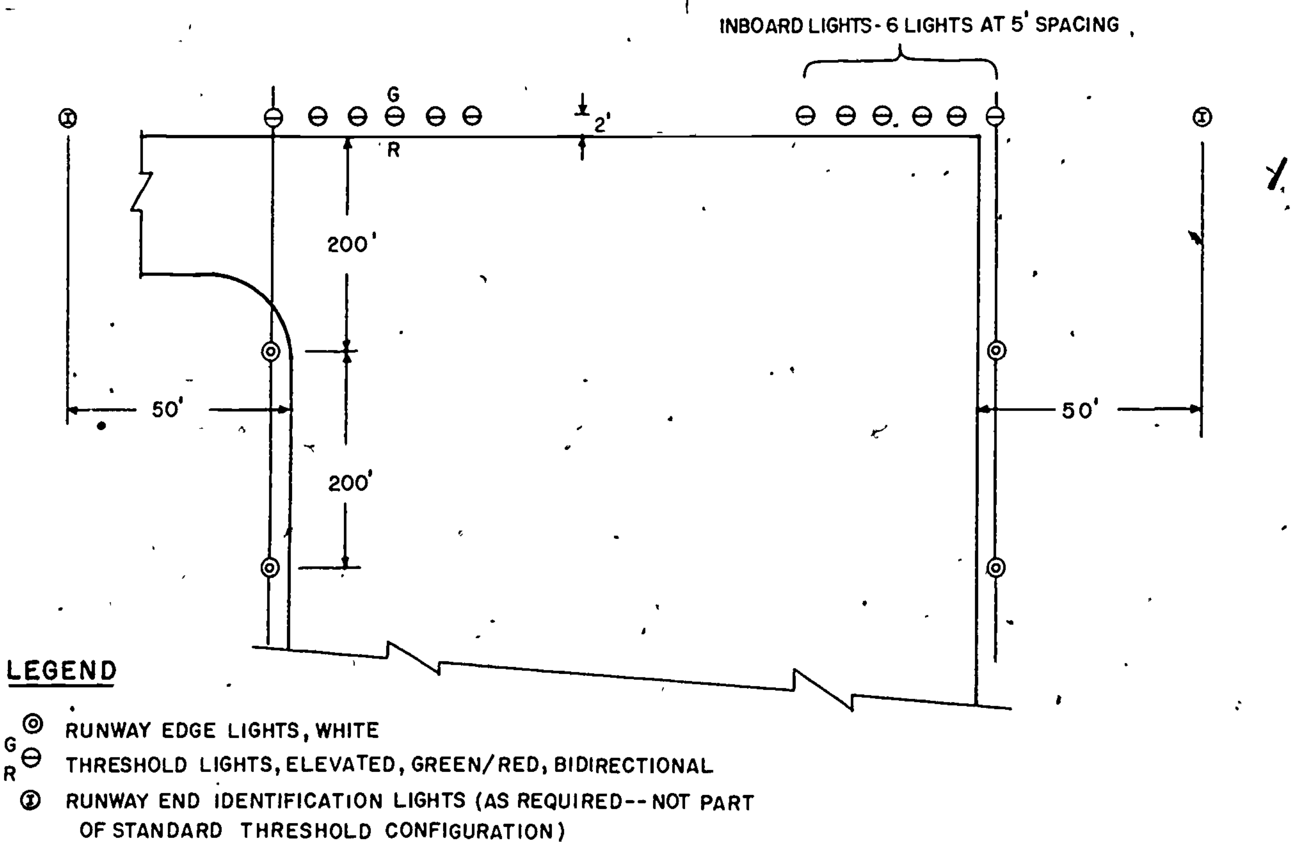


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Figure 10-10.—Typical threshold lighting configuration.

Table 10-2. — High intensity approach lights settings

Step	Day visibility	Night visibility
5	Less than 1 mile*	When requested
4	1 to 3 miles	When requested
3	3 to 5 miles	Less than 1 mile*
2	When requested	1 to 3 miles
1	Greater than 5 miles	Greater than 3 miles

* and/or 6000 feet or less of RVR on the runway served by the approach lighting and RVR.

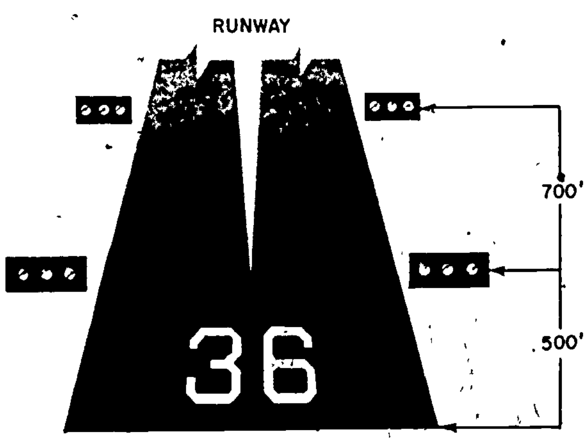

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Figure 10-11.—Visual approach slope indicator.

the approach lights can be varied from the control tower. To be most useful, the lights must be bright enough to penetrate the overcast effectively without blinding the pilot or producing halo effects. Different intensity settings are needed for day and night use. The operation and intensity setting selected may be determined by local procedure and instructions. Table 10-2 is a guide for determining the appropriate approach lights intensity settings.

The various configurations of approach lighting systems available to pilots today can be found inside the back cover of the Low Altitude Instrument Approach books.

Visual Approach Slope Indicator (VASI)

VASI is designed to provide by visual reference the same information that a glide slope of an ILS provides electronically. It provides a 2 1/2- to 3-degree visual glide slope within the approach zone which a pilot can see and use for descent guidance during an approach to a landing.

The VASI system is primarily intended for use during VFR conditions, day and night.

The standard installation consists of 12 light source units arranged in light bars of 3 units placed on each side of the runway opposite the 500-foot mark, and three units on each side of the runway opposite the 1,200-foot mark. (See fig. 10-11.) Each light unit projects a beam of light having a white color in the upper part and a red color in the lower part. The light units are so arranged that the pilot, during an approach, would see one of the combinations shown in Table 10-3.

The intensity of the VASI system is controllable at some installations while at others the intensity is controlled by an electronic device. Where controllable, the controls are located in the tower as is the on/off switch. Normally, the VASI system is left on at all times; however, local procedure and instructions may require otherwise.

Wheels-Up/Runway Waveoff Lights

Wheels-up/runway waveoff lights consist of six clusters of three red lights located on

Table 10-3.—VASI glide slope presentation

Aircraft position	Presentation
Above the glide slope	white white
On the glide slope	red white
Below the glide slope	red red

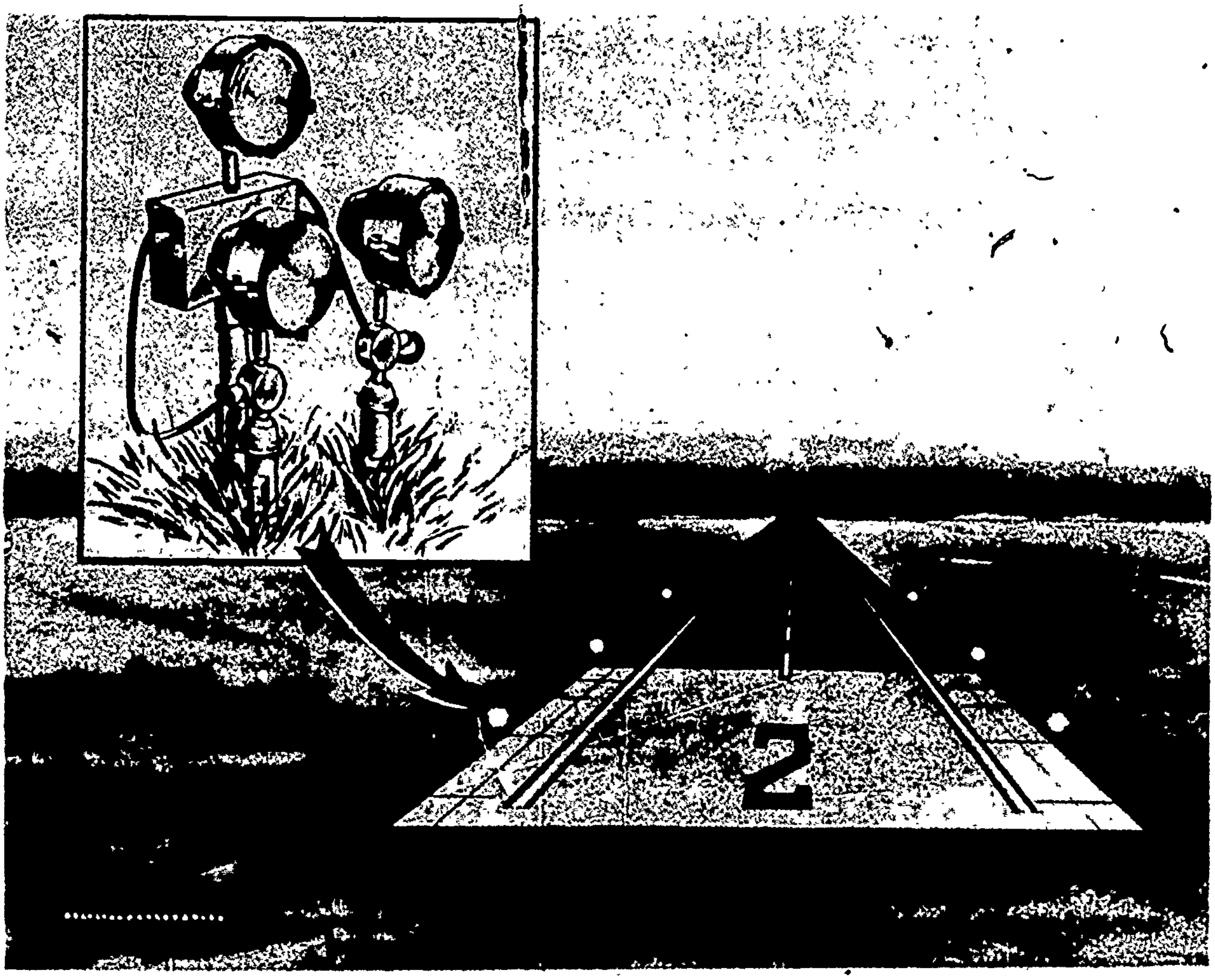

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Figure 10-12.—Wheels-up/runway waveoff lights.

each side of the runway starting approximately 900 feet from the runway threshold and spaced approximately 800 feet apart. Additionally, a wheels-up light bar is located approximately 1,000 feet outboard of the runway threshold on the same side of an imaginary extension of the runway as the control tower. (See fig. 10-12.)

The lights face landing aircraft and are turned in toward the runway centerline. The lights can be controlled from the wheels watch position and the Landing Signal Officer (LSO) platform. When activated, a flashing device causes the lights to flash 90 times per minute with equal on and off time.

Obstruction Lights

Obstruction lights are located on all elevated obstructions on the airport and on all other obstructions within a given glide angle of an airport. They are red in color and are lighted from sunset to sunrise and during daytime when flight visibility is restricted.

Fresnel Lens Landing System

Many facilities have a Fresnel lens optical landing system installed along the side of a heavily used runway for use in field carrier landing practice and for pilots to keep proficient using this type of landing approach.

Although the physical build of the shore-based lens may differ from the shipboard lens, the view presented to the pilot is the same in either case.

The Fresnel lens is discussed in detail in chapter 13 of this Rate Training Manual.

CONTROL TOWER

The key facility of the airport operational system is the control tower. It is elevated to a suitable height to afford the maximum visibility of the airport and the immediate area. The primary objective of the control tower is to promote the safe, orderly, and expeditious movement of air traffic. This includes the following:

1. Aiding pilots in preventing collisions between aircraft and between obstructions and aircraft in the movement area.

2. Expediting and maintaining an orderly flow of air traffic.

3. Assisting the person in command of an aircraft by providing such advice as may be necessary for the safe and efficient conduct of a flight.

4. Notifying appropriate organizations regarding aircraft known or believed to be in need of search and rescue aid, and assisting such organizations as required.

The control tower exercises control of all aircraft operating on and around an airfield; all movements of aircraft must have prior approval from the Control Tower. This includes instructions and permission to tow, taxi, takeoff, land, and related aircraft operations (except where preventive control has been authorized.)

NOTE: Preventive control differs from other airport traffic control in that repetitious, routine approval of pilot action is eliminated. Controllers intervene only when they observe a traffic conflict developing.

Some ATC facilities possess a mobile control tower or radio communications van which may be utilized to provide temporary operating facilities for the Air Controlman when the need arises.

These units may be used during periods of equipment outages in the main control tower; to provide coordination with the LSO (Landing Signal Officer) during times that field carrier landing practice (FCLP) is being conducted (discussed later in this chapter); or when special aircraft operations or test/evaluations are being accomplished on the field which require coordination with the controllers in the primary control tower.

The mobile communications van (AN/MRC-131) shown in figure 10-13 (A) is equipped with UHF, VHF, and FM radios which are operated from inside the cab of the vehicle. This unit also has provision for a remote station for outside operations. (See fig. 10-13 (A).)

The mobile control tower (AN/GRC-100) (fig. 10-14 (B)) contains an auxiliary power unit (APU) or 24-volt battery which provides the necessary power to operate the equipment.

Equipment contained in this unit generally consists of UHF, VHF, and FM radios, wind indicator, portable traffic control light, clock, interior lights, and other associated gear.

Generally speaking, the mobile control tower provides the controller with enough equipment to perform his duties in a satisfactory manner, especially during periods when traffic conditions are relatively light.

If your station is equipped with a mobile tower or radio van, you should make every effort to become familiar with the equipment installed in it and proficient in its operation.

COMBINED RESPONSIBILITIES

Both controllers and pilots are responsible to each other for good communications, coordination, and cooperation. These three factors are not separate entities but must be considered as different parts of responsibility which are shared by pilots and air traffic control personnel. Some of these responsibilities are set forth in publications, while others are not delineated as a regulation or a rule but are recognizable as definite responsibilities of a controller since his profession is one of service—that of aiding the pilot to accomplish a safe flight.

AUTHORIZED CONTROLLERS

Only those naval personnel properly qualified in accordance with OPNAV Instruction 3721.1 (Series) can exercise the control of air traffic.

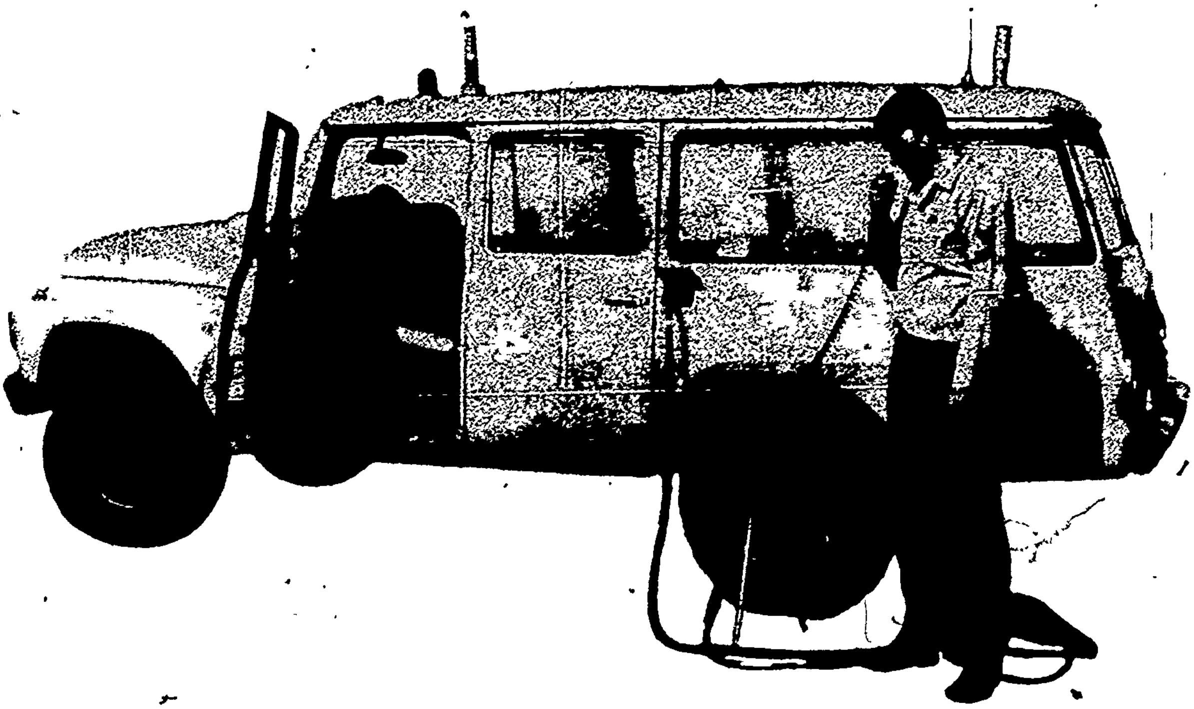

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Figure 10-13. — Mobile control facilities. AN/MRC-131 mobile radio communications van.

Tower controllers, to be considered fully qualified, must possess a Facility Rating for the airport to which they are assigned.

NOTE: Certification requirements for control tower operators are detailed in FAR, Part 65, and chapter 3 of this manual.

TOWER OPERATING POSITIONS AND RESPONSIBILITIES

Establishment of controller positions varies according to local requirements and type of facility, but those included in most control towers are Local Control position, Ground Control position, and Approach Control position.

The primary duties of the tower supervisor are to direct activities of a tower under the general supervision of the leading chief and/or watch officer. He supervises all positions of operation and directs the training of new personnel.

The following types of messages are ordinarily transmitted by the position indicated in the following paragraphs.

1. Local controller — issues information and clearances to air and vehicular traffic operating on the landing area, to VFR traffic operating in the control zone, and to IFR traffic released to local control position.

2. Ground control — assists other operating positions by handling taxiing aircraft and vehicular traffic on the landing area.

3. Approach control — provides separation between all aircraft operating IFR within the designated area of jurisdiction through application of separation standards.

At an ATC facility providing radar approach control services, the approach control position is located in the control room, normally designated as the "IFR room."

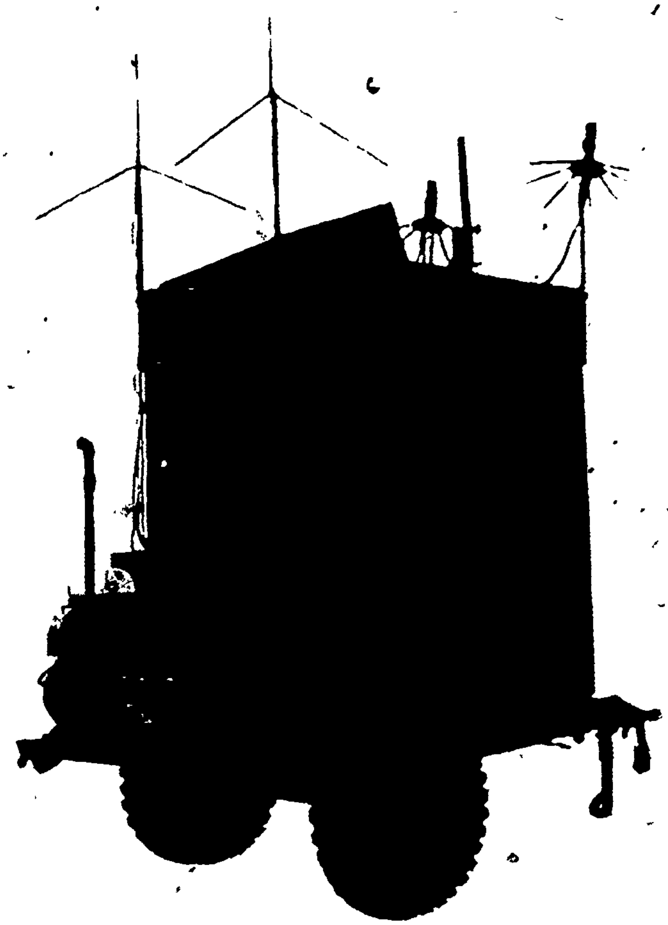

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Figure 10-14.—Mobile control facilities. AN/GRC-100 mobile control tower.

NOTE: Radar control facilities will be discussed in detail in chapter 13 of this manual.

Some facilities use a flight data position, the duties of which consist of receipt, posting, and relaying flight data for the other positions and assisting in the operation of the tower as directed.

AIRPORT TRAFFIC CONTROL PROCEDURES

Airport traffic control service is based only upon observed or known traffic and airport conditions which might, in the Air Controlman's judgment, constitute a hazard. These include parachutists within the control zone, vehicular traffic, large flocks of birds in the vicinity of the airport, and temporary obstructions on or near the airport.

Specific approval or disapproval for movement of vehicles, equipment, or personnel on the movement area is issued via radio or directional light gun. Approval of specific situations should not be qualified by conditional phrases such as BEHIND LANDING TRAFFIC, or AFTER THE DEPARTING AIRCRAFT.

A clearance to take off, land, or touch-and-go can be denied only on the basis of traffic conditions, except in the case of a closed runway or below minimum visibility conditions. Clearance for a low approach can be denied only on the basis of traffic conditions.

Should a pilot request to use a closed runway, he should be informed of the fact that the runway is closed and if necessary, the appropriate parts of the NOTAM applying to the runway should be quoted.

Any message relayed to an aircraft by the tower should include the source of the message.

EXAMPLE: OPERATIONS OFFICER ADVISES, or SQUADRON DUTY OFFICER REQUESTS (message).

A pilot's request to cross an airport traffic area at speeds in excess of the speed limit for an airport traffic area (200 knots for turbine-powered aircraft and 156 knots for reciprocating engine-powered aircraft) may be approved if traffic conditions permit. However, speeds in excess of 250 knots should not be approved unless the pilot advises that a higher minimum speed is required, or normal military operating procedures require such speeds.

If a controller should observe an abnormal condition of an aircraft, the pilot of such aircraft should be informed.

EXAMPLE: REAR BAGGAGE DOOR APPEARS OPEN.

When a pilot has any doubt that his landing gear is down and locked, he will notify the control tower. The controller will then instruct the pilot to perform a low pass in front of the tower for the purpose of a visual check. The controller will then relay to the pilot the results of the visual check.

EXAMPLE: LANDING GEAR APPEARS DOWN AND IN PLACE; or, NOSE GEAR DOES NOT APPEAR IN PLACE.

Should any doubt exist after a visual check, the controller would alert the crash and rescue equipment, and the aircraft would make a precautionary landing. After the landing rollout, the aircraft should not turn off the runway until ground personnel have made a visual check of the landing gear and installed the gear pins.

Unusual maneuvers of an aircraft within an airport traffic control area should not be approved or requested if such maneuvers are not essential to the performance of the flight.

Wake Turbulence

Since the existence and effect of wake turbulence are unpredictable, a controller is not responsible for anticipating the need for such information in all cases. However, controllers must be especially alert for a situation wherein the possibility of aircraft under their jurisdiction encountering wake turbulence exists and ensure that the affected pilots are advised. This will enable the pilot to avoid the suspected hazardous area and enhance the safety of flight.

Turbulence generated by aircraft, which was once thought to be prop wash, is now categorized as "thrust stream turbulence" and "wingtip vortexes." These categories of turbulence are collectively termed WAKE TURBULENCE.

Thrust stream turbulence is associated with ground operations, such as taxiing and warm-up operations.

Wingtip vortexes are trailing masses of disturbed air created by the wing of an aircraft as it produces lift. An aircraft creates two such vortexes with rotational air movement, one trailing each wingtip. Once formed, the vortexes extend and may be hazardous for an undetermined distance behind the generating aircraft. The turbulence is directly related to the weight, wing span, and speed of the aircraft. Its intensity is directly proportional to the weight, and inversely proportional to the wing span and speed of the aircraft. The heavier and slower the aircraft, the greater will be the intensity of the turbulence. Thus, modern large transport aircraft will create maximum turbulence during takeoff and landing at or near maximum gross weights. The manner in which wake turbulence is generated is illustrated in figure 10-15.

Trailing vortexes have certain behavioral characteristics which can help a pilot visualize the wake location and thereby take avoidance precautions:

1. Vortexes are generated from the moment the aircraft leaves the ground, since trailing vortexes are a by-product of wing lift. (See fig. 10-16.)

2. The vortex circulation is outward, upward, and around the wing tips. Tests have shown that the vortex flow field covers an area about two wing spans in width and one wing span in depth.

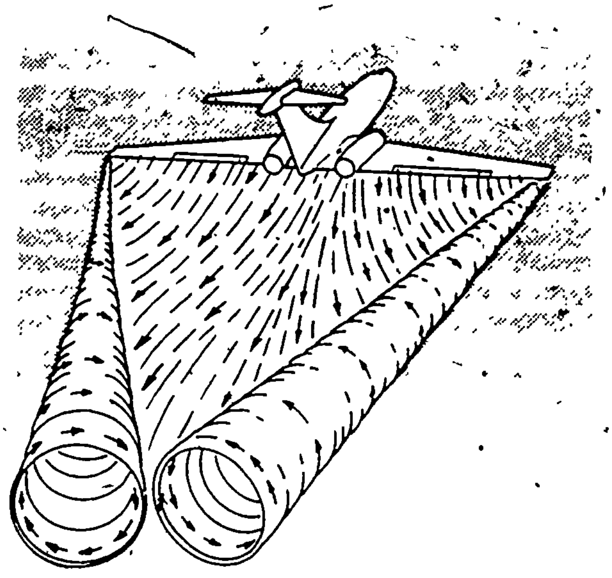

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Figure 10-15.—Vortex generation.

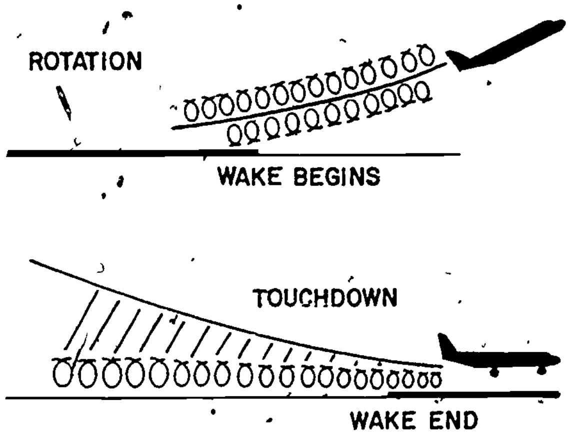

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Figure 10-16.—Beginning and ending of vortex generation.

The vortexes remain so spaced (about a wing span apart), even drifting with the wind, at altitudes greater than a wing span from the ground. Vortexes from large aircraft sink at a rate of about 400 to 500 feet per minute. They tend to level off at a distance about 900 feet below the flight path of the generating aircraft. When the vortexes of large aircraft sink close to the ground (within about 200 feet), they tend to move laterally over the ground at a speed of about 5 knots. (See fig. 10-17.)

If a tower controller should foresee the possibility of wake turbulence, cautionary information should be issued to the pilot of the aircraft concerned. Refer to ATP 7110.8 (Series) for cautionary advisory phraseology to be employed for Heavy Aircraft operations.

Traffic Information

Local traffic information is issued when in the judgment of the controller such information is necessary in the interest of safety or when requested by a pilot.

Vehicles, equipment, or personnel on the movement area are described in a manner which will assist pilots in recognizing them.

Military air traffic is described as follows:

1. Military designator, with numbers spoken in group form.
2. Service and type with the following exception.

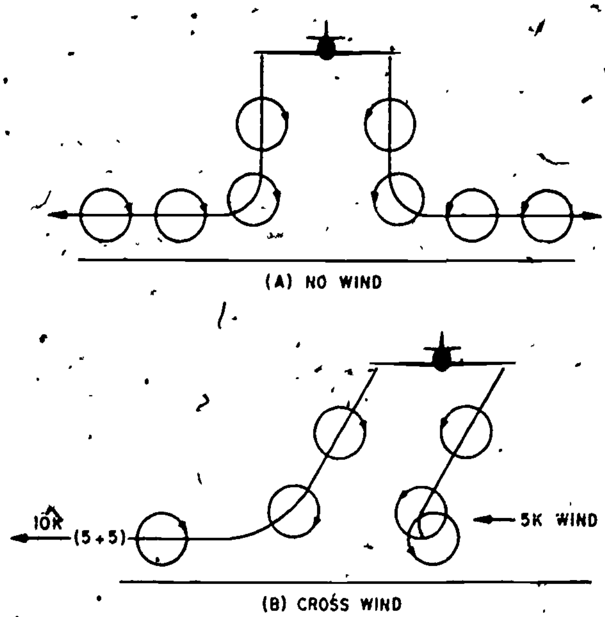

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Figure 10-17.—Vortex movement in ground effect. (A) no wind; (B) cross wind.

3. Type only, if no confusion or misidentification is likely.

EXAMPLES: F-FOUR; NAVY FIGHTER; or, FIGHTER.

Air carrier traffic is described as follows:

1. Manufacturer's name or model.
2. Add company name or other identifying features if confusion or misidentification is likely.

EXAMPLES: VISCOUNT; AMERICAN DC-NINER; or, UNITED VISCOUNT.

General aviation air traffic is described as follows:

1. Manufacturer's model, name or designator.
2. Add color when considered advantageous.

EXAMPLES: TRI-PACER; CESSNA THREE TEN; or, GREEN APACHE.

When it is necessary to make a hurried, brief transmission of traffic information, the aircraft type may be omitted.

The relative position of traffic must be issued to pilots in an easily understood manner, such as TO YOUR RIGHT, or AHEAD OF YOU, instead of local terminology or compass directions.

EXAMPLES: TRAFFIC U ELEVEN ON DOWNWIND LEG TO YOUR RIGHT; or, F FOUR INBOUND FROM INITIAL, RUNWAY SIX.

Field Condition Information

Pertinent field condition information necessary for an aircraft's safe operation is issued in time for it to be useful to the pilot. The following information concerning field conditions must be issued to pilots concerned:

1. Construction work on or immediately adjacent to the movement area.
2. Rough portions of the movement area.
3. Braking conditions caused by ice, snow, slush, or water.
4. Snowdrifts or piles of snow on or along the edges of the area and the extent of any plowed area.
5. Parked aircraft on the movement area.
6. Irregular operation of part or all of the field lighting system.
7. Any other field conditions considered pertinent by the controller.

Description of field conditions issued should be stated clearly and concisely.

EXAMPLES: MOWER TO LEFT OF RUNWAY; or, WORKMAN ON TAXIWAY.

Weather Information

The tower may transmit to pilots or other ATC facilities, without consulting weather service personnel, any elements of weather information derived directly from instruments, from radar, or received as a pilot report. Observed weather conditions such as LARGE BREAKS IN THE OVERCAST, VISIBILITY LOWERING TO THE SOUTH, or similar statements which do not include specific values may be transmitted. Terminal radar control facilities should inform towers for which they provide approach control service about storm areas observed on radar.

Elements of weather information which include specific values (such as ceilings and visibility) may not be transmitted unless the observing controller is properly certificated and acting as a weather observer, or the weather observation was made or verified by weather service personnel.

Controllers should inform local weather service personnel of any differences between weather conditions observed from the tower and those reported by weather service.

Bird Activity Information

Bird activity information including position, size, and species (if known), and their course of flight should be issued to pilots of aircraft concerned for at least 15 minutes after receipt of the information from pilots or adjacent facilities. This time may be reduced when either visual observations or subsequent reports reveal that the activity is no longer a factor.

Visual Signals

Air traffic control light signals are used to control aircraft and movement of vehicles, equipment, or personnel on the movement area when radio communications cannot be employed. These signals are in accordance with figure 11-2 in chapter 11 of this training manual.

To obtain an acknowledgment from aircraft equipped with a receiver only, a controller should request the pilot of the aircraft to move the aileron or rudders on the ground, or rock the wings when airborne, during daylight hours; or, blink the navigation or landing lights at night.

Runway Use

Except where a "runway use" program is in effect, the selection of the runway to use, or the duty runway, is as follows:

1. The runway most nearly aligned with the wind, when the wind velocity is 5 knots or more.

2. The calm wind runway, when the wind velocity is less than 5 knots.

Use of a runway other than those mentioned above is permissible if it will be operationally advantageous or if it is requested by a pilot. If a pilot prefers to use a runway different from that specified by a controller, he is expected to advise the controller accordingly.

Runway use programs for large aircraft and turbojet aircraft may be established at some airports. Where such programs are established, runway assignment is affected by consideration of noise sensitive areas and noise abatement benefits. Acceptance or refusal of such assignments is still the pilot's prerogative.

Both wind direction and velocity must be issued when authorizing the use of runways, even though the wind velocity is less than 5 knots and the calm wind runway is to be used. This information is necessary since some aircraft are adversely affected by a tailwind or crosswind component, and pilots must be aware of the exact wind condition to make the decisions necessary for a safe flight. Therefore, the wind condition is described as "calm" only when the velocity is less than 3 knots.

Runway conditions

At those facilities affected by winter weather conditions, runway condition and braking action are important information which must be relayed to pilots when adverse conditions exist on the landing area.

Detailed procedures for the determination and reporting of runway surface conditions in terms of runway condition reading (RCR) are contained in chapter 7 of this manual and may also be found in the FLIP IFR-Supplement (Procedures).

Separation

Air traffic should be controlled in accordance with established traffic and taxi patterns. The controller must establish a sequence of arriving and departing aircraft by issuance of instructions and information that require pilots of aircraft to adjust flight or ground operation as necessary to achieve proper spacing or separation.

The minimums contained in TATC Handbook 7110.8 (Series) are considered to be "Standard Separation." Unless otherwise authorized, the minima and procedures contained therein should be adhered to.

"Reduced Separation" implies that a reduction to the standards specified in TATC Handbook 7110.8 (Series) has been authorized by the Chief of Naval Operations for the Navy or other appropriate headquarters for the other service branches. This reduction in separation is applicable between military aircraft in special procedures such as altitude reservations, air refueling, and fighter-interceptor operations, etc.

To assist the controller in determining the minimum interval between various operations, the following categories of aircraft have been established.

1. Category 1.—Lightweight, single-engine, personal-type, propeller-driven aircraft. (Does not include high performance aircraft such as the T-28.)

2. Category 2.—Lightweight, twin-engine, propeller-driven aircraft weighing 12,500 pounds or less, such as the U-11 and C-45.

3. Category 3.—All other aircraft such as the high-performance single-engine, heavy twin-engine, four-engine, and turbo jet aircraft.

4. Heavy aircraft.—All aircraft with a gross takeoff weight of 300,000 pounds or more.

The application of procedures and minimums, local deviations or application of reduced separation, and conditions allowing such operations are the same as those listed under IFR CONTROL PROCEDURE later in this chapter.

Table 10-4.—Criteria for simultaneous, same direction operations on parallel runways

Aircraft type	Minimum distance in feet between.	
	Runway center-lines	Adjacent edges of runway or landing strips
Light-weight, single-engine, propeller-driven	300	200
Twin-engine, propeller-driven	500	400
All others	700	600

Table 10-5. — Criteria for simultaneous, opposite direction operations on parallel runways

Time of operation	Minimum distance in feet between.	
	Runway center-lines	Adjacent edges of runways or landing strips
Between sunrise and sunset	1400	1400
Between sunset and sunrise	2800	Not authorized

SIMULTANEOUS OPERATIONS ON PARALLEL RUNWAY.—Simultaneous, same direction operations may be authorized on parallel runways, or landing strips, under the following conditions:

1. Operation must be conducted in VFR conditions unless visual separation is applied between aircraft concerned by the tower controller or pilots of the aircraft conducting the operation.

2. Two-way radio communications must be maintained with the aircraft involved, and pertinent traffic information must be issued.

3. The distance between the runways, or landing strips, must be in accordance with table 10-4.

NOTE: If two categories of aircraft are involved, the greater distance must be applied.

Simultaneous, opposite direction operations on parallel runways or landing strips, or on a runway and a parallel landing strip, may be authorized under the following conditions:

1. Operations must be conducted in VFR conditions.

2. Two-way radio communications are maintained with the aircraft involved, and pertinent traffic information is issued.

3. The distance between the runways or landing strips must be in accordance with table 10-5.

SEPARATION OF DEPARTING AIRCRAFT.—Departing aircraft are separated from other aircraft using the same runway by ensuring that they do not begin takeoff roll until one of the following conditions exists:

1. The other departing aircraft has crossed the runway end, or is airborne and turning to avert any conflict. (See fig. 10-18.)

2. Provided that distances by reference to suitable landmarks can be determined, the other

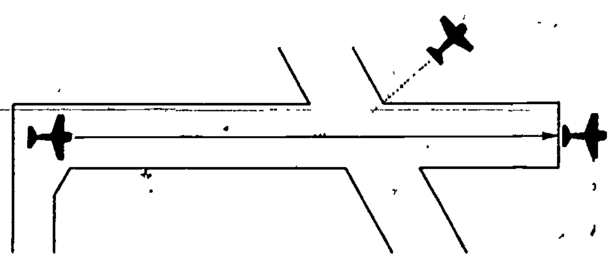

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Figure 10-18.—Separation of departing aircraft.

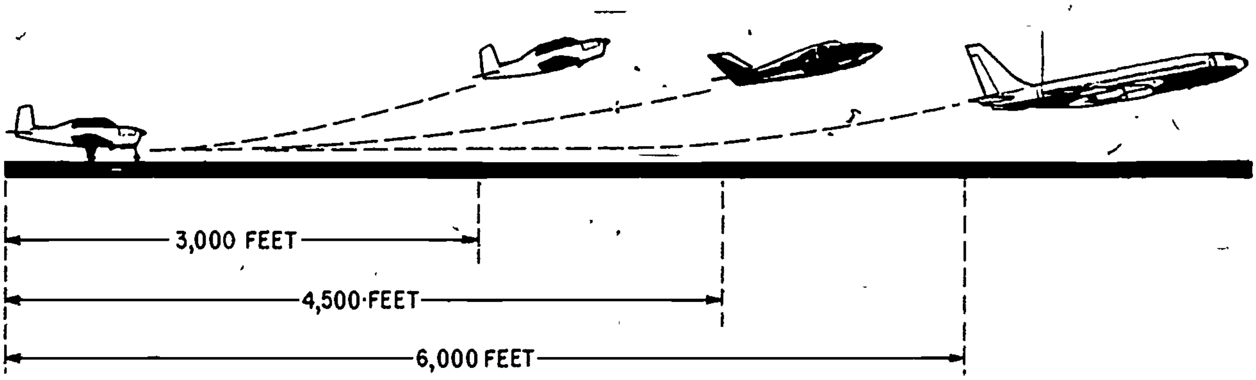

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Figure 10-19.—Separation of different category departing aircraft.

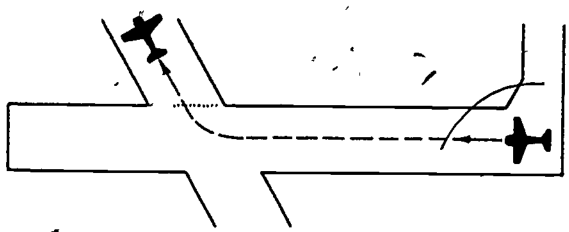

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Figure 10-20.—Separation between departing and a preceding arriving aircraft.

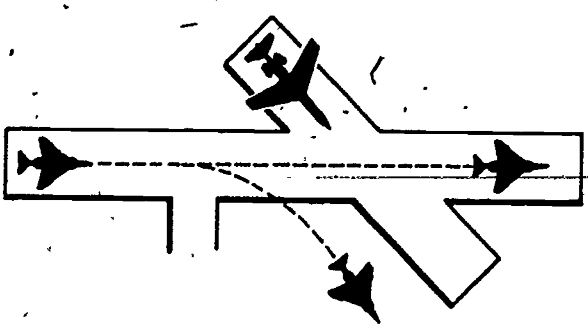

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Figure 10-21.—Separation between departing aircraft using intersecting runways.

departing aircraft need be airborne only if the following minimum distances exist between aircraft (fig. 10-19):

a. If only category 1 aircraft are involved—3,000 feet.

b. If a category 1 aircraft is preceded by a category 2 aircraft—3,000 feet.

c. If the succeeding or both aircraft are category 2—4,500 feet.

d. If either aircraft is a category 3 aircraft—6,000 feet.

3. A preceding arriving aircraft has taxied off the runway. (See fig. 10-20.)

A departing aircraft is separated from another aircraft using an intersecting runway by ensuring that it does not begin takeoff roll until one of the following conditions exists:

1. The preceding departing aircraft has passed the intersection or is airborne and is turning to avert any conflict. (See fig. 10-21.)

2. The preceding arriving aircraft has taxied off the landing runway, or completed the landing roll and will hold short of the intersection, or has passed the intersection. (See fig. 10-22.)

NOTE: If reasonable assurance exists that the prescribed separation will be met when the aircraft commences takeoff roll, controllers need not withhold takeoff clearance until the separation actually exists.

In addition to the separation criteria governing departing aircraft, care must be exercised to ensure that a category 1 or 2 aircraft that will be taking off from an intersection on the same runway behind a preceding departing category 3 aircraft, does not commence takeoff roll for at least 3 minutes following the departure. This procedure does not apply to aircraft departing behind a heavy jet.

SEPARATION OF ARRIVING AIRCRAFT.—Arriving aircraft are separated from other aircraft using the same runway by ensuring that the arriving aircraft does not cross the landing threshold until one of the following conditions exists:

1. The other arriving aircraft has taxied off the runway. (See fig. 10-23.)

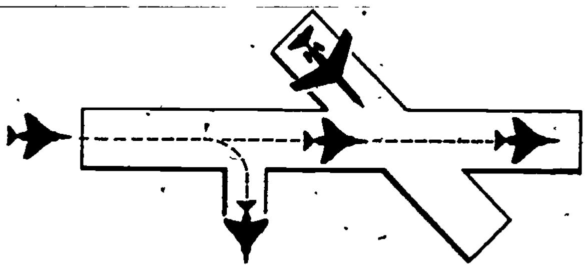
2. Between sunrise and sunset, if distances by reference to suitable landmarks can be determined and the other aircraft has landed, the preceding arrival need not clear the runway if the following minimum distances from the landing threshold exist (fig. 10-24):

a. When a category 2 aircraft is landing behind a category 1 or 2 aircraft—4,500 feet.

b. When a category 1 aircraft is landing behind a category 1 or 2 aircraft—3,000 feet.

3. The other departing aircraft has crossed the end of the runway. (See fig. 10-25.)

4. If distances by reference to suitable landmarks can be determined and the preceding departure is airborne, it need not have crossed the runway end if the following minimum



201.148

Figure 10-22.—Separation between departing and arriving aircraft using intersecting runways.

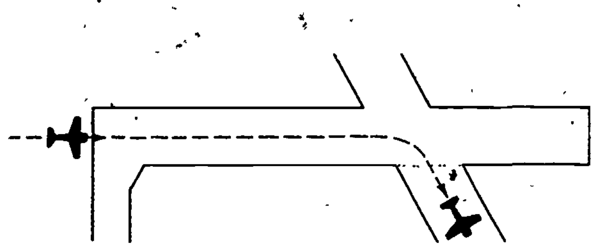


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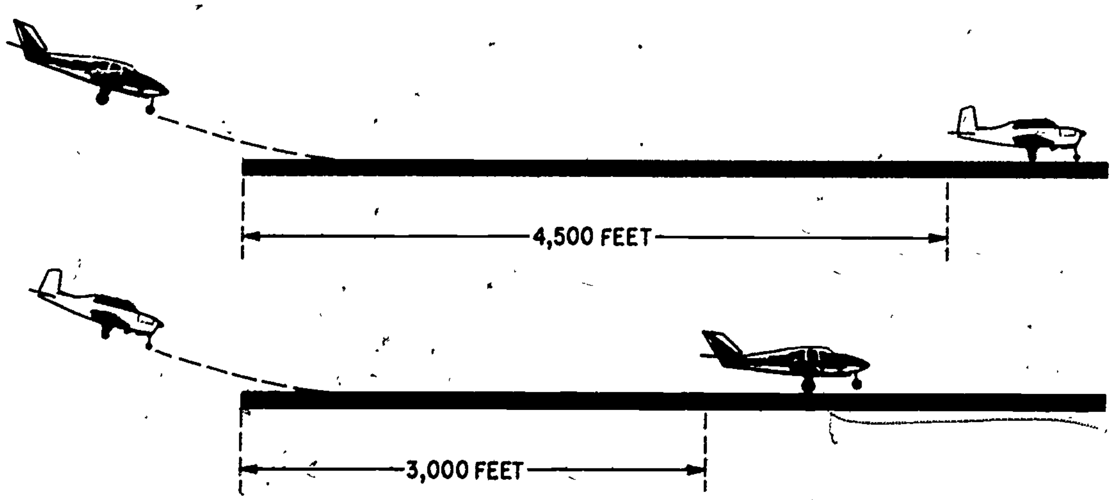
Figure 10-23.—Separation between arriving aircraft.



201.150

Figure 10-24.—Separation of different category arriving aircraft.

distances from the landing threshold exist (fig. 10-26):

a. When only category 1 aircraft are involved—3,000 feet.

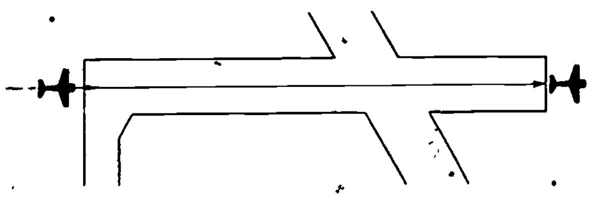
b. When either aircraft is a category 2 aircraft—4,500 feet.

c. When either aircraft is a category 3 aircraft—6,000 feet.

An arriving aircraft is separated from another aircraft using an intersecting runway by ensuring that the arriving aircraft does not cross the landing threshold until one of the following conditions exists:

1. The preceding departing aircraft has passed the intersection or is airborne and turning to avert any conflict. (See fig. 10-27.)

2. A preceding arriving aircraft has taxied off the landing runway, completed landing roll and will hold short of the intersection, or has passed the intersection. (See fig. 10-28.)



201.151
Figure 10-25.—Separation of arriving and preceding departing aircraft.

SEPARATION OF HELICOPTERS.—Departing helicopters are separated from other helicopters by ensuring that they do not take off until one of the following conditions exist:

1. A preceding departing helicopter has proceeded away from the takeoff area. (See fig. 10-29 (A).)

2. A preceding arriving helicopter has taxied off of the landing area. (See fig. 10-29 (B).)

An arriving helicopter is separated from other helicopters by ensuring that it does not land until one of the following conditions exists:

1. A preceding arriving helicopter has come to a stop or taxied off the landing area. (See fig. 10-30.)

2. A preceding departing helicopter has proceeded away from the landing area. (See fig. 10-31.)

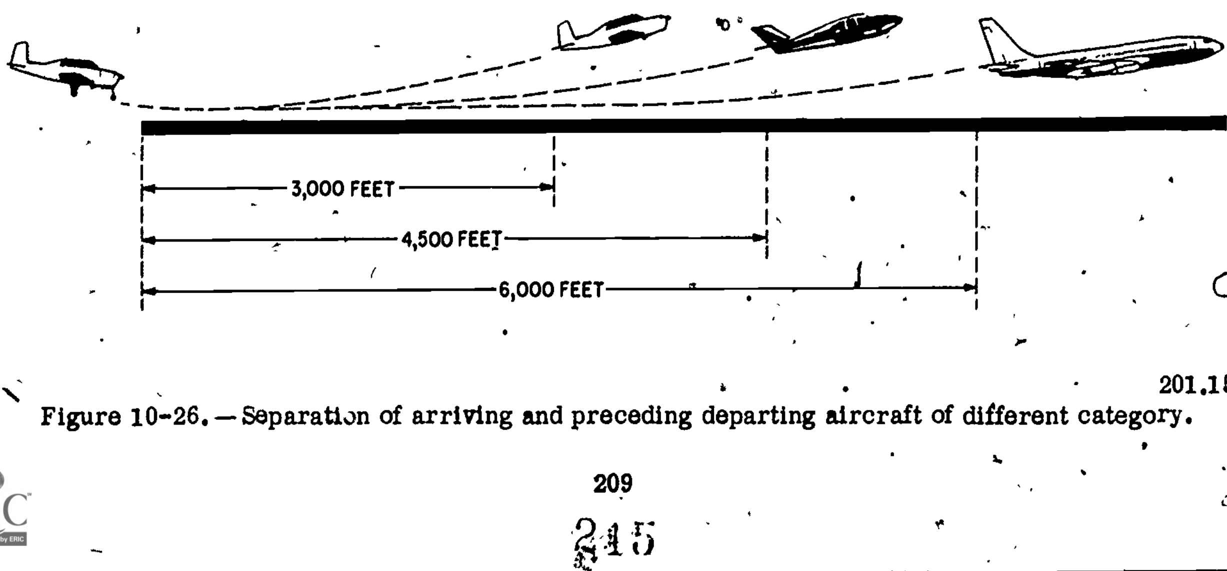
Helicopters may be authorized to conduct simultaneous landings or takeoffs if the distance between the landing and takeoff points is at least 200 feet and the courses to be flown do not conflict. (See fig. 10-32.)

NOTE: Surface markings would have to be referred to, in order to determine the minimum distance between helicopters, or the pilots of the helicopters may be instructed to remain at least 200 feet from other helicopters.

Helicopters performing air taxiing operations (normally not above 10 feet) on the movement area are considered to be taxiing aircraft.

Departing Aircraft

Taxi information issued to departing aircraft is listed in chapter 11 of this training manual.



201.152
Figure 10-26.—Separation of arriving and preceding departing aircraft of different category.

Pilots of departing aircraft will contact ground control prior to ta.d for taxi information. Formation leaders may request and receive taxi information for their entire flight.

Ground control issues the necessary instructions, and clears an aircraft from the parking area to the warmup area. Pilots of taxiing aircraft should remain on ground control frequency while in the warmup area until instructed to change frequency by the ground controller, or until ready for takeoff clearance.

Departing IFR flights receive their ATC clearance on ground control frequency or a designated clearance delivery frequency. Navy pilots are required to "read back" ATC clearances that differ from the filed flight plan.

IFR flights should be informed of the appropriate departure control frequency before takeoff. This information should be issued on the clearance delivery or ground control frequency.

Departing aircraft will hold well clear of the duty runway until cleared for takeoff by the control tower.

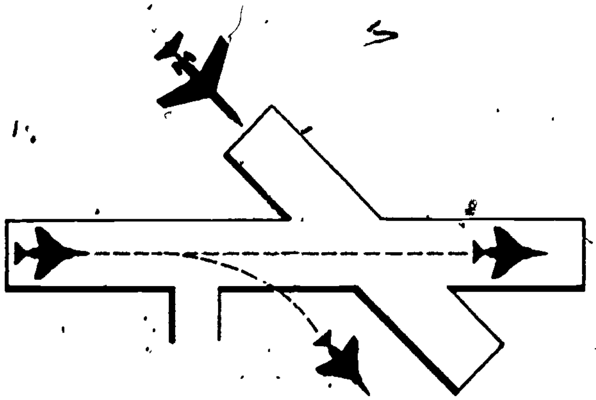


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Figure 10-27.—Separation of arriving and other departing aircraft using intersecting runways.

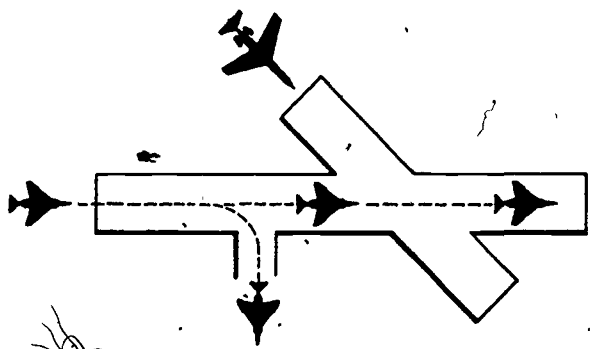

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Figure 10-28.—Separation of arriving and other arriving aircraft using intersecting runways.

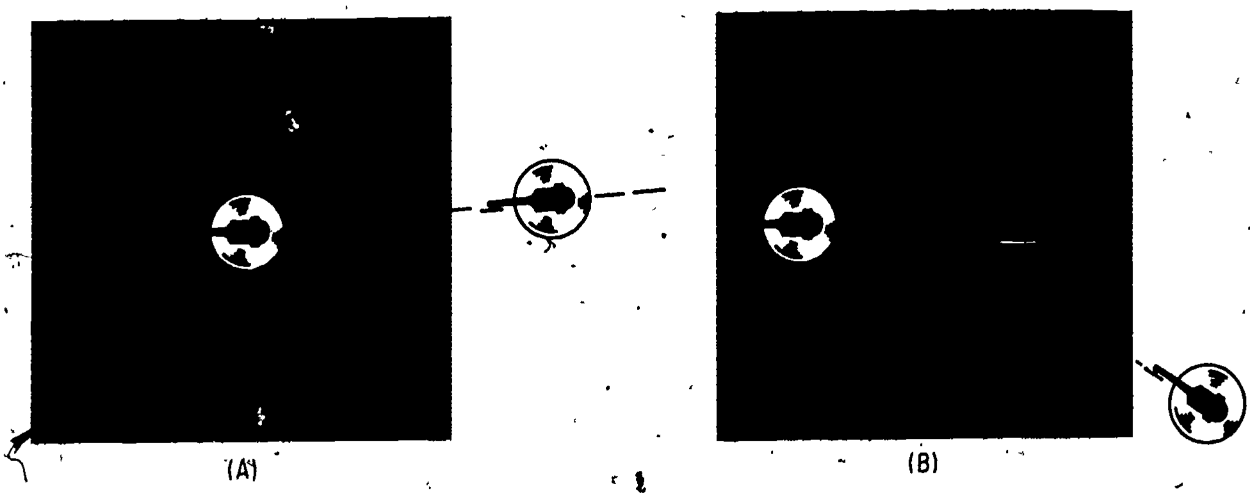

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Figure 10-29.—Separation of a departing helicopter. (A) From a preceding departure; (B) from a preceding arrival.

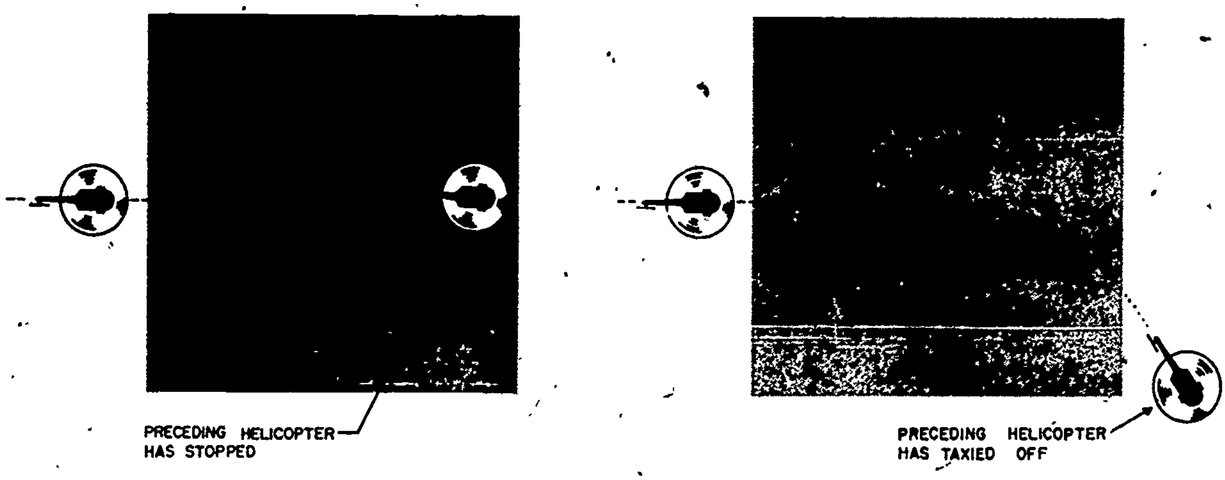

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Figure 10-30.—Separation of an arriving helicopter from a preceding arrival.

Departing IFR flights may be authorized to depart and maintain VFR until the ATC clearance for the IFR flight is received, provided that the pilot requests such clearance and approval is obtained by coordination with the facility responsible for issuing the IFR clearance. The departure time must be forwarded to the facility issuing the clearance and the pilot instructed as to the proper frequency, time, and place to contact such facility. If the IFR facility is unable to issue clearance because of traffic conditions, the pilot should be informed and a suggestion offered that he take the delay on the ground. If the pilot still desires to take off VFR and obtain IFR clearance in the air, the clearance may be issued as local traffic conditions permit. The facility must be informed of the VFR departure time.

Official ceiling and visibility are issued to departing VFR flights prior to takeoff when the weather is below VFR minimums, and to departing IFR flights when the weather is below

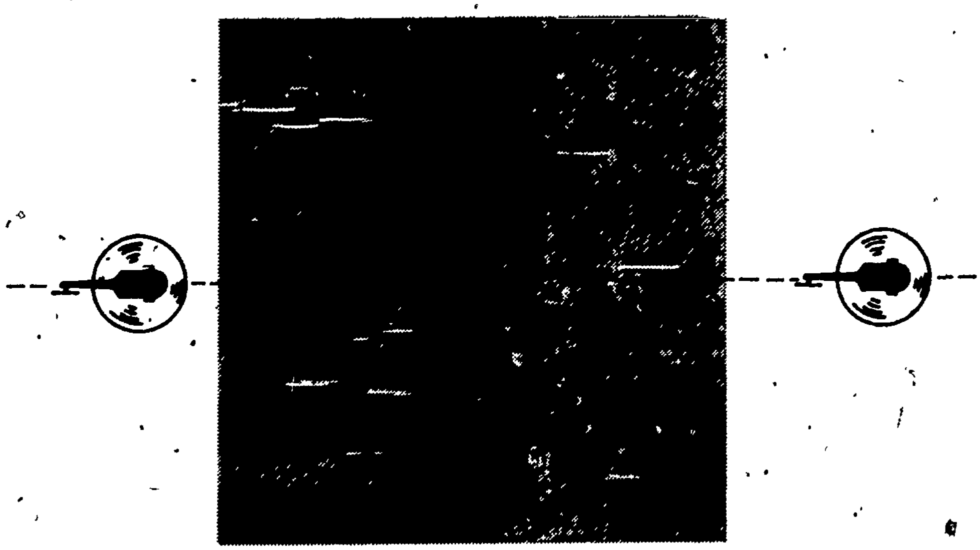

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Figure 10-31.—Separation of an arriving helicopter from a preceding departure.

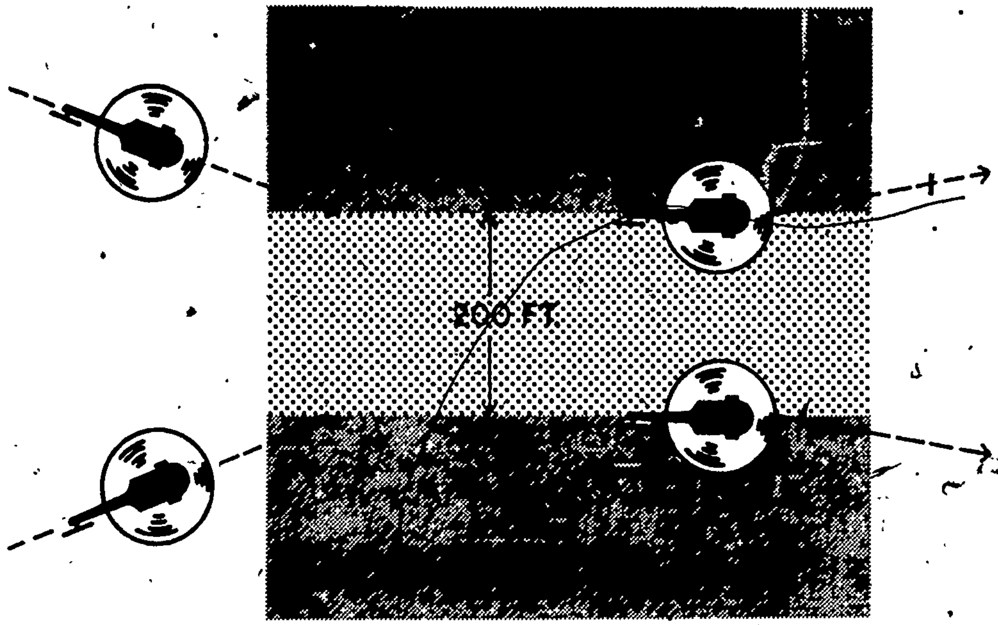

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Figure 10-32.—Separation of simultaneous helicopter operations.

takeoff minimums, or if none are established, when the weather is below VFR minimums.

The Navy has established takeoff minimums for IFR flights based on the pilot's instrument rating. These ratings are entitled Special or Standard and are issued to individual pilots after successful completion of a flight check and written exam administered by an Instrument Flight Board which is established by the Commanding Officer of a facility. There are no takeoff minimums established for pilots with a Special instrument rating, and takeoff will depend on the judgment of the pilot and urgency of the flight. Takeoff may be authorized for pilots with a Standard instrument rating under the following conditions:

1. Three hundred feet ceiling and 1 statute mile visibility.

2. When a radar approach facility with published minimums less than 300 feet ceiling and visibility 1 mile is available, takeoff is authorized provided the weather is at least equal to the precision approach minimums for the runway in use, but in no case when the weather is less than 200 feet ceiling and visibility 1/2 mile/2400 feet RVR.

At certain air stations where commercial or air carrier aircraft are authorized to operate carrying passengers or cargo for hire or compensation, there is a minimum visibility below which takeoff clearance to such aircraft must be denied. The specific minimum visibility is variable, depending upon the type of visibility reporting procedure and equipment available at the particular station. Should your station be so affected, refer to the appropriate section of TATC Handbook 7110.8 (Series) for the applicable minimum visibility.

A departing IFR flight should be instructed to contact departure control when appropriate. For aircraft that can change radio frequencies after takeoff, the instructions are normally issued when the aircraft is one-half mile beyond the end of the runway provided that no further communications with the tower are required. For others, the instructions may be issued prior to, or in conjunction with, the takeoff clearance.

Takeoff clearance need not be withheld until prescribed separation exists if there is reasonable assurance that it will exist when the aircraft starts its takeoff roll.

Arriving Aircraft

Landing information, as appropriate, to be issued to arriving aircraft is listed in chapter 11 of this training manual.

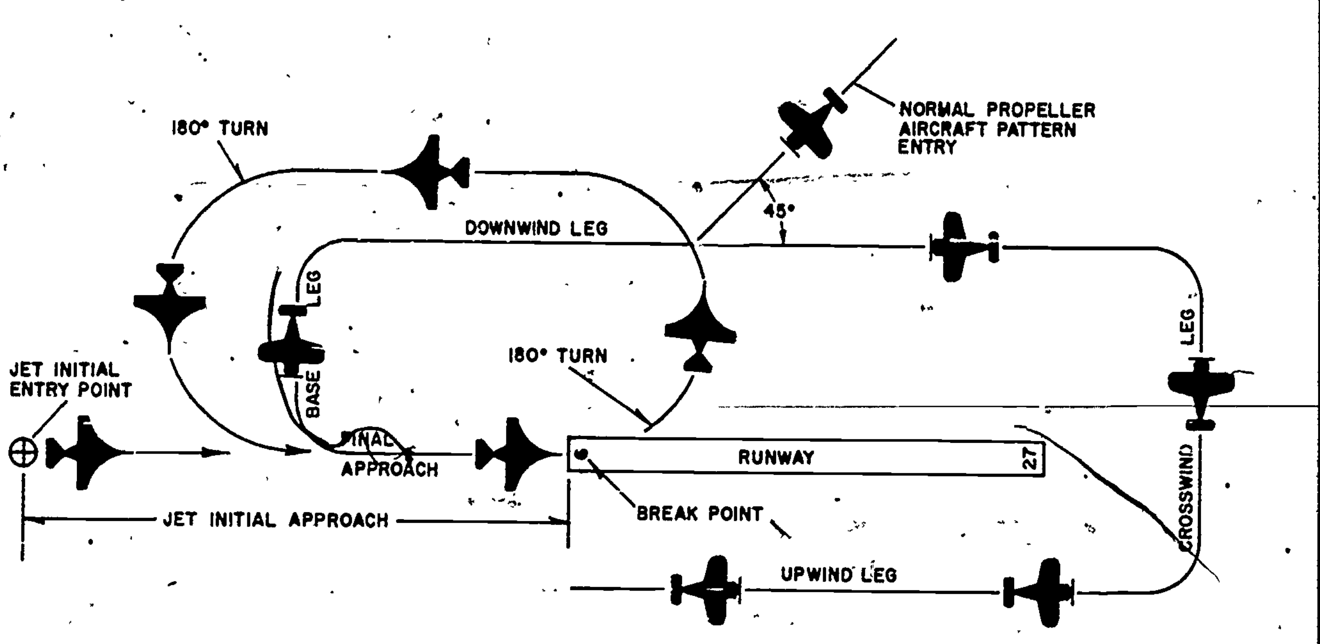

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Figure 10-33.—Conventional and overhead approach traffic patterns.

At certain facilities, procedures may be established for arriving VFR traffic to contact approach control for landing and traffic information. In such cases approach control assists the local controller with the communications workload and traffic spacing in addition to enhancement of safety by making traffic information available for a greater distance from the airport. Local instructions will be promulgated which govern such operations.

Arriving aircraft normally call the tower for landing instructions prior to entering the airport traffic area. Aircraft carrying very important persons (VIP), or cargo requiring assistance, should contact the tower as soon as possible and again when entering the airport traffic area.

Spacing of arriving aircraft must begin prior to their reaching that portion of the traffic pattern where a landing clearance must be given. VFR traffic tends to arrive at irregular intervals or in large numbers requiring a controller to issue the necessary instructions and information to establish an evenly timed flow of traffic.

Traffic patterns are established at airports to specify the desired flow of air traffic in the vicinity of the airport. Standard patterns are left-hand patterns as depicted in figure 10-33. A conventional pattern, used mostly by reciprocating engine-powered aircraft, consists of the following:

1. Upwind leg. A flight course parallel to the landing runway in the direction of landing.

2. Crosswind leg. A flight course at right angles to the landing runway off its upwind leg.

3. Downwind leg. A flight course parallel to the landing runway in the direction opposite to landing.

4. Base leg. A flight course at right angles to the landing runway off its approach end and extending from the downwind leg to the intersection of the runway centerline extended.

5. Final approach. A flight course in the direction of landing along the runway centerline extended from the base leg down to the runway. (See fig. 10-33).

A standard overhead approach pattern for use by military high performance aircraft consists of the following:

1. An initial approach 3 to 5 miles in length.

2. A breakpoint at which the first 180-degree turn is started. (Normally over the numbers on the runway of intended landing.)

3. Direction of turns is normally left.

4. Pattern altitudes at least 500 feet above the conventional pattern until the second 180-degree turn is started.

5. A rollout on final approach not less than one-fourth mile from the runway threshold and not less than 300 feet above the ground. (See fig. 10-33.)

Entry of the overhead approach pattern is normally from the initial point. Entry of the conventional pattern is normally an interception of the downwind leg at an angle of 45 degrees. (See fig. 10-33.)

Specified procedures and control techniques vary from one facility to another, as well as from one controller to another. However, certain basic rules apply regardless of the techniques that are used; for example:

1. The controller is responsible for issuing instructions and information relative to all known traffic conditions.

2. All turns by the pilot around the airport will be left-hand, unless otherwise specified by the controller.

3. At least one component of a traffic pattern (final approach) will be used by the pilot, consistent with instructions issued by the controller.

4. Pilots are responsible for conformance with the applicable pattern requirements established by antinoise programs, etc.

5. Pilots have the final authority for the acceptance of clearances issued from the tower.

6. All instructions issued by the controller, and accepted by the pilot, must be adhered to by the pilot concerned.

7. Pilots landing or taking off are entitled to all usable and available portions of the runway.

If it is necessary to hold arriving VFR aircraft at visual holding points because of traffic congestion, such aircraft would be cleared to a selected, prominent geographical fix easily recognized from the air and preferably one depicted on aeronautical charts. Instructions should be issued regarding the direction of holding and turns. Traffic information is issued to aircraft cleared to hold at the same fix.

Landing clearance is normally issued when arriving aircraft turn to base leg or begin the second 180-degree turn for the overhead approach. Such clearance is normally issued after prescribed separation between aircraft concerned exists and the pilot reports "wheels down."

Landing clearance need not be withheld until prescribed separation exists if there is reasonable assurance that it will exist when the aircraft crosses the landing threshold. However, a succeeding aircraft should not be cleared to land before a preceding arriving aircraft crosses the landing threshold.

Landing clearance may be issued to a radar-controlled aircraft when it is 3 miles from touchdown or landing threshold even though the preceding aircraft has not crossed the landing threshold provided that there is reasonable assurance that appropriate separation will exist when the radar-controlled aircraft crosses the threshold. Traffic information should be included with the landing clearance.

A landing clearance may not be withheld indefinitely, even though it appears a violation has been committed. The apparent violation might be the result of an emergency situation. In any event, assist the pilot to the maximum extent possible.

If the pilot of an aircraft requests clearance for an operation from a closed or unsafe runway, he should be advised of the runway condition. If the pilot persists in his request, a controller may quote the applicable parts of the NOTAM concerning the runway and inform the pilot that a clearance cannot be issued. Then if the pilot still insists and in the opinion of the controller the operation would not adversely affect other traffic, he should be informed that the operation will be at his own risk.

Parking Transient Aircraft

Pilots of arriving aircraft will normally shift to ground control frequency upon clearing the duty runway. At this time the ground controller will issue any additional instructions necessary for the aircraft to proceed to the appropriate destination on the field. Pilots of aircraft based aboard a particular station or those who are known to be familiar with the field may need only an acknowledgment from ground control that they are on ground control frequency and a brief instruction to complete the operation.

EXAMPLE: TAXI TO YOUR LINE.

Pilots who are unfamiliar with the field may need precise step-by-step instructions to get the aircraft to the proper place. Actual parking of the aircraft is accomplished by a line crew; however, the ground controller should provide the line crew with advance notification of the aircraft arrival so that the transition from instructions issued by the tower to visual signals provided by the lineman is a smooth and continuous operation. Use of FOLLOW ME vehicles is common at many fields to simplify the procedure of getting an unfamiliar pilot to his destination on the field as expeditiously as possible. The ground controller will have communications with both the FOLLOW ME vehicle and the aircraft, but communications do not normally exist between the vehicle and the aircraft. This requires liaison and coordination to get the vehicle in the proper pickup position and ensure that the pilot establishes visual contact with the vehicle. These vehicles are usually lighted for night use.

Refueling operations are outside the authority or responsibility of tower controllers; however, they may be called upon to relay advance information to the appropriate personnel about the type or grade of fuel required by a transient aircraft. This allows the refueling truck to be called out and meet such aircraft when they are parked, thereby expediting refueling and reducing ground time.

Priority

Air traffic control service is provided on a first come, first serve basis as circumstances permit, with the following exceptions:

1. Maximum possible priority should be provided military air evacuation flights when requested by a particular pilot. Particular consideration to priority should be given in terminal areas and to avoid turbulent conditions.

2. Maximum assistance should be provided SAR aircraft while performing a SAR mission.

3. Special handling may be required to expedite a Semiautomatic Flight Inspection Aircraft (SAFI), which is a specially equipped aircraft with a preplanned system of checking certain navigation aids.

4. Special consideration must be given to expedite the movement of the Presidential or the Vice Presidential aircraft and any escort aircraft as well as related control messages when traffic conditions and communications facilities permit.

5. Expeditious handling is required for any aircraft using the code name FLYNET. This code name indicates that the aircraft is transporting a nuclear emergency team to the location of a nuclear incident.

Insofar as assigning priorities for the handling of aircraft experiencing emergencies is concerned, no set priorities can be prescribed because of the infinite variety of possible situations which may occur.

It should be remembered however, that aircraft in distress have the right of way over all other traffic.

All naval air activities may assign priorities to VFR traffic. Priority is not normally given to VIPs; however, all Navy air traffic control facilities may give consideration to VIPs as long as safety is not affected.

The operation of jet-propelled aircraft necessitates expeditious handling to avoid excessive fuel consumption during taxiing, takeoff, and landing operations. Therefore, the following instructions must be followed by naval control tower operators:

1. Jet aircraft must NOT be granted priority for taxiing, takeoffs, or landings unless the pilot so requests.

2. In granting priority: (1) Jet aircraft may be cleared first when propeller-driven aircraft will delay taxiing and takeoff; (2) if jet aircraft are ready for takeoff and propeller-driven aircraft are approaching for landing, jet aircraft may be cleared for takeoff and all other aircraft except jet, hospital evacuation, and aircraft in emergency may be instructed to circle the field; (3) jet aircraft approaching for landing may be cleared ahead of all other aircraft (both jet and conventional) taking off and ahead of all other aircraft landing except those in emergency and hospital evacuation aircraft.

Pilots of jet aircraft should not request priority except when considered necessary. Ordinarily, the necessity should not exist for flights in local flying areas.

VFR Helicopter Operations

Where helicopter and fixed-wing aircraft use the same facility, a controller must consider the maneuverability and operational characteristics of helicopters when issuing instructions and information to establish a smooth flow of traffic. Helicopters do not necessarily conform to a standard traffic pattern as do fixed wing aircraft. Local procedures may be established to ensure uniformity of helicopter operations. Local pilots would probably be familiar with such local procedures, but transient pilots would depend upon the controller to issue appropriate instructions. Conflicting flight paths and movements between helicopters and fixed-wing aircraft must be prevented.

Pilots of helicopters should request permission from the control tower to cross a duty runway, or runway in use. The controller should then issue appropriate instructions based upon an assessment of the current traffic situation.

Navy helicopter flights within a control zone should not exceed an altitude of 500 feet unless authorized to do so by the control tower or other appropriate agency.

Helicopter training flights should stay well clear of other traffic. When they are within the boundaries of the airfield, the pilot should guard the tower frequency so a controller can keep the pilot informed of current traffic information.

Practice autorotations (defined in appendix III) may be conducted within the limits of the field boundaries over a surface where a full autorotation might be safely completed, and which is readily accessible to crash and firefighting equipment. Practice autorotations require the approval of the control tower.

Simulated Flameout (SFO) Procedures

Military turbojet aircraft may be authorized to make SFO maneuvers. Practice SFO approaches are authorized only for specific aircraft. However, precautionary SFO approaches might be made by any aircraft when engine failure is considered possible.

The following are requisite if practice SFOs are authorized:

1. A Letter of Agreement authorizing SFOs is in effect.
2. Known traffic information is relayed to the aircraft conducting the SFO and to any other aircraft within or adjacent to the flameout maneuvering area.
3. Altitudes to be utilized by aircraft conducting simulated flameout operations or practice precautionary approaches must be obtained by ATC prior to granting approval for the operation.

A simulated flameout pattern consists of the following:

1. High Key, which is a position over the airport where the pilot begins to maneuver the aircraft to enter a high downwind leg. (Recommended altitude 5,500 to 15,000 MSL.)

2. Low Key, which is a position on high downwind leg just before turning on base leg. (Recommended altitude 3,500 to 10,000 MSL.)

3. Flameout Maneuvering Area, which is that airspace to be occupied by an aircraft conducing a SFO approach, which begins at high key, includes the low key, and ends at the landing threshold. (See fig. 10-34.)

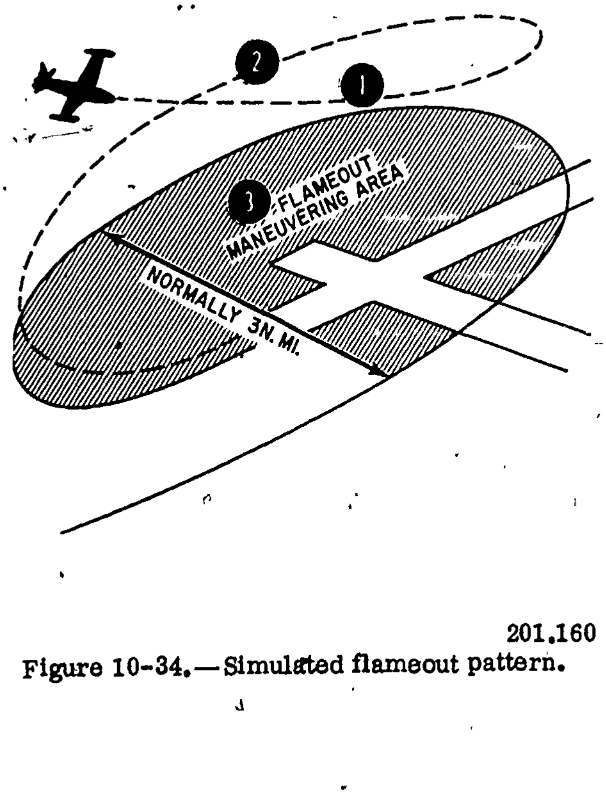

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Figure 10-34.—Simulated flameout pattern.

Aerial Tow Target Operations

Aerial tow targets and related equipment are used in gunnery practice by ships and shore installations and in air-to-air firing exercises. Towing operations enable gunners to fire at targets that simulate moving aircraft in speed, shape, and maneuvers.

Most aerial tow targets presently employed are of the type that can be released, or trailed, behind the aircraft in flight and retracted when the mission is completed. These targets do not normally require any special consideration concerning airport traffic control. However, the possibility of a mechanical malfunction exists, and a pilot may not be able to retract the target. In such cases the pilot may desire to make a low approach over the airport and drop the target in an area from which it could be retrieved. The local Air Operations Manual designates specific procedures and areas for dropping towed targets.

It should be kept in mind that an aircraft with a tow in the traffic pattern is a definite hazard and the Air Controlman has the responsibility of controlling traffic accordingly. This may require additional spacing of traffic or having other traffic vacate the traffic pattern until the tow drop is complete.

Field Carrier Landing Practice

Involvement of the Air Controlman in the procedures of field carrier landing practice (FCLP) stems from his position of control of aircraft at and around the airport. The extent to which he is called upon to exercise control and handle other aspects connected with FCLP is discussed in the following sections.

The landing signal officer (LSO) is an experienced carrier pilot, designated and trained by the Navy to assist and instruct pilots in carrier and field carrier landing techniques. The LSO has direct responsibility for the aircraft in the FCLP pattern. The tower retains overall control of the traffic, which means the control tower will issue instructions whenever there is danger present to the aircraft in the pattern. To effectively accomplish this, there must be close coordination between the tower and the LSO regarding any emergency action that may be necessary. In addition, tower operators can relay any information to the LSO pertaining to the aircraft in the pattern if it will result in safer operations. The only instructions, other ~~than~~ those issued by the control tower during FCLP when a hazardous condition exists, are initial takeoff clearance and taxi instructions. All other instructions given to the pilots of aircraft conducting FCLP are given by the LSO.

FCLP is the most hazardous routine operation conducted on the field. The tower operation must be constantly alert for any emergency while these operations are in progress. These emergencies may result from spins, stalls, and ground loops, due to the slow speed and low altitude of the aircraft in the pattern. While conducting FCLP, more than the normal amount of crash equipment is required to be available on the field because of the greater hazards involved. Station instructions designate the positioning of this equipment and the amount required.

Pilots receive an extensive training program at shore installations, preparing them for actual carrier landings prior to going aboard an aircraft carrier. Therefore, to approximate shipboard landing conditions, a runway is marked off in size and shape similar to the flight deck of an aircraft carrier. Landing area markings, discussed earlier in this chapter, sometimes serve as a simulated flight deck for FCLP. However, when it is impractical to conduct FCLP operations on the landing area marking, additional simulated flight deck markings are painted at appropriate locations on the runway. Lights are used to outline the runway for nighttime use. These may be either portable lights or smudge pots.

FCLP PATTERN.—The FCLP pattern is usually a touch-and-go pattern. This means that the aircraft is able to stay in the pattern and complete more approaches. When the aircraft takes off, the pilot will usually turn slightly to the right so as to leave the runway clear of turbulence. An aircraft entering turbulence from an aircraft ahead may have trouble recovering because of the low altitude, and a crash may result. The airspeeds used vary with the type of aircraft; however, they are normally not much above stalling speeds. In their final approach, aircraft are controlled by the LSO. The LSO may, at his discretion, wave off an aircraft at any point in the landing approach. The pilot will land after completion of the required number of approaches, or when low on fuel. The control tower will then issue instructions to the pilot for taxiing back to the parking area.

An aircraft receiving a waveoff will remain in the pattern and will make its next approach in its regular sequence, wih other aircraft still in the pattern.

Most facilities have a portable or permanently installed Fresnel lens for use with FCLP. This visual landing aid is the same as that used aboard ship and is illustrated in chapter 13 of this manual.

MINIMUM FUEL

Minimum fuel is an advisory term indicating that, in the judgment of the pilot, his fuel state is such that no undue delay can be accepted enroute to his destination. This is not an emergency situation, but undue delay may result in an emergency. If at any time the remaining usable fuel supply suggests the need for traffic priority to ensure a safe landing, the pilot shall declare an emergency and report fuel remaining in minutes. Both minimum fuel advisories and emergency fuel state shall be reported each time control is transferred to a new controller.

EMERGENCY AND CRASH PROCEDURES

The facilities for fighting fires and aiding personnel involved in crashes are a vital part of the airport equipment.

While flight operations are being conducted, commanding officers must ensure that adequate firefighting, crash, rescue, and ambulance equipment is on hand. They must also see that the equipment is favorably located, adequately manned, and in efficient operating condition and that the crew is alerted. Only a minimum of equipment is required on the field during normal operations, but other crash and rescue equipments are held in readiness at all times.

All air stations maintain a current crash bill detailing the duties of those assigned the handling of such emergencies including control tower operators. Additionally, procedures are established for handling emergencies or accidents when the aircraft involved is carrying hazardous cargo. These instructions are normally separate from the crash bill because of their classified nature.

It is the primary responsibility of the control tower operator to observe closely all activities on the airfield and within the visible traffic pattern, and maintain radio communications with aircraft concerned. Normally the control tower operator will obtain initial information on an impending emergency or accident. Control tower personnel must speedily convey exact information to crash, firefighting, and rescue units so that prompt action by those units can be taken.

At any time a pilot reports an emergency or an aircraft emergency is suspected, immediate response is required to assure that the pilot has appropriate and adequate runway lights or other applicable light systems lighted for his landing when lights are required. For suspected inbound lost communications aircraft, the runway lights, approach lights, and other required light systems must be lighted as prescribed 30 minutes prior to the estimated time of arrival of the unreported aircraft. The lights must remain on until the aircraft has been reported located or 30 minutes after it is estimated that the aircraft's fuel supply is exhausted.

Primary Crash Alarm Intercommunications System

This system is a direct wired intercommunications system normally installed between the stations listed herein.

Its purpose is to provide an immediate means of communication to primary emergency activities so they may notify all essential supporting activities.

1. Control tower.
2. Crash/rescue alarm room.
3. Air operations dispatcher.
4. Structural fire alarm room.
5. AirOps duty office.
6. Station hospital or dispensary.

Secondary Crash Alarm Intercommunications System

This system may operate through the regular telephone switchboard and may be activated from the control tower and the flight clearance desk. This system is referred to as the "crash phone." Telephone receivers on this system are installed as required at each facility. The following stations are suggested:

1. Crash/rescue alarm room.
2. Structural fire organization.

3. Hospital or dispensary.
4. Aircraft maintenance department.
5. Photographic laboratory.
6. Crash boat house (if applicable).
7. Security office.
8. Airfield operations office.

This system allows notification of all essential personnel and activities simultaneously by the flight clearance dispatcher without further interference with control tower duties.

The "crash phone" is tested daily at all facilities to ensure its satisfactory operation. This test is usually originated by the control tower or the flight clearance branch.

As procedures may vary at different ATC facilities, no attempt will be made here to explain actual test procedures; however, you should become thoroughly familiar with the entire operation of the crash phone system as it pertains to your facility.

Emergency Radio Communications Systems

Two radio networks are provided for the purpose of coordinating crash and firefighting activities. The primary network is referred to as the "crash network" which provides communications between the control tower and the necessary mobile units such as crash trucks and ambulances. The other network is a standby or spare in case of outage of the primary equipment. The secondary network is referred to as the "internal security network."

Responsibility

In the event of a crash or impending emergency, control tower personnel must convey exact information to the necessary units concerned and keep them advised of the status and pertinent details. They must notify all traffic on the field and in the air of the crash or emergency, and, at the direction of the operations officer or his authorized representative, close the field to traffic until free for normal operations.

When activating the crash phone system, give the following information if available:

1. Location.
2. Type of aircraft.
3. Nature of emergency.
4. Fuel state.
5. Number of personnel aboard.
6. Explosives, ordnance stores, or other dangerous cargo.
7. Landing runway and ETA.
8. Any other pertinent information.

Aircraft crashes are usually described as to location by using a grid map system especially constructed for this purpose. (See fig. 10-35.) Sometimes it is desirable to construct two grid maps. One map is used for crashes on or near the airport, and one is expanded to cover more area for off-station crashes. In either case, all crash vehicles, crashboats, and rescue aircraft must be supplied with copies of these maps to be able to interpret tower directions. Two examples in using this map are: Area THREE FOXTROT would include the approach end of runway 18 and SIX BRAVO would include the approach end of runway three.

There is a certain amount of excitement generated with the occurrence of an emergency or crash. However, since you are transmitting very vital information it is extremely important that you be CORRECT, CONCISE, and CALM. Remember that you are talking to several people at one time and they must absorb the information that you are giving in order to take proper action.

Emergencies and crashes more distant from the field are usually handled by search and rescue facilities. The procedures for alerting search and rescue facilities are covered in chapter 5 of this manual.

For detailed information pertaining to the organization and duties of the crash crew, you should consult the U.S. Navy Aircraft Firefighting and Rescue Manual (NAVAIR 00-80R-14.)

Locator Beacon Signals

Personal survival equipment worn by aircrewman of fighter and attack-type aircraft is equipped with an emergency locator beacon which is activated either manually or automatically after ejection or bailout from a disabled aircraft.

Beacon locators consist of a self-contained radio transmitter which operates on batteries and is very compact, weighing approximately 1 pound.

These units will transmit a distinctive tone on 243.0 (guard frequency). Their purpose is to call attention to the emergency and to provide a signal that can be used for homing or fixing to locate the downed airman. In addition, some equipment used by Navy aircrewmen has a

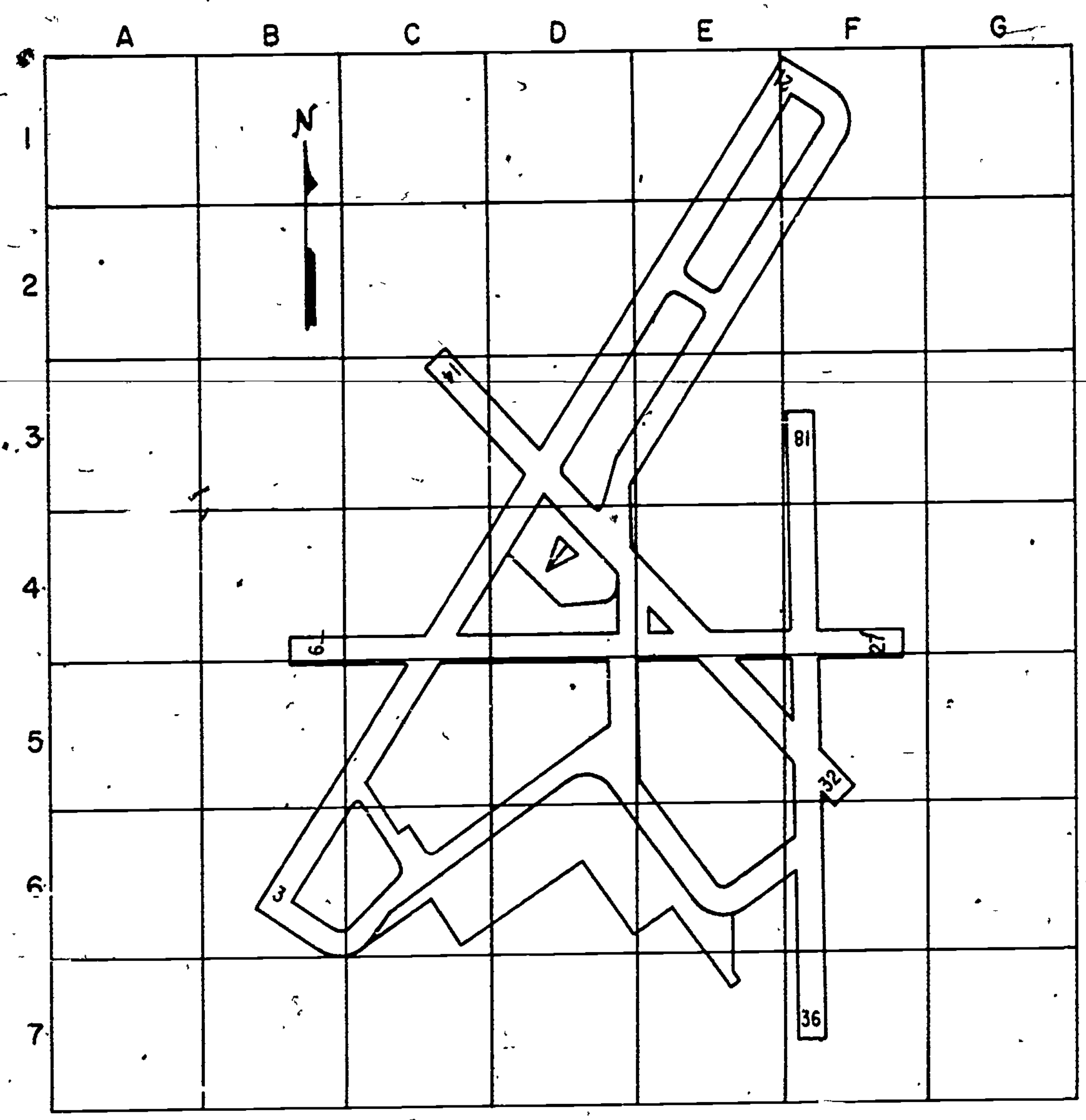

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Figure 10-35.—Crash grid map.

voice transmit-receive capability for use after the airman has reached the ground.

Preventing Wheels-Up Landings

There are many and varied reasons for wheels-up landings. They range all the way from mechanical failure of the landing gear system to forgetfulness on the part of the pilot.

In order to keep wheels-up landings at a minimum regardless of the cause, most naval air stations post a wheel watch at the approach end of the duty runway. This watch is normally provided with two LSO paddles or flags and a pyrotechnic flare pistol or a control switch to the wheels-up warning lights (discussed earlier in this chapter) where installed.

The duty of the wheel watch is to closely observe each aircraft approaching for a landing;

if the landing wheels appear to be down and in place, he signals a ROGER (arms extended parallel to the ground). A waveoff (signal not to land) is given to all aircraft not having landing gear extended (wave arms overhead to side).

At any time there is any doubt, the wheel watch gives a waveoff. If the aircraft continues, and it becomes apparent that the waveoff signal has not been observed, pyrotechnic flares are fired or the wheels-up warning lights are activated, if applicable.

EMERGENCY RECOVERY EQUIPMENT

Emergency recovery equipment is installed at naval airfields to provide a means of bringing tailhook-equipped aircraft to a safe stop after landing whenever normal landing procedures cannot be employed.

This method of recovery may be utilized by aircraft that have experienced a partial failure of their hydraulic system, thereby resulting in a possible loss of brakes, and quite frequently the inability to lower part or all of the landing gear—also in the event of a blown tire or for any other reason that the pilot would deem it advisable to make an arrested landing.

When an emergency arrestment is planned in advance, controllers should be alert to ensure that the tailhook is actually down prior to engagement with the arresting cable.

This may be accomplished by a visual sighting of the hook itself during daylight hours and by observing the sparks generated by the hook dragging on the runway during night landings.

The most common aircraft arresting systems and runway overrun barriers employed at naval air stations are discussed in this section.

E-5 EMERGENCY CHAIN-TYPE ARRESTING GEAR

The E-5 chain-type emergency arresting gear uses the principle of dragging weight behind an aircraft to stop it. The weight in this instance is chain that has been positioned on the runway parallel to and approximately 1 foot inboard from the edges. Two cross deck pendants (cables stretched across the runway) attached to the ends of the chain permit aircraft to be arrested by the tailhook catching the cross deck pendant and dragging the chain until the aircraft comes to a stop.

The chain gear consists of two cross deck pendants, two lengths of chain, and the necessary equipment to tie the two together to make the arresting gear unit.

The operation of the chain gear is very simple. The aircraft catches one of the cross deck pendants with its tailhook, and at this time the shearpin is broken. This releases the pendant, which is now connected only to the chain. The chain is then towed down the runway by the aircraft. (See fig. 10-36.) This permits

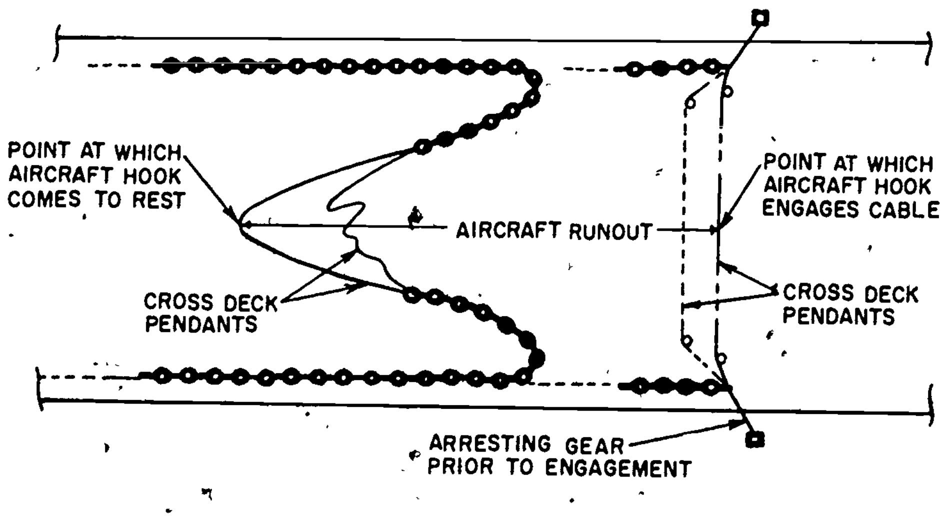

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Figure 10-36.—Operation of chain arresting gear.

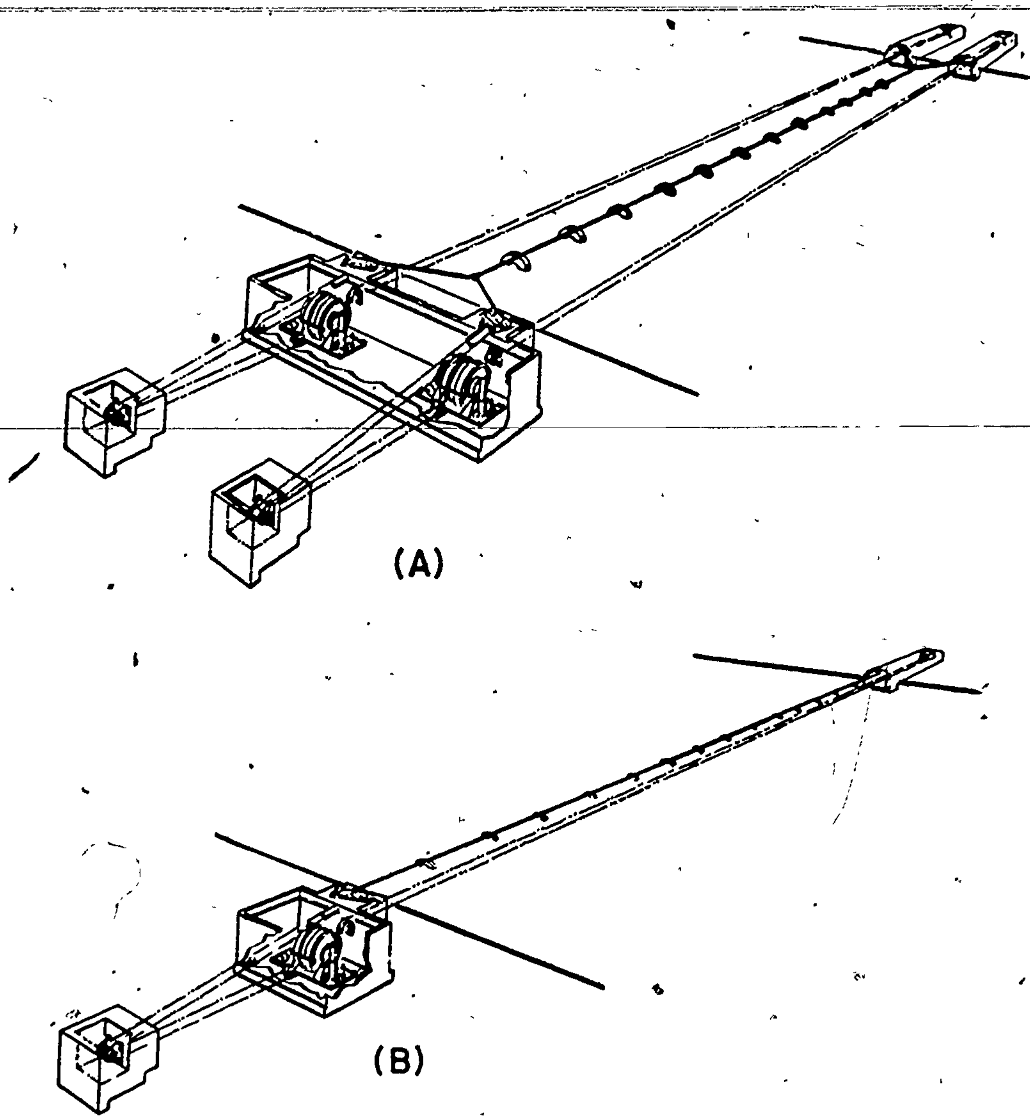

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Figure 10-37.—Bidirectional arresting gear. (A) E-15 gear; (B) E-27 gear.

the transfer of the energy of the arrested aircraft to the chain. The arrangement of the chain causes it to pay out gradually, thus progressively increasing the weight pulled by the aircraft. The energy of the arrested aircraft is dissipated by the chain until the arrestment is completed. Then the aircraft is disengaged from the gear, and the gear is restored for future use.

E-15 AND E-27 ARRESTING GEAR

These types of emergency arresting gear are bidirectional and designed as landbased emergency standby gear for arresting tailhook-equipped aircraft. The arresting engine is a rotary friction-type energy absorber and is designed to dissipate the energy of a landing aircraft. All types of E-15 and E-27 arresting gear use essentially the same engine for arrestment, although engine components may be changed as necessary to suit individual installation requirements.

Aircraft arrestment is accomplished by the engagement of the aircraft arresting hook with a deck pendant which spans the runway. During runout the kinetic energy of the arrested aircraft is absorbed by the rotary friction arresting engine. The arrestment is entirely automatic. The arresting gear engine is activated when the aircraft arresting hook engages the deck pendant, thereby pulling out the attached purchase tapes. As the tapes unwind, the reels rotate, turning sprockets which simultaneously drive a hydraulic pump and rotate a valve cam. The pump supplies pressure to the friction brakes, and the amount of pressure supplied is programmed by the amount of restriction in a cam-controlled valve. The brake application decreases the rotational speed of the reels, thereby slowing down the purchase tape payout which in turn applies a braking force on the aircraft.

Arresting engines for both the E-15 and E-27 may be installed above or below ground (in a pit). A typical E-15 installation is depicted in figure 10-37 (A); the E-27 equipment is shown in figure 10-37 (B).

MOREST EMERGENCY ARRESTING GEAR

Morest arresting gear is a self-sustaining, mobile, portable unit that is capable of being installed on small landing fields. (See fig. 10-38.)

The arresting engines are mounted on a semi-trailer for mobility. In figure 10-38 the wheels have been removed from the trailer so the engines can be stabilized.

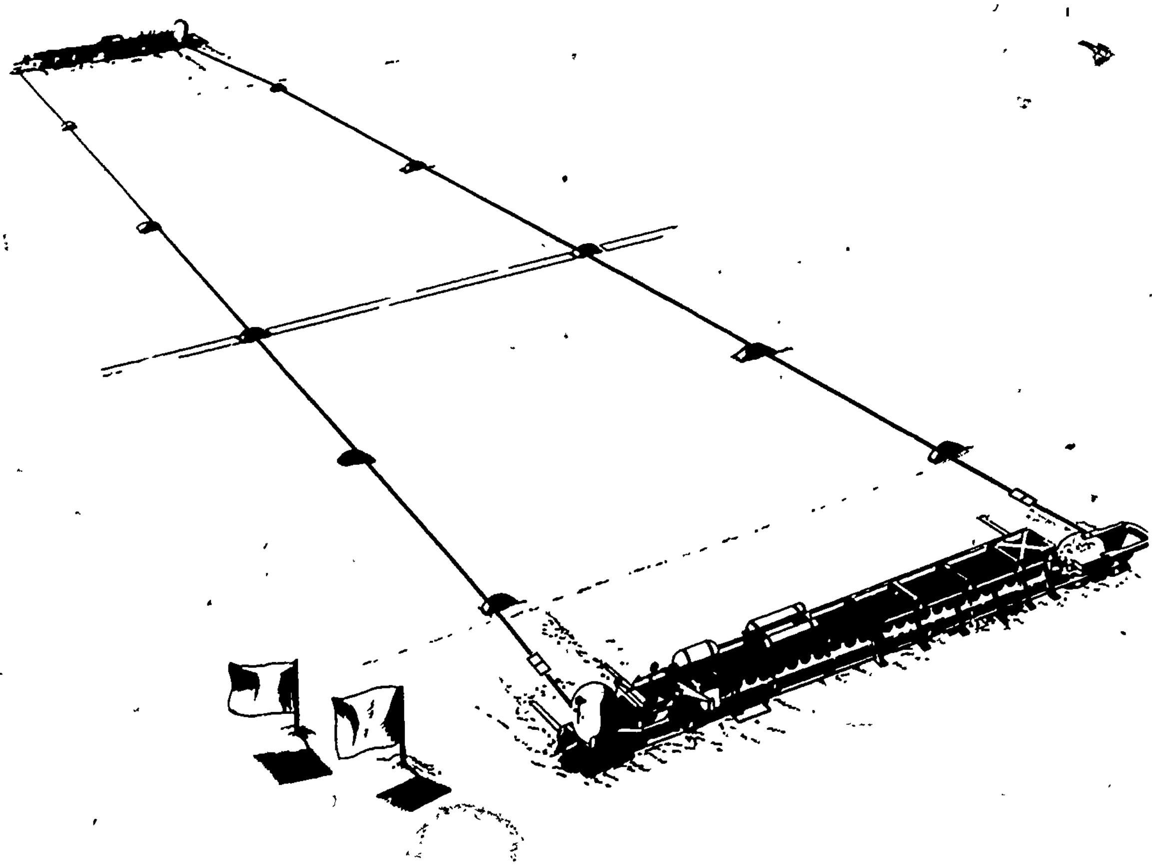

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Figure 10-38.—Morest emergency arresting gear.

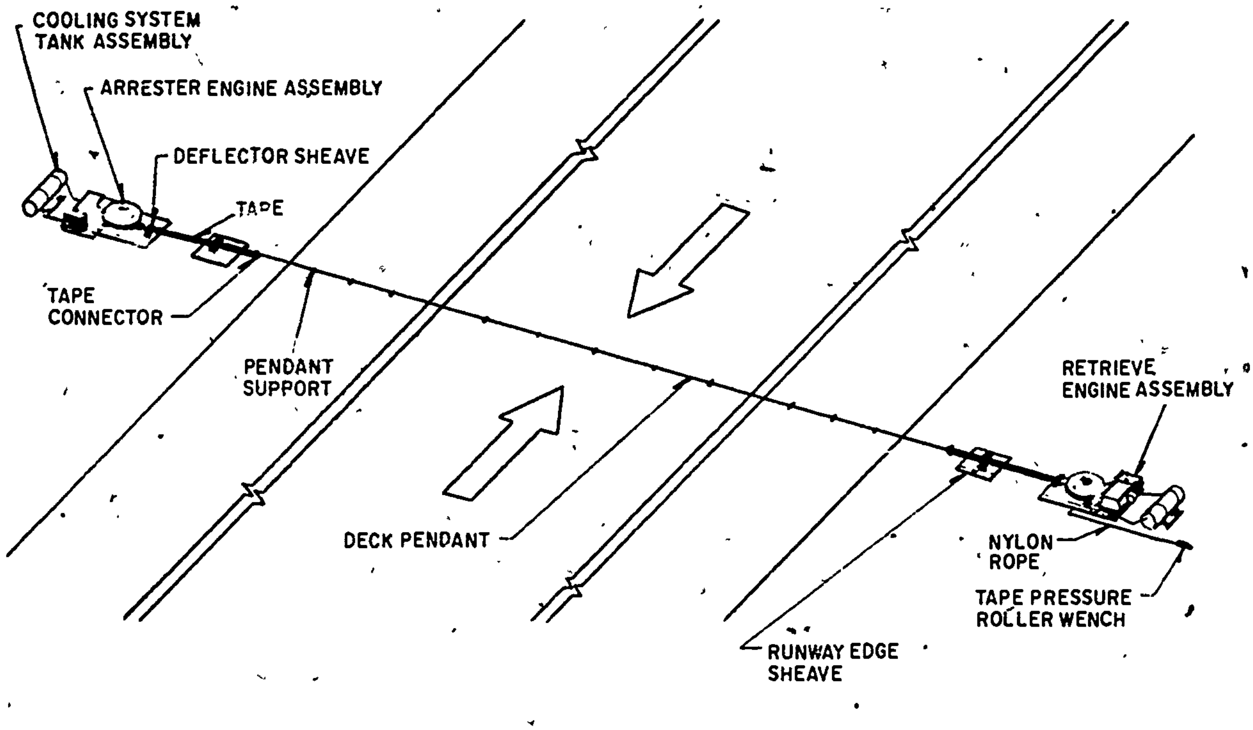

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Figure 10-39.—E-28 emergency arresting gear.

E-28 EMERGENCY RUNWAY ARRESTING GEAR

The E-28 arresting gear is a rotary hydraulic system. It is fast and efficient, and needs little maintenance. It can arrest hook-equipped aircraft in all types of landings. The simplicity of the gear's structure, and its high caliber reliability, make it exceptional. The cycle time for reuse is approximately 80 seconds. No initial preparation or adjustments are necessary for arresting any type of naval aircraft. A man can usually qualify to operate the E-28 within a day or so. Figure 10-39 is an example of the E-28 installation. It is anticipated that the E-28 will replace all other types of arresting gear ashore eventually.

Basically, the E-28 includes a rotary hydraulic system with two identical arresting engines that control the payout of a cross-deck pendant held by the nylon tapes that feed into a winding drum mechanism attached to each energy absorber unit. Each system also contains a cooling system and a retrieve system. Once the hook engages the pendant, the forward motion of the aircraft pulls out the nylon purchase tape and activates the energy absorber units. Each such unit has a rotor and an arrangement of stationary vanes in a container of hydraulic fluid. As the tape unwinds, the rotating wheel turns the rotor, thus creating turbulence in the fluid. This turbulent fluid offers such resistance against the rotor that the speed of the unwinding wheel reel diminishes to the point where the payout of tape is stopped. The heat generated by resistance of the turbulence is drawn off by the pumping of the hydraulic fluid through a cooling tank in which the large exposed surface serves as a heat exchanger, dissipating excess heat to the outside air. The retrieve assembly is a gasoline engine-driven assembly with an electrical starting system and is operated from a control panel on the assembly base. The retrieve assembly rewinds the tape and pre-tensions the pendant after each arrest.

RUNWAY OVERRUN BARRIER

Barriers are that part of the shore-based recovery equipment used for the emergency arrestment of aircraft which, because of tailhook

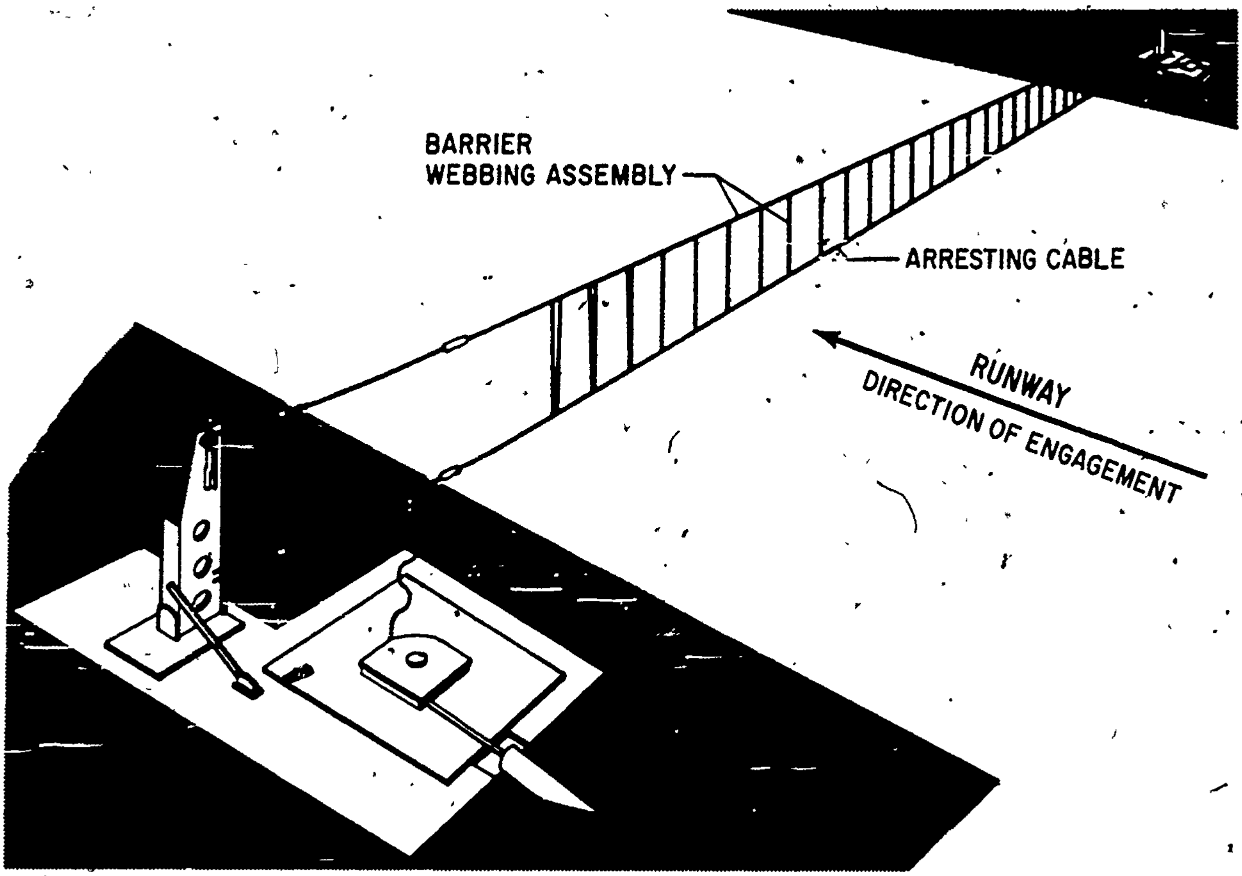

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Figure 10-40.—Runway overrun barrier.

of other mechanical failure, cannot make a normal arrested landing during an emergency situation. The makeup of the barrier includes the following basic items or parts: nylon webbing, port and starboard stanchions, and cross-deck pendants that are attached to the arresting gear as previously described.

The barrier webbing assembly is a group of all-nylon webbing straps combined as a unit, through which the kinetic energy of an aircraft is absorbed, to produce arrestment within a short runout distance. (See fig. 10-40.)

When the aircraft engages the barrier, the nose penetrates the webbing, and the vertical straps engage the leading edges of the wings and wrap about the aircraft. The barricade then passes the forces of arrestment to the chain or nylon tape, at which point the arresting procedure follows in the same manner as the three previously described emergency arresting techniques.

Whenever possible, the barrier is located in the runway overrun area at a sufficient distance from the end of the runway to permit it to remain in a ready position while conducting normal aircraft operations. If sufficient overrun area is not available for such installation, the barrier is located as close to the end of the runway as possible. However, locating the barrier so near the runway makes the barrier an obstruction hazard when making approaches over it. For this reason it is required that it be possible to raise and lower the barrier. At most installations, it can be controlled remotely from the tower.

Emergency recovery of an aircraft by the barrier is the least desirable system described in this chapter, since some damage to the aircraft is likely to result. However, damage is usually minor compared to what could result during the aborted takeoff or during a landing when the aircraft would roll past the runway or overrun area into rough surface where considerable damage and injury to occupants could occur.

RUNWAY FOAMING

Due to the numerous variables present in any emergency landing there is little chance of positively and accurately predicting the usefulness of foam in any given emergency. However, where there is likelihood of fuel spillage that may ignite from friction-produced sparks, the use of foam on the runway will decrease the possibility of a fire from this source by a significant factor. Time is of the essence. First consideration is an estimate of how long the aircraft concerned can remain airborne. The crash trucks require a minimum of 10 to 20 minutes to apply a foam blanket, recharge, and return to the standby position. The operations officer (operations duty officer) is responsible for the decision to foam the runway with or without pilot request if considered desirable, and conversely, to deny the procedure if necessary.

Foam Patterns

Presently there are two basic foam patterns used. They are as follows:

1. Foam is laid from the 2,000-foot to the 5,000-foot position in the center of the runway approximately 40 feet wide. This pattern is usually associated with the landing gear retracted or "belly landing."

2. Foam is laid immediately upwind of the arresting gear that is to be used. It extends for 1,500 feet and fans out toward the side in which the aircraft is anticipated to swerve.

Foam may be removed from the runway in one or two ways. During hours of sunshine, water will settle out of foam and evaporate readily in 2 or 3 hours, or small areas may be washed away with high pressure hose.

In any event, the runway may have reduced braking action until the foam is dry or is removed.

CHAPTER 11

AIR TRAFFIC CONTROL COMMUNICATIONS

Consider the vital link supplied by communications between controllers and air traffic. Without such communications, the controller is severely limited to approval or disapproval of anticipated air traffic movements and then only when visual contact exists, such as with the traffic control light as illustrated in chapter 9 of this training manual. It stands to reason that such an important tool deserves considerable attention from the controller. Existing communications equipment at naval ATC facilities is relatively simple to operate; however, correct application of the simple or basic procedures is a prerequisite to reliable communications when engaged in air traffic control. This chapter is intended to provide the AC with the fundamental knowledge necessary for the correct use of communications and equipment.

RADIO PROCEDURE

RECEIVER CHECK

It is a generally accepted practice to check all receivers at least once during each watch to be sure they are operating. Logically the oncoming watch will do this upon relieving the offgoing watch to determine the usability of the equipment. This may be accomplished by making short transmissions on each assigned frequency at one operating position with all receivers OFF at that position but ON at another position to monitor the check transmission. In actuality, both the transmitters and receivers are being checked by this method since no reception of the check transmission on a particular frequency could indicate a malfunction of either the transmitter or receiver. In the event a malfunction is indicated, controllers should notify the technicians who make further checks and repairs where necessary.

VOLUME ADJUSTMENT

NOTE: The Phone Level, Speaker Level, Mic Level controls, and VU meter referred to in this section are illustrated in chapter 9 of this training manual on the FSA-17, 52 and 58 communications equipment.

Volume adjustment is an individual operation in that each controller has his own desired level of volume. The basic requirement to consider, however, is that volume is not reduced to the extent that transmissions from aircraft within your area of responsibility might not be heard. Conditions affecting volume adjustment vary also. If a controller is monitoring only one frequency and is using a headset, then volume adjustment consists only of adjusting the Phone Level control for a comfortable listening level in the headphone. If a speaker is used, then the Speaker Level control is adjusted for a reasonable listening level but not louder than absolutely necessary, so as not to disturb other controllers at different operating positions. In the case of overhead speakers in the tower, the Speaker Level control is usually physically located in the equipment room and once the levels are set at a comfortable level, they are left in that position. However, there will be times when a controller will want more volume, in which case someone has to go to the equipment room and make the adjustment.

Along with volume control, the Mic Level control should be set for proper modulation of the transmitters. To accomplish this, set all radiophone switches in the OFF position; depress the Mic switch, and speak into the microphone in a normal conversational manner. Vary the Mic Level control until the majority of the peak swings on the VU meter needle pass just above the zero level on the meter. This will properly modulate the transmitters and set the level for the interphone circuits.

FREQUENCY MONITORING

Radio frequencies are assigned to naval facilities by appropriate military authority, each for a particular function. Monitoring procedure differs between facilities; however, the normal procedure at most continuously manned facilities is to monitor all tower and approach control frequencies on a continuous basis. At certain operating positions, such as approach control where the operator normally uses a headset, the receivers may be switched to a speaker and the volume increased during periods of light or no traffic.

PHRASEOLOGY

The use of standard phraseology is necessary for efficient utilization of communications frequencies. Controllers through acquired experience in using standard phraseology are able to make transmissions as brief as possible yet completely understandable. Proficiency may be developed to the extent that in the exchange of communications between controller and pilot the intent of the message is understood even before the verbal transmission is complete. In other words, proper phraseology is second nature to a proficient controller.

Radio Ground Checks

To give a radio check a better description than you actually receive could jeopardize a pilot's life by putting him in instrument flying conditions with a poor radio, or cluttering the already crowded airways with an aircraft that has an inoperative radio.

Give an accurate response to a request for a radio check by using one of the following examples.

1. LOUD AND CLEAR
2. LOUD AND GARBLED
3. WEAK BUT CLEAR
4. WEAK AND GARBLED
5. UNREADABLE

Avoid depressing the mike button until absolutely ready to talk. Do not tie up a frequency with excessive test signals and radio checks. Normally, radio checks are completed prior to the start of daily flight operations, thus causing little interference with the tower routine during peak periods of traffic.

Identification of Ground Facilities

The Air Controlman must know how ground facilities such as towers, centers, approach control, and communications stations are identified during radiotelephone communications. He must know how to identify all types of aircraft—even those of foreign registry. He cannot communicate with these aircraft properly if he is not completely familiar with how to make radio contacts through use of standard phraseologies.

Airport traffic control towers are identified during radiotelephone communications as follows:

State the name of the facility, followed by the word TOWER. Where military and civil airports are located in the same general area and have similar names, state the name of the military service, followed by the name of the military facility and the word TOWER.

EXAMPLES: MEMPHIS TOWER; NAVY MEMPHIS TOWER.

Air Route Traffic Control Centers (ARTCCs) are identified by the location name followed by the word CENTER.

EXAMPLE: KANSAS CITY CENTER.

Approach control facilities, including Army radar approach control facilities (ARACs), and radar approach control facilities associated with the USAF (RAPCONs) are identified by the name of the facility, followed by the word APPROACH. Where military and civil facilities are located in the same general area and have similar names, state the name of the military service, followed by the name of the military facility, and the word APPROACH.

EXAMPLES: DENVER APPROACH; NAVY JACKSONVILLE APPROACH.

Functions within a terminal facility are identified by the name of the facility, followed by the name of the function.

EXAMPLES: OCEANA DEPARTURE; MERIDIAN GROUND.

Radar facilities having air surveillance radar (ASR) and/or precision approach radar (PAR) but not providing approach control service are identified by the name of the facility followed by the letters "G-C-A."

EXAMPLE: ALAMEDA G-C-A.

Air traffic communications stations are identified during radiotelephone communications in the following manner:

Navy communications stations; by the word NAVY, followed by the name of the station and the word RADIO.

EXAMPLE: NAVY NORFOLK RADIO.

Air Force communications stations; by the name of the station followed by the word AIRWAYS.

EXAMPLE: BROOKLEY AIRWAYS.

FAA flight service stations (FSS) by the name of the station followed by the word RADIO.

EXAMPLE: LEXINGTON RADIO.

Aircraft Identification

Military aircraft are identified by one of the following:

1. The service name followed by the last five digits of the serial number.

EXAMPLE: NAVY FIVE SIX ONE TWO THREE.

2. The abbreviations for special military operations followed by the last five digits of the serial number.

EXAMPLES: MAC SEVEN EIGHT FIVE SIX TWO (Military Airlift Command); SAM NINER ONE FIVE SIX TWO (Special Air Mission); LOGAIR SEVEN FIVE EIGHT SIX ONE (USAF Contract Aircraft); NAVY AIR EVAC; MARINE AIR EVAC (air evacuation flights); ARMY RESCUE: (rescue flights); NAVY COPTER (helicopters); FLIGHT CHECK (flight inspection of navaids).

3. Military tactical and training.

a. U.S. Air Force, Air National Guard, Military District of Washington priority aircraft, and USAF civil disturbance aircraft — Pronounceable words of 3, 4, 5, or 6 letters followed by a 4-, 3-, 2-, or 1-digit number.

EXAMPLES: PAUL TWO ZERO; GAYDOG FOUR; PAT ONE FIVE SEVEN.

b. Navy or Marine fleet and training command aircraft — The service name and 2 letters or a digit and a letter (use letter phonetic equivalents) followed by 2 or 3 digits.

EXAMPLE: NAVY GOLF ALPHA TWO ONE.

c. NORAD interceptors — An assigned double letter 2-digit flight number.

EXAMPLE: ALPHA KILO ONE FIVE.

d. Foreign military — Except Canada, the name of the country and the military service followed by the separate digits or letters of the registration or call sign. Canadian Armed Force aircraft shall be identified by the word CANFORCE followed by separate digits of the serial number, except that the Transport Command of the Canadian Armed Force shall be identified by the words CANADIAN MILITARY followed by the separate digits of the serial number.

EXAMPLES: CANFORCE FIVE SIX TWO ONE; BRAZILIAN AIR FORCE FIVE ONE SIX EIGHT ONE.

4. Presidential or Vice Presidential aircraft are identified as follows:

a. When the President or the Vice President is aboard a military aircraft, state the name of the military service followed by the word ONE for the President or the word TWO for the Vice President.

b. When the President or the Vice President is aboard a civil aircraft, state the words EXECUTIVE ONE for the President or EXECUTIVE TWO for the Vice President.

c. When a member of the President's family is aboard any aircraft, and the U.S. Secret Service or the White House Staff determines it is necessary, state the words EXECUTIVE ONE FOXTROT.

Civil aircraft are identified by the aircraft type, model name, or manufacturer's name (if none of these are known, use the word November or the letter N), followed by the digits and letters of the registration number.

EXAMPLES: APACHE ONE FOUR TWO PAPA; DOUGLAS THREE ZERO ONE ROMEO; NOVEMBER THREE SEVEN ONE FIVE.

Air carrier and other civil aircraft having FAA authorized call signs are identified by the call sign followed by the flight number in group form.

EXAMPLES: AMERICAN FIVE TWENTY ONE; COMMUTER SIX ELEVEN; GENERAL MOTORS THIRTY SEVEN.

Aircraft of foreign registry are identified by one of the following:

1. Civil—The letters or digits of the aircraft registration or call sign.

EXAMPLE: C-F-R-L-G.

2. Air carrier—The abbreviated name of the operating company followed by the letters or numbers of the registration or call sign or the flight number in group form.

EXAMPLES: AIR FRANCE F-L-R-L-G; SCANDINAVIAN SIXTY ONE.

If a controller should encounter an unfamiliar call sign, the same identification as the pilot used in the initial callup should be used in the reply even though it may be different from those listed in the appropriate publications.

Procedure Words and Phrases

There are certain procedure words and phrases that have special meanings. These must be mastered by all Air Controlmen, as they are used repeatedly. The following are some of these procedure words and phrases and their meanings:

WORDS AND PHRASES	MEANING
Acknowledge	Let me know that you have received and understand this message.
Affirmative	Yes.
Correction	An error has been made in this transmission (or message indicated). The correct version is . . . .
Go ahead	Proceed with your message.
How do you hear me	Self-explanatory.
I say again	Self-explanatory.
Negative	No or Permission not granted or That is not correct.
Out	This conversation is ended and no response is expected.
Over	My transmission is ended and I expect a response from you.
Read back	Repeat all of this message back to me.
Roger	I have received all of your last transmission. (To acknowledge receipt; do not use for any other purpose.)
Say again	Self-explanatory.
Speak slower	Self-explanatory.
Standby	I must pause for a few seconds. (If the pause is longer than a few seconds, or, if used to prevent another station from transmitting, add the ending, OUT.)
That is correct	Self-explanatory.
Verify	Confirm.
Wilco	I have received your message, understand it and will comply.
Words twice	Communication is difficult. Please say every phrase twice. (As a request.) Since communication is difficult, every phrase in this transmission will be spoken twice. (As information.)

Statement of Numbers

Statement of numbers is always of extreme importance in radiotelephone messages. The following pronunciation of the numerals has been found to be the best and most intelligible.

NUMERALS	PRONUNCIATION
1	WUN
2	TOO
3	TREE
4	FOW-ER
5	FIFE
6	SIX
7	SEV-EN
8	AIT
9	NIN-ER
0	ZERO

ALTITUDES.—State the separate digits of the thousands plus the hundreds.

EXAMPLES:

ALTITUDE	STATEMENT
500	FIVE HUNDRED
4,500	FOUR THOUSAND FIVE HUNDRED
9,000	NINER THOUSAND
10,000	ONE ZERO THOUSAND
13,000	ONE THREE THOUSAND

FLIGHT LEVELS.—State the words FLIGHT LEVEL, followed by the separate digits of the flight level.

EXAMPLES:

FLIGHT LEVELS	STATEMENT
180	Flight level one eight zero.
275	Flight level two seven five.

SERIAL NUMBERS.—State the separate digits.

EXAMPLES:

NUMBER	STATEMENT
18143	ONE EIGHT ONE FOUR THREE
26075	TWO SIX ZERO SEVEN FIVE

TIME.—State the separate digits of the hour and minutes in terms of Greenwich Mean Time (GMT) based on the 24-hour clock.

EXAMPLES:

TIME	STATEMENT
0615 GMT	ZERO SIX ONE FIVE
2230 GMT	TWO TWO THREE ZERO

NOTE: GMT is often referred to as ZULU time which is the phonetic equivalent of the designated letter suffix (Z) of the zero time zone.

Upon request, state the digits of the hours and minutes in terms of GMT, followed by local standard time based on the 24-hour clock.

EXAMPLE:

TIME	STATEMENT
1430 PST (2230 GMT)	TWO TWO THREE ZERO GREENWICH, ONE FOUR THREE ZERO PACIFIC

TIME CHECKS.—State the word TIME followed by the separate digits of the hour, minutes, and nearest quarter minute.

EXAMPLE: TIME, ONE FOUR ONE FIVE AND THREE QUARTERS.

ABBREVIATED TIME.—State the separate digits of the minutes only.

EXAMPLE:

TIME	STATEMENT
1415	ONE FIVE

FIELD ELEVATION.—State the words FIELD ELEVATION followed by the separate digits of the elevation.

EXAMPLES:

ELEVATION	STATEMENT
17 feet	FIELD ELEVATION ONE SEVEN
150 feet	FIELD ELEVATION ONE FIVE ZERO

ALTIMETER SETTING.—State the word ALTIMETER, followed by the separate digits of the altimeter setting.

EXAMPLE:

SETTING	STATEMENT
30.01	ALTIMETER, THREE ZERO ZERO ONE

SURFACE WIND.—State the word WIND, followed by the indicated wind direction to the nearest 10-degree heading, the words DEGREES AT, and the indicated velocity in knots.

EXAMPLE:

WIND, TWO SIX ZERO DEGREES AT ONE FIVE.

HEADINGS.—State the word HEADING, followed by the three digits of the number of degrees and omit the word DEGREES. Use heading 360 to indicate a north heading.

EXAMPLES:

HEADING	STATEMENT
005 degrees	HEADING ZERO ZERO FIVE
095 degrees	HEADING ZERO NINER FIVE

RADAR BEACON CODES.—State each digit of the four-digit code.

EXAMPLES:

CODE	STATEMENT
1000	ONE ZERO ZERO ZERO
2100	TWO ONE ZERO ZERO

RUNWAYS.—State the word RUNWAY, followed by the separate digits of the runway designation. For a parallel runway, state the word LEFT, CENTER, or RIGHT if the letter L, C, or R is included in the designation.

EXAMPLES:

DESIGNATION	STATEMENT
3	RUNWAY THREE
~~24L~~	~~RUNWAY TWO FOUR LEFT~~
7R	RUNWAY SEVEN RIGHT

FREQUENCIES.—State all the digits of the frequency, inserting the word POINT where the decimal point occurs. When the frequency is in the L/MF band, include the word KILOHERTZ.

EXAMPLES:

FREQUENCY	STATEMENT
142.74 MHz	ONE FOUR TWO POINT SEVEN FOUR
360.2 MHz	THREE SIX ZERO POINT TWO
302 kHz	THREE ZERO TWO KILOHERTZ

SPEEDS.—State the separate digits of the speed followed by the word KNOTS.

EXAMPLES:

SPEED	STATEMENT
250	TWO FIVE ZERO KNOTS
180	ONE EIGHT ZERO KNOTS
90	NINER ZERO KNOTS

NOTE: The word KNOTS may be omitted when using speed adjustment procedures.

International Phonetic Alphabet

It is quite often necessary to identify particular letters and groups of letters and/or spell out difficult words since certain sounds have low intelligibility when heard in noise. The standard phonetic alphabet identifies each letter of the alphabet with more readily recognized words. This is done to make the message clear when individual letters of the alphabet are transmitted, and to spell out words that are hard to understand on the air. The phonetic alphabet is as follows:

LETTER	RECOGNIZED WORD	PRONUNCIATION
A	ALFA	AL-FAH
B	BRAVO	BRAH-VOH
C	CHARLIE	CHAR-LEE or SHAR-LEE
D	DELTA	DELL-TAH
E	ECHO	ECK-OH
F	FOXTROT	FOKS-TROT
G	GOLF	GOLF
H	HOTEL	HOH-TELL
I	INDIA	IN-DEE-AH
J	JULIETT	JEW-LEE-ETT
K	KILO	KEY-LOH
L	LIMA	LEE-MAH
M	MIKE	MIKE
N	NOVEMBER	NO-VEM-BER
O	OSCAR	OSS-CAH
P	PAPA	PAH-PAH
Q	QUEBEC	KEH-BECK
R	ROMEO	ROW-ME-OH
S	SIERRA	SEE-AIR-RAH
T	TANGO	TANG-GO
U	UNIFORM	YOU-NEE-FORM or OO-NEE-FORM
V	VICTOR	VIK-TAH
W	WHISKEY	WISS-KEY
X	XRAY	ECKS-RAY
Y	YANKEE	YANG-KEY
Z	ZULU	ZOO-LOO

Airways and Jet Route Description

One of the Air Controlman's most important duties is correctly copying and relaying IFR clearances to IFR flights.

A careful study of the following procedures and examples will enable him to properly describe routes and navaids, using proper phraseology.

VOR/VORTAC/TACAN AIRWAYS.—State the word VICTOR followed by the number of the airway in group form. For RNAV routes add the word ROMEO.

EXAMPLES:

VICTOR THREE NINETEEN.
VICTOR SEVEN TEN ROMEO.

VOR/VORTAC/TACAN JET ROUTES.—State the letter J followed by the route number in group form. For RNAV routes add the word ROMEO.

EXAMPLES:

J SIXTY NINER.
J EIGHT THIRTY ROMEO.

L/MF AIRWAYS.—State the color of the airway followed by the number in group form.

EXAMPLE: BLUE EIGHTY ONE.

NAVAID Description

Describe radials, arcs, courses, and bearing of navaids as follows:

VOR/VORTAC/TACAN NAVAIDS.—State the name of the navaid, followed by the magnetic bearing of the radial, omitting the word DEGREE.

EXAMPLE: MEMPHIS TWO FIVE ZERO RADIAL.

ARCS ABOUT VOR-DME/VORTAC/TACAN NAVAIDS.—State the distance in miles from the navaid, followed by the words MILE ARC, the direction from the navaid in terms of the eight principal points of the compass, the word OF, and the name of the navaid.

EXAMPLE: TWO ZERO MILE ARC NORTHWEST OF GRANTSVILLE.

L/MF NAVAIDS.—State the name of the station, followed by the bearing of the course from the station in terms of the eight principal points of the compass, and the word COURSE.

EXAMPLE: ROSWELL NORTHEAST COURSE.

NONDIRECTIONAL BEACONS.—State the course to, or the bearing from the radio beacon, omitting the word DEGREE, followed by the words COURSE TO, or BEARING FROM, the name of the radio beacon and the words RADIO BEACON.

EXAMPLES: ZERO FOUR FIVE BEARING FROM MEMPHIS RADIO BEACON; TWO TWO FIVE COURSE TO MEMPHIS RADIO BEACON.

NAVAID Fix Description

Describe fixes determined by reference to a radial/localizer and distance from a VOR-DME/VOR-TAC/TACAN/ILS-DME as follows:

a. When a fix is not named, state the name of the navaid followed by the specified radial/localizer and state the distance in miles followed by the phrase MILE FIX.

EXAMPLES: APPLETON ZERO FIVE ZERO RADIAL THREE SEVEN MILE FIX; RENO LOCALIZER BACK COURSE FOUR MILE FIX.

b. When a fix is named, state the name of the fix, followed by the phrase D-M-E FIX, or WAYPOINT as appropriate.

EXAMPLES: JAMES D-M-E FIX; JAMES WAYPOINT.

Radio Contact Procedure

Radio communications may be initiated with an aircraft by using the following format:

1. Initial callup:
   a. Identification of the aircraft being called.
   b. Identification of the calling unit.
   c. The type of message to follow, when this will assist the pilot.
   d. The word OVER.
2. Replying to callup from an aircraft:
   a. Identification of the aircraft initiating the callup.

b. Identification of the replying unit.
c. The word OVER.

EXAMPLES: MARINE THREE ONE FIVE SIX EIGHT, LEMOORE TOWER, ATC CLEARANCE, OVER; NAVY GOLF ALFA TWO ONE, LEMOORE TOWER, OVER.

This same format is used after communication has been established except that after stating the identification of the calling or replying unit, the message to be sent is stated or the message received is acknowledged.

A clearance or instructions intended for a specific aircraft must be prefaced with the identification of that aircraft, except that aircraft identification may be omitted after initial callup when conducting the final descent portion of a radar approach.

Where no confusion is likely, transmissions may be shortened as follows:

1. After communications have been established, and type of aircraft is known, the aircraft identification (with the exception of an air carrier or other civil aircraft having an FAA authorized call sign) may be shortened to the appropriate prefix and the last 3 digits or letters of the identification number, and the facility identification may be omitted.
2. The word OVER may be omitted when the message obviously requires a reply.
3. A message may be transmitted immediately after callup (without waiting for aircraft reply) when it is short and receipt is generally assured.

In the following example, the words which may be omitted are enclosed within parentheses:

Aircraft—(MIRAMAR TOWER) NAVY (SEVEN FIVE) ONE THREE ONE, FOUR MILES SOUTH (AT) TWO THOUSAND, LANDING MIRAMAR, (OVER).

Tower—NAVY (SEVEN FIVE) ONE THREE ONE ROGER, RUNWAY TWO FOUR, WIND TWO SIX ZERO DEGREES AT ONE FIVE, (OVER).

Aircraft—NAVY (SEVEN FIVE) ONE THREE ONE, (ROGER) (OUT).

Traffic Clearances and Instructions

An airport traffic controller should issue such traffic clearances and instructions as are, in his judgment, necessary for the purpose of controlling and protecting air traffic. He accomplishes this by aiding pilots in the prevention of collisions between aircraft under his jurisdiction.

A clearance issued by an airport traffic control tower is authority for a pilot to proceed only insofar as known air traffic and field conditions are concerned; it does not constitute authority for him to violate any provisions of military or federal air regulations.

Clearances issued by airport traffic controllers are predicated upon known or observed traffic and field conditions which, in the judgment of the controller, affect safety in aircraft operations. Such known traffic conditions include not only aircraft observed in the air within the control zone and on the movement area over which control is being exercised, but also any known or observed vehicular traffic or other obstructions not permanently installed on the movement area in use.

If a clearance issued by the airport traffic controller is not acceptable to the pilot, he may request and, if practicable, receive an alternate clearance.

Departure Information

Information, as appropriate, is provided to departing aircraft. Information which is currently contained in the Automatic Terminal Information Service (ATIS) broadcast may be omitted if the pilot indicates that he has prior knowledge of this data by using the term "HAVE NUMBERS" or a similar phrase.

NOTE: ATIS will be discussed later in this chapter.

In the examples listed below, the runway in use, surface wind, and the altimeter setting may be omitted from taxi instructions if the pilot indicates that he already possesses this information as indicated in the previous paragraph. However, controllers should be alert to provide this information if it is apparent that a change has taken place since the last recorded data was broadcast.

The following information, as appropriate, is issued to departing aircraft:

1. Runway in use.

EXAMPLE: TAXI TO RUNWAY TWO FOUR LEFT; or, RUNWAY TWO FOUR LEFT.

2. Surface wind.

3. Altimeter setting. Unless specifically requested by the pilot, this need not be issued to local aircraft operators who have requested this omission in writing or to scheduled air carriers.

4. Time check. When requested.

5. Issue the official ceiling and visibility to a departing aircraft before takeoff as follows:

a. To a VFR aircraft—when weather is below VFR minima.

b. To an IFR aircraft—when weather is below that published as the highest takeoff minimums for the airport, or if none are published, when weather is below VFR minimums.

6. Taxi information as necessary. Taxi route information need not be issued unless specifically requested by the pilot.

7. Inform departing IFR aircraft of the appropriate departure control frequency. This may be issued on the clearance delivery or ground control frequency.

The following is an example of departure information issued in response to a request from the pilot of a departing IFR aircraft:

NAVY ONE THREE SEVEN, MAYPORT GROUND, RUNWAY TWO FOUR LEFT, WIND TWO ONE ZERO DEGREES AT ONE FIVE, ALTIMETER THREE ZERO ZERO ONE, TIME ONE FOUR ONE FIVE AND ONE QUARTER, TAXI EAST ON THE PARALLEL TAXIWAY, DEPARTURE CONTROL FREQUENCY WILL BE THREE TWO FIVE POINT TWO.

Normally, the taxi instructions issued permit an aircraft to proceed to a specified point without delay or confliction to other traffic under tower jurisdiction. If in the judgment of the controller, a potential conflict exists, taxiing aircraft must be held short of the area in which the conflict may exist to await further instructions. Issue concise and easily understood taxi information.

An example of taxi instructions from one point to another on the movement area would be as follows:

NAVY TWO ONE SEVEN TURN RIGHT AT THE FIRST INTERSECTION, TAXI STRAIGHT AHEAD TO END OF TAXIWAY, THEN TURN LEFT.

Subsequent taxi instructions to the above would be as follows:

NAVY TWO ONE SEVEN TAXI ACROSS RUNWAY TWO FOUR, CONTINUE TAXIING, STRAIGHT AHEAD. TURN LEFT AT THE NEXT INTERSECTION TO OPERATIONS.

The absence of holding instructions authorizes the aircraft to cross all runways which the taxi route intersects except the runway to which it has been instructed to proceed.

Takeoff Clearances

The takeoff clearance, as the name implies, is issued after the aircraft has taxied to the warmup area at the end of the runway. The pilot has previously received information on the runway in use, wind direction and velocity, the altimeter setting, and time check. By his statement to the tower, READY FOR TAKEOFF, the pilot indicates he is interested in obtaining authorization to commence his takeoff, and he needs information on such local traffic that may affect his flight while in the control zone.

Takeoff clearance should be issued in the following form:

1. (Identification).
2. (Any pertinent information).
3. CLEARED FOR TAKEOFF.

EXAMPLE: NAVY THREE TWO ONE, CLEARED FOR TAKEOFF.

Immediately after takeoff, many pilots want their time off the ground. An example of a response to such a request would be as follows:

NAVY ONE TWO THREE, OFF AT ONE SIX.

Cancellation of a previously issued clearance for takeoff shall be issued as follows:

EXAMPLE: CANCEL TAKEOFF CLEARANCE.

Aircraft may be authorized to taxi into takeoff position and hold when takeoff clearance cannot be issued because of traffic. Traffic information should be issued such aircraft unless the traffic is another aircraft which has landed or is taking off on the same runway.

EXAMPLE: TAXI INTO POSITION AND HOLD (traffic information, if required).

Aircraft CANNOT be authorized to taxi into position to hold for an unreasonable length of time before takeoff clearance can be issued or to hold simultaneously on intersecting runways.

When issuing additional instructions or information to an aircraft holding in takeoff position, include instructions to continue holding or taxi off the runway, unless it can be cleared for takeoff.

EXAMPLE: CONTINUE HOLDING; or, TAXI OFF THE RUNWAY.

Clearance for a requested right/left turn after takeoff is given at the discretion of the controller based on the existing traffic situation, and is usually included with the takeoff clearance. This would be stated as:

RIGHT/LEFT TURN APPROVED, CLEARED FOR TAKEOFF.

In the event an aircraft is on final approach and there is still sufficient time to clear a departing aircraft for takeoff, the following phraseology should be used:

CLEARED FOR IMMEDIATE TAKEOFF.

In the event an aircraft is on final approach and there is still sufficient time to clear a departing traffic aircraft which is in takeoff position, but some doubt exists as to whether or not the departing aircraft will take off immediately, the following phraseology should be used:

TAKE OFF IMMEDIATELY OR TAXI OFF THE RUNWAY.

Intersection takeoffs may be authorized to expedite the movement of traffic. Such procedure may be initiated by a controller or in response to a pilot's request. If a pilot requests the distance from the intersection to the end of the runway, the measured distance from an appropriate chart constructed for this purpose is issued.

Prior to issuing takeoff clearance to IFR jet aircraft, the local controller should instruct the pilot to change to the departure control frequency (where this service is provided).

EXAMPLE: CHANGE TO DEPARTURE CONTROL FREQUENCY, CLEARED FOR TAKE-OFF.

In the event that it becomes necessary for the local controller to communicate with the aircraft after the pilot has changed frequencies and the tower possesses override capability, the controller may transmit urgent instructions directly to the aircraft on this frequency.

If the tower does not possess override capability, aircraft will also be instructed to monitor the emergency frequency. Any messages or instructions of an urgent nature will then be transmitted to the aircraft on the emergency frequency.

EXAMPLE: CHANGE TO DEPARTURE CONTROL FREQUENCY, MONITOR GUARD CHANNEL, CLEARED FOR TAKEOFF.

If the appropriate mode/code beacon assignment has not been previously made, this should be included in the takeoff clearance.

EXAMPLE: SQUAWK TWO THREE ZERO ZERO, CHANGE TO DEPARTURE CONTROL FREQUENCY, CLEARED FOR TAKEOFF.

Avoid requiring pilots to make radio frequency or beacon changes before the aircraft reaches 2,500 feet above the surface for turbojet aircraft, or the MEA, if lower, for A-1 aircraft.

Landing Information and Instructions

Instructions to enter the traffic pattern to approach the airport and land must include the following:

1. Specific traffic pattern information. (May be omitted if the aircraft is to circle the airport to the left.)

EXAMPLES:

ENTER LEFT/RIGHT BASE.
STRAIGHT-IN.
MAKE STRAIGHT-IN.
STRAIGHT-IN APPROVED.
RIGHT TRAFFIC.
MAKE RIGHT TRAFFIC.
RIGHT TRAFFIC APPROVED.
CONTINUE.

2. Runway in use.

3. Surface wind direction and velocity. (When the aircraft is being controlled by a radar facility not having wind measurement equipment,

relay this information to the radar controller at the time low approach, landing, or touch-and-go clearance is issued.)

4. Altimeter setting.

5. Any supplementary information.

6. Clearance to land (when appropriate).

7. Requests for additional position reports when required.

Using the above form, instructions governing a flight from a visual reporting point, holding point or fix, or other outlying point to the traffic pattern would be stated as follows:

NAVY THREE TWO NINER, NAVY MEMPHIS TOWER, ROSEMARK AT TWO THOUSAND, ENTER DOWNWIND, RUNWAY THREE SIX, WIND ZERO ONE ZERO DEGREES AT ONE FIVE, REPORT ENTERING DOWNWIND.

Instructions to a jet aircraft that will use the overhead type of approach would be as follows:

NAVY FOUR ONE FIVE, OCEANA TOWER, FIVE MILES SOUTH AT TWO THOUSAND, RUNWAY THREE TWO LEFT, WIND THREE ONE ZERO DEGREES AT ONE FIVE, REPORT INITIAL.

It should be noted that information which is contained in the ATIS broadcast (as mentioned in the section covering departure information) need not be transmitted to aircraft if the pilot indicates that he has knowledge of this data. Items 1, 2, 3, and 4 previously listed need not be repeated if the pilot states "HAVE NUMBERS" or a similar phrase and the information is still current.

NOTE: Refer to chapter 10 for detailed descriptions of traffic patterns and control techniques applicable to arriving traffic.

The instructions to enter a traffic pattern should not be confused with the clearance to land since the former is issued when the aircraft is some distance from the field and traffic conditions usually do not permit the issuance of a landing clearance at that point. Clearance to land should be given as follows:

NAVY THREE TWO NINER, CLEARED TO LAND.

In the event aircraft are landing and taking off at an airport without coming to a stop during their landing roll, such operations are described as touch-and-go landings. Pilots are required to request approval of same at least by the time they are turning on their final approach leg. Approval for such operation should be issued by use of the following phraseology:

CLEARED FOR TOUCH-AND-GO.

In the event it is not possible to approve a requested touch-and-go operation, but a full stop landing can be approved, the following phraseology is used:

UNABLE TOUCH-AND-GO, MAKE FULL STOP LANDING OR GO AROUND (CIRCLE THE FIELD).

If an aircraft cannot be cleared to land and it is desired that it continue to circle the airport, the following phraseology should be used:

CIRCLE THE AIRPORT.

When it is desired to delay an aircraft in effecting separation, and a normal circle of the field would take more than the required time, the following phraseology should be used if circumstances permit:

MAKE LEFT/RIGHT THREE SIXTY/TWO SEVENTY.

When an aircraft is on final approach and it becomes necessary to cancel the landing clearance, the following phraseology should be used:

GO AROUND.

Whenever it is desired that the pilot shorten his approach path, the following phraseology should be used:

MAKE SHORT APPROACH.

When it is desired that the pilot lengthen the downwind leg, the following phraseology should be used:

EXTEND DOWNWIND.

To inform pilots of arriving aircraft of their respective positions in the traffic pattern landing sequence, the following phraseology may be used:

NUMBER (landing sequence number).

If it is desirable or necessary to be specific and indicate that an arrival follow a particular aircraft in the traffic pattern, the following phraseology may be used:

FOLLOW (description and location of traffic).

If other landing traffic is utilizing a runway different from that which an arriving aircraft will use, traffic information should be issued to the arrival as follows:

TRAFFIC IS (description and location of traffic).
LANDING RUNWAY (number).

When describing location, descriptions such as TO YOUR RIGHT, ABOVE YOU, ONE MILE AHEAD OF YOU, etc., are much more satisfactory than NORTH OF YOU, ONE MILE EAST OF YOU, etc.

Remind aircraft to check wheels down when it reaches an appropriate position in the traffic pattern, unless the pilot has previously reported wheels down, as follows:

CHECK WHEELS DOWN.

Landing clearance should not be issued to an arriving aircraft until a WHEELS DOWN report is received.

Controllers should make a visual check of all landing aircraft to ensure that wheels are actually down. It is possible that a pilot may receive an erroneous indication from his wheels down light in the cockpit.

This visual sighting is normally made with the binoculars found in all control towers.

In the event an aircraft has encountered landing gear difficulty and has to proceed within close proximity of the control tower for personnel to observe the landing gear, the following phraseology should be used:

1. If the landing gear appears to be in a normal position the control tower personnel should transmit:

LANDING GEAR APPEARS DOWN AND IN PLACE.

2. If the landing gear does not appear normal, a description of the appearance should be given, as for example:

RIGHT WHEEL APPEARS RETRACTED, or LEFT WHEEL DOES NOT APPEAR IN PLACE.

Additional Phraseology

Controllers approve or disapprove pilots' requests as circumstances and traffic conditions permit. In cases where specific phraseology is not set forth for the applicable procedure, use of the words APPROVED, or UNABLE (include reason and/or additional instruction when necessary), as appropriate.

EXAMPLES: FREQUENCY CHANGE APPROVED; UNABLE HIGH SPEED LOW APPROACH, SLOWER TRAFFIC IN THE PATTERN.

The word IMMEDIATELY is used in phraseology only when expeditious compliance is required to avoid an imminent situation. If time permits, the reasons for this action should be included.

ACs should refer to the appropriate sections of TATC Handbook 7110.8 (Series) for additional phraseology not included here or for possible changes thereto.

AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS)

Automatic Terminal Information Service (ATIS) is a means of providing arriving and departing aircraft with advance information relative to operational, meteorological, and NOTAM data.

This data is recorded and broadcast continuously on a discrete frequency either from the control tower or on the voice feature of a VOR, VORTAC, or UHF Homer.

Frequencies utilized for ATIS broadcasts are listed in the COMMUNICATIONS section of the AERODROME/FACILITY DIRECTORY (Enroute Supplement).

ATIS is currently in use at selected high density terminal airports, both military and civilian. In addition to supplying aircraft with advance information, ATIS also relieves congestion on ATC frequencies allowing controllers more time for actual control instructions.

Items which are normally included in an ATIS message are as follows:

1. Airport name and phonetic alphabet code of message (each ATIS message is identified by a letter beginning with ALFA and continuing through the alphabet as necessary when messages are updated).
2. Active runway (pattern direction, etc.).
3. Weather conditions (VFR/IFR).

4. Ceiling and visibility.
5. Runway temperature (as required).
6. Dew point.
7. Altimeter.
8. Remarks (NOTAMs, runway conditions, etc.).
9. Instructions for the pilot to acknowledge receipt of the ATIS message by informing the appropriate controller on initial contact.

The absence of a sky condition and/or visibility on ATIS indicates a sky condition of 5,000 feet or above and visibility of 5 miles or more.

A sample ATIS message would be broadcast as follows; "PATUXENT AIRPORT INFORMATION BRAVO, ACTIVE RUNWAY THREE ONE, RIGHT TRAFFIC PATUXENT VFR; CEILING MEASURED THREE THOUSAND BROKEN, VISIBILITY FIVE, RUNWAY TEMPERATURE EIGHT NINE, DEW POINT SEVEN FIVE, ALTIMETER THREE ZERO ZERO NINER, PATUXENT TACAN OUT OF SERVICE UNTIL FURTHER NOTICE, INFORM PATUXENT TOWER, GROUND, OR APPROACH ON INITIAL CONTACT THAT YOU HAVE RECEIVED INFORMATION BRAVO."

COMMUNICATIONS SECURITY

The security of ATC communications is not normally a major factor during periods of peacetime, particularly within the CONUS; however, during wartime, where the Navy is operating carriers in close proximity to land areas, this subject takes on a different perspective.

Modern aircraft require speed and accuracy in the communications facilities through which they are controlled.

The range, speed, and traffic volume capacity of radio make it highly desirable for communications. However, the major disadvantage of radio is that it is the least secure means of transmission. The unauthorized interception and recording of radio transmissions cannot be detected or conclusively prevented.

Communications security (COMSEC) is the protection resulting from the application of measures designed to deny the enemy, or other unauthorized persons, information of value which might be derived from a study of communication materials and information. An additional objective is to mislead unauthorized persons in their interpretation of the results of such a study.

Defenses Against Interception

Transmission security measures are based upon the following two assumptions:

1. Electromagnetic transmissions can be intercepted and recorded by the enemy.

2. Silence is the only positive protective measure against enemy interceptions and direction finding activity.

Based upon these assumptions, the following defensive measures have been developed and should be used whenever possible or appropriate:

1. Use the least amount of transmitter power consistent with reliable communications.

2. Eliminate unnecessary and unauthorized transmissions.

3. Reduce transmission time to a minimum.

4. Ensure transmitting and receiving equipment is adjusted accurately.

5. Maintain strict circuit discipline.

Factors to consider when attempting to limit the interception or jamming of radio transmissions include the nature of the transmission path, propagation conditions (discussed in chapter 8), frequencies employed, and equipment used.

Propagation conditions affect the range of transmissions; line-of-sight distances in the Very High Frequency (VHF) band and higher ranges are exceeded because of abnormal and unpredictable ionosphere and meteorological conditions.

Electronic Emission Control (EMCON)

As has been pointed out, no radio transmission, whatever its nature and the area in which it is made, can be regarded as being completely safe from interception.

Electronic Emission Control (EMCON) procedures have been established onboard aircraft carriers and other surface ships to minimize the possibility of radio transmissions being intercepted by the enemy.

These procedures provide a control of all electromagnetic radiations, including radar as well as communications equipment. During the imposition of EMCON, no electronic emitting device will be operated unless it has been determined to be essential to the mission.

Varying degrees of EMCON silence exist; these are based upon the following factors:

1. Type of mission.
2. Tactical situation.
3. Frequency band being utilized.
4. Propagation characteristics of the equipment employed.

The responsibility for determining the requirements necessary for the implementation of EMCON silence rests with the appropriate Fleet Commander. Since the actual conditions under which emission control would be implemented are classified, no attempt will be made here to list the varying degrees of EMCON silence.

If you are assigned duties in a Carrier Air Traffic Control Center (CATTC) (discussed in chapter 13), you will receive detailed instructions concerning this vital area of communications security.

SCATANA

Federal Air Regulation 99.7 (special security instructions) is quoted in part: ". . . comply with special security instructions issued by the Administrator in the interest of national security and that are consistent with appropriate agreements between the FAA and Department of Defense."

The special security instructions referred to in the above paragraph are the plan for the Security Control of Air Traffic and Air Navigation Aids (short title: SCATANA). This plan is distributed in the Navy as OPNAV Instruction 3722.30 (Series). This plan defines the responsibilities of the Administrator and the appropriate military authorities for the security control of civil and military air traffic and Federal air navigation aids. It defines the responsibility of the Federal Communications Commission (FCC) for the security control of non-Federal civil air navigation aids. It describes the situations which concern national security, and the necessary action to be taken. It also provides for testing the plan at least once every 60 days.

During SCATANA tests, all actions will be simulated to achieve the following objectives:

1. Aircraft need not be grounded or diverted.
2. Air navigation aids should not be shut down.
3. Test messages are not transmitted over air/ground/air frequencies.
4. Interruption of radio communications is not necessary.

Figure 11-1 illustrates the SCATANA Test Report (FAA Form 2372-1) which is completed upon termination of the SCATANA test and forwarded to the appropriate Air Route Traffic Control Center (ARTCC).

Air Controlmen should study OPNAV Instruction 3722.30 (Series) as all control tower personnel will become involved in an actual implementation of the plan or the frequent test procedures.

EMERGENCY COMMUNICATIONS

Because of the infinite variety of possible situations, specific procedures cannot always be prescribed for every situation which might be considered an emergency. As a rule of thumb, an emergency includes any situation which places an aircraft in danger; i.e., uncertainty, alert, being lost, or in distress. Emergency communications would be any communications associated with these situations as described.

All military towers and most civil towers guard the emergency frequencies 121.5 MHz and 243.0 MHz. The prowords established for use to indicate the severity of an emergency situation in voice communication are MAYDAY, to indicate that the aircraft is threatened by serious and imminent danger and immediate assistance is required; and PAN, to indicate that the aircraft is in a situation which requires urgent action but is not in actual distress.

Controllers may expect to receive the following information from pilots of aircraft in an emergency condition:

1. PAN or MAYDAY 3 times and aircraft call sign 3 times.
2. Type of aircraft.
3. Actual or estimated position with the time.
4. Heading.
5. Indicated airspeed.
6. Altitude/FL.
7. Fuel remaining. (In hours and minutes.)
8. Nature of emergency.
9. Pilot's intentions.
10. Assistance desired.
11. Two 10-second dashes with the mike button for DF purposes.

The pilot will accept "communications control" of one particular ground station, and all other stations must remain silent so as not to interfere.

FEDERAL AVIATION AGENCY **SCATANA TEST REPORT**	TEST DATE	FACILITY NAME

	ACTION	ACTION TIME (GMT)
1	SCATANA Test Message received from –	Z
2	Broadcast simulated	Z
3	Notification completed (FAA Form 7610–1, item 1A)	Z
4	Area simulated clear of known aircraft	Z
	ARTCC at notified	Z
5	Simulated shutdown of air NAVAIDS listed in item 2C, FAA Form 7610–1	Z
6	"Terminate SCATANA/modify emergency SCAT rules" message received	Z
	~~Simulated return of air NAVAIDS to operation~~	Z
	Simulated broadcast of "termination/modification" message	Z

OFFICES NOT ALERTED *(Listed in item 1A on FAA Form ~~XXXX~~* 7610.1	SIGNATURE OF PERSON REPORTING

FAA Form 2372-1 (12-68) PREVIOUS EDITION IS OBSOLETE 0052-071-9000 (7610) *Form Approved Budget Bureau No. 04-R068.1*

201.92

Figure 11-1.—SCATANA test report.

CIRVIS Messages

The contraction CIRVIS is derived from the title of a document published by the Joint Chiefs of Staff, Joint Communication Electronics Board. It is entitled "Communications Instructions for Reporting Vital Intelligence Sightings from Airborne and Waterborne Sources." FAA facilities become involved with CIRVIS messages since they contact aircraft, both civil and military, by radio.

The procedures used by aircraft to call ground stations and report CIRVIS information should be similar to those used when sending position reports, except that the call should be preceded by the word CIRVIS (pronounced SURVEES) spoken three times to clear the frequencies of all other communications except DISTRESS or URGENCY. Should this procedure fail to clear the frequencies, the International Urgency Signal XXX transmitted three times on telegraph transmissions or the word PAN spoken three times may be employed as an alternate signal. CIRVIS reports are transmitted in plain language and as soon as possible (FLASH precedence is authorized) to any U.S. or Canadian military or civil air-ground communications facility.

There are three types of CIRVIS messages which controllers may be called upon to handle, as follows:

1. CIRVIS Report. Initial sighting report.

2. Additional CIRVIS Reports. Additional reports should be made if more information becomes available concerning a previously sighted object. These reports should contain a reference to the original report to identify them with it.

3. Cancellation Report. Cancellation reports should be made in the event that a previously reported sighting is positively identified as friendly or that it has been erroneously reported.

EXAMPLE OF INITIAL CIRVIS REPORT:

Aircraft — CIRVIS CIRVIS CIRVIS, BERMUDA THIS NAVY TWO FIVE NINER THREE SIX, CIRVIS REPORT, OVER.

Communications facility — NAVY TWO FIVE NINER THREE SIX, THIS IS BERMUDA, GO AHEAD.

Aircraft — NAVY TWO FIVE NINER THREE SIX SIGHTED FORMATION OF SIX JET BOMBERS, CONFIGURATION IS SWEPT WING WITH EIGHT JET ENGINES, TWO HUNDRED MILES EAST OF BERMUDA ON THIRTEEN MAY AT ONE THREE FIVE ZERO ZULU, ALTITUDE THREE FIVE THOUSAND, HEADING TWO SEVEN ZERO DEGREES, NO MARKINGS OBSERVED, OVER.

Communications station — BERMUDA, ROGER OUT.

FAA stations and Navy towers must immediately pass the CIRVIS messages to the appropriate ARTCC. FAA ARTCCs in the conterminous United States forward the CIRVIS messages immediately by direct interphone to the appropriate Air Division Control center. If no direct interphone is available, the report should be relayed to the ARTC center nearest to and having direct interphone connection with the Air Division Control center. The Air Division is responsible for forwarding to other military services, or higher headquarters, as required.

FIGHTER DIRECTOR VOCABULARY

Air Controlmen should be well versed in the brevity codes which are used for aircraft control, search and rescue, carrier deck conditions, and flight operations. These brevity codes are provided in the current Allied Communications Publication (ACP) 165 and are required knowledge factors for all Air Controlmen.

VISUAL COMMUNICATIONS

ATC LIGHT SIGNALS

The nomenclature and operation of the portable traffic control light were previously discussed in chapter 9. However, since the portable traffic control light is used to control the movement of personnel and vehicles on the landing area, as well as aircraft without radio, the control signals and their meaning are discussed at this time.

In addition to the operation and limitations of the portable traffic light, the Air Controlman must know the meaning of the traffic control light signals used. Figure 11-2 shows the meaning of the signals to be used for aircraft, vehicles, and personnel on the ground and for aircraft in the air. This is shown in tabular form in table 11-1.

A series of alternating red and green flashes from a directed traffic control light are used as general warning signals to advise a pilot or driver of a vehicle on the landing area to be on the alert for hazardous or unusual conditions. As an example, the warning signal may be directed to a pilot to indicate a change of runway, since this can prove hazardous if the pilot attempts to land crosswind.

In controlling traffic by means of visual signals it should be remembered that the warning signal is not a prohibitive signal. This means that it may be followed by either a red or a green light as circumstances warrant. The general warning signal is directed to pilots of the aircraft concerned as follows:

1. When aircraft are converging and there is a possibility of collision.

2. When hazardous conditions are present and the pilot must be unusually alert in order to complete the operation safely. (Such conditions include obstructions, soft field, ice on runway, and many others.)

3. When mechanical trouble is apparent to the controller and he has reason to believe that the pilot may not be aware of it.

4. At any other time when believed necessary in the opinion of the controller.

SPECIAL LIGHT SIGNALS

Aircraft Inbound Without Radio

Between sunset and sunrise, a pilot wishing to land should turn on a landing light as he

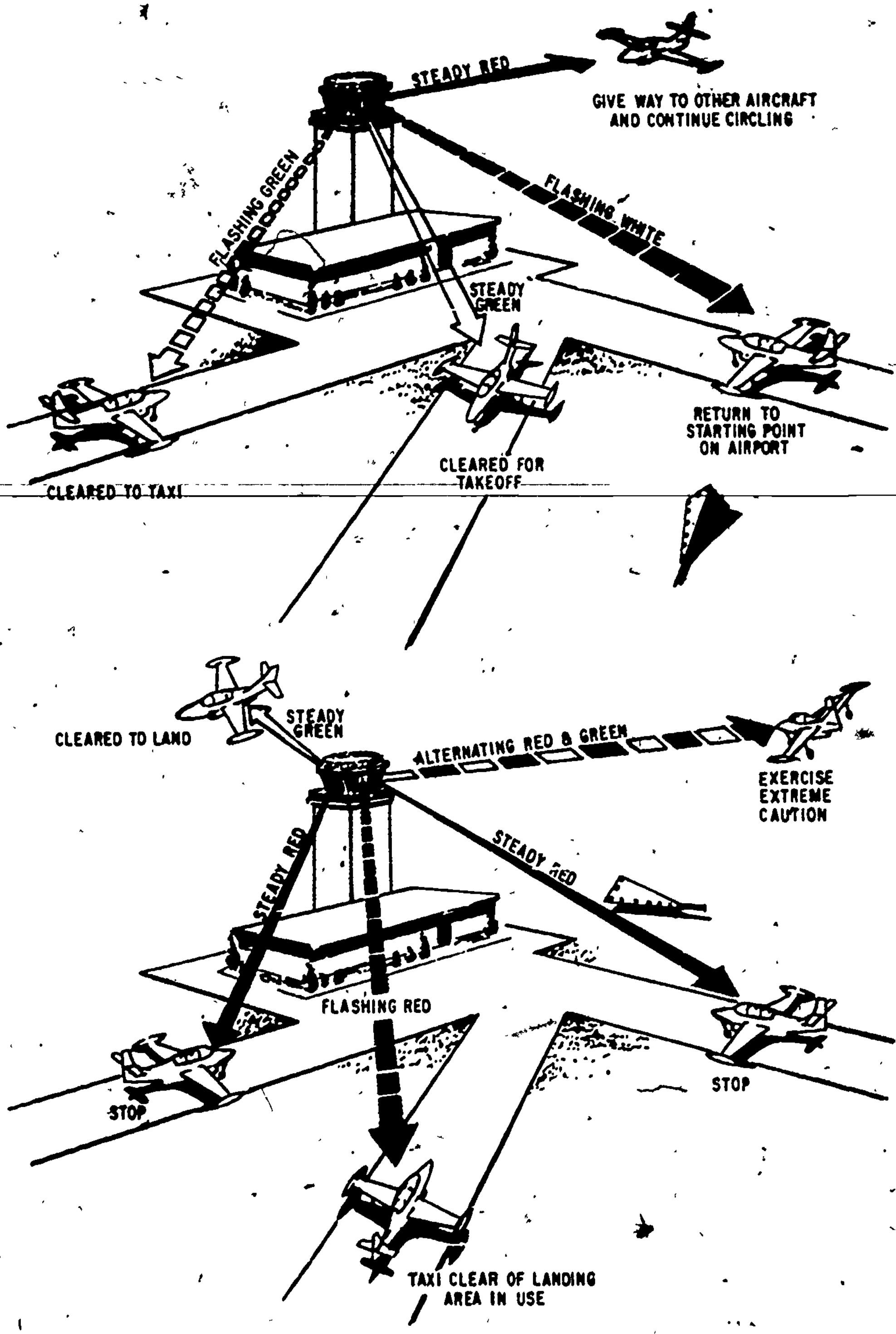

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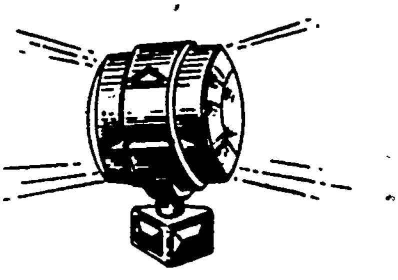
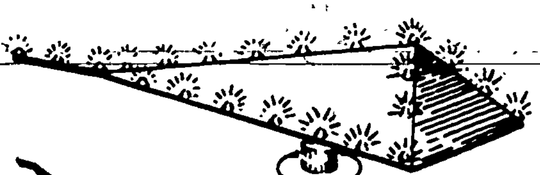
Figure 11-2.—Meaning of traffic control light signals.



ROTATING BEACON (day only)

Ground visibility in control zone less than 3 miles and/or ceiling less than 1,000 feet. Traffic clearance required for landings, takeoffs, or flight in the traffic pattern in a control zone.



FLASHING LIGHTS OUTLINING WIND DIRECTION INDICATOR (night only)

Ground visibility in control zone less than 3 miles and/or ceiling less than 1,000 feet. Traffic clearance required for landings, takeoffs, or flight in the traffic pattern in a control zone.

201.132

Figure 11-3. — Low ceiling and visibility signals.

approaches the airport unless he has already been given a green light.

Pilots should acknowledge portable traffic control light signals by rocking the aircraft's wings during hours of daylight and by blinking their landing or navigation lights during the hours of darkness.

Aircraft on the Airport Without Radio

During the hours of darkness, a pilot wishing to attract the attention of the control tower operator should turn on a landing light and taxi the aircraft in a position so that the light is visible to the tower controller. The landing light should remain on until appropriate signals are received from the tower.

Pilots should acknowledge light signals by moving the ailerons or rudder during the hours of daylight or by blinking the landing or navigation lights during the hours of darkness.

Low Ceiling and Visibility Signals

Take the following action to indicate that the reported ceiling and visibility are below basic VFR minimums:

a. Between sunrise and sunset—operate the airport rotating beacon. (See fig. 11-3.)

b. Between sunset and sunrise—operate the flashing lights on the traffic or wind direction indicator. (See fig. 11-3.)

Airport Course Lights

Some military airports have special light signals, such as course lights, which indicate landing direction, runway in use, traffic pattern in use, and other similar information for local activities. These lights are to be used as directed by the commanding officer. The principal advantage in using the course lights is that it gives pilots pertinent and specific visual information; therefore, radio contact with the control tower is unnecessary. However, the meaning and arrangement of these lights have no standardization and are used only for pilots known to be familiar with the meaning of the special light signals.

Table 11-1.—Meaning of traffic control light signals

Color and type of signal	On the ground	In flight
STEADY GREEN	Cleared for takeoff	Cleared to land
FLASHING GREEN	Cleared to taxi	Return for landing (to be followed by steady green at proper time).
STEADY RED	Stop	Give way to other aircraft and continue circling.
FLASHING RED	Taxi clear of landing area (runway) in use.	Airport unsafe—do not land.
FLASHING WHITE	Return to starting point on airport.	Not applicable.
ALTERNATING RED AND GREEN	General warning signal—exercise extreme caution.	

CHAPTER 12

IFR/SVFR CONTROL PROCEDURES

Controlling air traffic under IFR conditions is a demanding task. Controllers must be precise in their actions, considering the increased responsibilities as compared to VFR air traffic control. In the case of the latter, clearances and instructions were issued to assist the pilot in avoiding collision and to enhance the flow of air traffic. In comparison, clearances and instructions are issued to IFR traffic for the purpose of keeping all such traffic appropriately separated and at a safe altitude above terrain.

Navy ACs will most likely be involved with the control of IFR traffic at a terminal facility. However, there is a possibility that your terminal facility may operate in an en route capacity. Since you will be controlling IFR flights into and out of a terminal area, a basic knowledge of the entire airspace system is necessary.

As with any difficult procedure, the logical start is with basic details. The intent herein is to discuss IFR/SVFR air traffic control procedure and minima so the AC3 or AC2 can describe them, and with the necessary supervised experience, apply them to the actual control of IFR air traffic.

NATIONAL AIRSPACE SYSTEM

The national airspace system as it exists today began to develop in 1918 with the U.S. Post Office airmail service. Radio equipment was installed near telephones, providing a link of air and ground communications for keeping track of air traffic.

Lighted airways were set up using rotating light beacons, spaced at specific intervals, by which pilots could navigate. Coded lights were later added to the rotating beacons so that pilots could determine their distance from a certain reference point with knowledge of the code. Low-frequency radio range stations were established and became a government-operated system for aircraft navigation when landmarks and lighted airways were obscured by clouds, etc. In striving for increased reliability and to meet increasing air traffic needs, several types of air navigation aids were developed and put into general use. Military technology added impetus to the drive to provide the best possible navigation aids for use within national airspace with contributions such as radar, IFF, and tactical air navigation (TACAN).

The Federal Aviation Act of 1958 established the Federal Aviation Administration (FAA) which is charged by Congress with the safe and efficient use of airspace of the U.S. This includes military aircraft operations within the U.S. airspace, hence the required compliance of Navy ACs with air traffic rules and regulations of the FAA.

Two route systems have been established for air navigational purposes within the contiguous U.S.—the Federal airway system and the jet route system. The Federal airway system (as illustrated in figure 12-1) consists of airways designated from not less than 1,200 feet above the surface, up to but not including 18,000 feet MSL, and is designed to serve aircraft which operate at these altitudes. They are predicated solely on VOR/VORTAC navaids. They are designated on aeronautical charts by a V and referred to orally as Victor airways. The jet route system consists of jet routes established from 18,000 feet MSL to FL 450 inclusive, and are designed to serve aircraft which operate at these altitudes. They are identified by a J on aeronautical charts and referred to orally by statement of the same letter.

The airspace structure above FL 450 is designed to permit free selection of routes. Navigation is conducted by navaids serving the jet route system provided the aids are not more

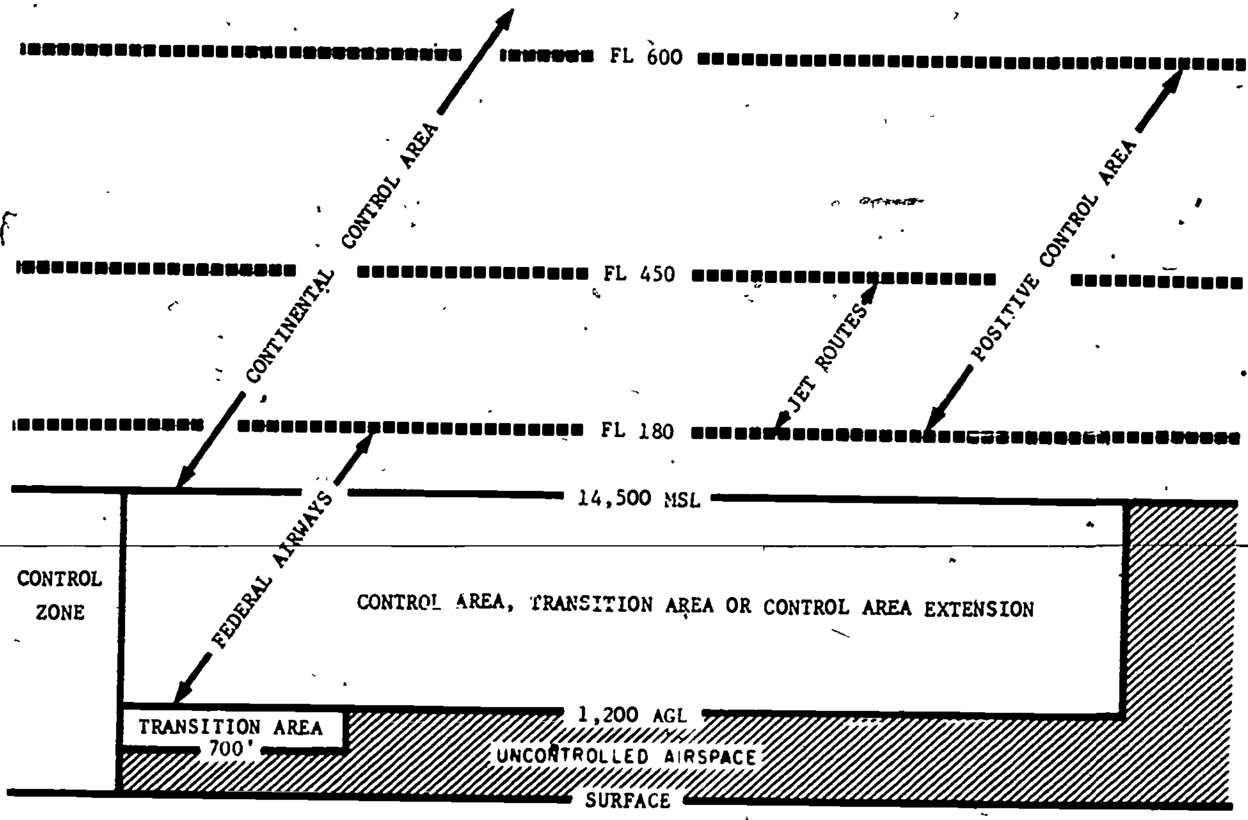


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Figure 12-1.—Airspace structure.

than 200 miles apart. Flight above FL 600 must contain at least one fix within each ARTCC's area through which flight is planned without regard to distance between fixes.

IFR air traffic control service is provided within controlled airspace. This controlled airspace includes federal airways, jet routes, control areas, transition areas, control zones, and the continental control area. These areas are described in chapter 3 of this training manual and depicted in figure 12-1.

AREA NAVIGATION (RNAV)

Area Navigation (RNAV) is a method of navigation that permits aircraft operations on any desired course within the coverage of station-referenced navigation signals or within the limits of self-contained system capability.

Application of area navigation equipment and procedures in the National Airspace System requires that they be compatible with the VOR/DME system on which route structure and air traffic control are based. Implementation, therefore, requires that area navigation devices employed assure proper positioning with respect to the VOR/DME ground facilities. Such systems must further permit navigation along, and within the protected airspace of, conventional VOR routes, airways, and terminal procedures.

Introduction of an area navigation capability into the National Airspace System provides a means of overcoming many of the disadvantages of the present VOR structure. By eliminating the requirement to fly along radials that lead directly to or from the ground station, it is possible to design routes and procedures that better facilitate the movement of traffic. Typical of the benefits that will result are:

1. Congested area bypass routes.

2. Multiple routes to allow segregation of traffic according to speed or other operating characteristics.
3. Pilot navigation of commonly flown radar vector paths.
4. Improved alignment or routes.
5. Dual routes for one-way traffic.
6. Increased instrument approach capability.
7. Optimum location of holding patterns.
8. Procedures designed for STOL and helicopter operations.

Only pilots of aircraft equipped with area navigation equipment approved for IFR operation may file for an RNAV route. When filing an IFR flight plan, area navigation routes or a combination of area navigation routes and VOR airways and routes may be specified for operations at or below FL 450. Area navigation route numbers may be filed in the same manner as VOR airway/route numbers. The letter "R" is placed after the route to indicate an RNAV route.

Example: V301R. The filed route should clearly define the intended route during transition from the VOR structure and vice versa.

The complexities involved in determining route width, reference facility, usable distance, and obstruction clearance altitudes make impromptu routes impractical during initial implementation phases of area navigation.

It should be noted that in addition to providing lateral and longitudinal guidance, area navigation also provides vertical data to the pilot.

Further development and expansion of RNAV is anticipated; therefore, you should consult the various Navy and FAA technical publications to become more familiar with this latest aspect of air navigation as it pertains to air traffic control.

POSITIVE CONTROLLED AIRSPACE

The vertical extent of the Positive Control Area (PCA) is from an altitude of 18,000 feet MSL up to and including FL 600. Positive control airspace is depicted on en route high altitude charts.

Positive control of all aircraft within this area is exercised, and additional requirements for flight apply as follows:

1. All VFR activities are prohibited, including climbs, descents, and VFR on top operations on IFR flight plans.

2. Complete IFR flight procedure is required and prior ATC approval mandatory.

3. All aircraft must be equipped with a coded radar beacon transponder (discussed in chapter 13), having a Mode 3, 64-Code capability which must be operated to reply to Mode 3 interrogation with the code specified by ATC, provided that in the event a radar beacon transponder failure is experienced in flight, ATC may approve operation within positive control area.

In all other cases, requests for an authorization to deviate must be submitted at least four days before the proposed operation, in writing, to the ARTCC having jurisdiction over the PCA concerned.

4. All aircraft must be equipped with radio equipment capable of providing direct pilot-controller communications on the frequencies specified by ATC for the sector in which flight is conducted. Pilots will monitor assigned ATC frequency and request ATC permission prior to any change. This includes aircraft information and those operating in altitude reservations.

5. Local flying areas are established within the positive control area to permit activities which are not readily adaptable to air traffic control. This includes activities in which aircraft do not maintain constant heading and/or altitude; that is, local areas are not restricted areas but are open to any user, traffic permitting. ATC clearance is required, and aircraft are assigned to a flight level or group of levels by ATC, depending on the activity. Using military activities may schedule aircraft to operate in local flying areas in excess of the quantities that can be accepted by ATC, subject to Military Assumption of Responsibility for Separation of Aircraft (MARSA). In this event, participating aircraft must remain in VFR conditions to preclude collision with other aircraft in the local areas.

6. Radius of action flight plans may be approved consistent with traffic conditions. However, pilots should be prepared to convert

to point-to-point routing should radius clearance be refused.

7. Altitude reservations continue to apply within the positive control areas.

Procedures for entering and departing positive control areas are as follows:

1. Pilots operating on IFR flight at an assigned flight level require no additional clearance.

2. Pilots operating VFR and VFR on top (on IFR flight plan) must obtain an ATC clearance with an assigned flight level prior to entering positive control areas. An abbreviated flight plan containing the following information must be provided ATC at least 30 minutes prior to estimated penetration:

a. Identification

b. True airspeed (TAS)

c. VFR position and altitude/flight level

d. Estimated time and point of penetration

e. Requested route and flight level.

3. When flight inbound to destination is VFR on top above the positive control area, or departure from the area is to be IFR/VFR on top, only the discrete frequency of the sector of arrival or departure need be preset.

4. Upon departing the area, IFF/SIF is reset to the proper Mode 3 Code as assigned by ATC.

IFR CONTROL PROCEDURES

The procedure and minima which apply when providing IFR air traffic control service are those contained in Terminal Air Traffic Control Handbook 7110.8 (Series). When other procedures are contained in a Letter of Agreement (discussed later in this chapter), or other appropriate FAA or military document, they may only supplement the TATC Handbook 7110.8. Any minima they specify cannot be less than those in TATC Handbook 7110.8 unless appropriate military authority has authorized application of reduced separation between military aircraft in special procedures. The ultimate authority for naval ATC procedures is CNO. Deviation is also permitted when necessary to conform with pertinent ICAO Documents, National Rules of the Air, or special agreements in airspace outside the U.S. and its possessions where the U.S. provides air traffic control service.

Military procedures in the form of additions, modifications, and exceptions to the basic FAA procedure are provided in TATC Handbook 7110.8 when a common procedure has not been attained or to fulfill a specific requirement. These military procedures are applied by ATC facilities operated by the designated military service, by ATC facilities supporting a designated military service exclusively, or by other ATC facilities when specified in a Letter of Agreement.

IFR CONTROL RESPONSIBILITY

Air Route Traffic Control Centers (ARTCCs) provide air traffic control service to aircraft operating on an IFR flight plan within controlled airspace principally during the en route phase of flight.

Approach control service is provided by a terminal area traffic control facility for arriving and departing IFR aircraft and occasionally for VFR traffic.

Authority to establish an approach control facility at a naval airfield is delegated to the Commanding Officer by the FAA. When established, approach control authority may be exercised through a tower, or mobile or fixed radar facilities.

NOTE: These radar facilities and the specific duties of those personnel assigned to them are discussed in detail in chapter 13 of this manual.

Prior to the actual implementation of approach control procedures, coordination with local FAA officials must be undertaken and a tentative local letter of agreement drawn up.

This tentative letter of agreement contains all facets of agreed approach control functions and delineates the responsibilities of the FAA and the naval ATC facility.

A copy of this tentative letter of agreement, together with a request to establish approach control facilities, is then forwarded to the Chief of Naval Operations (CNO) for approval. If additional personnel or electronic equipment are required in providing this service, this requirement should also be included.

Upon receipt of approval from CNO, a formal letter of agreement is executed with the local

FAA air traffic control authorities. A copy of this finalized version must be sent to CNO for record purposes.

Guidelines for the development and preparation of letters of agreement between the Navy and FAA are contained in OPNAVINST 3721.1 (Series).

Although you will normally not be directly concerned with the preparation or revision of a letter of agreement, you will, by necessity, be required to know and understand the contents of this important document.

It should be pointed out that a letter of agreement is required to be executed not only for the establishment of an approach control facility but also for a control tower, GCA unit, or whenever any new type of procedure is initiated; i.e., SIDs, SFA (Single Frequency Approach), etc.

A copy of the formal letter of agreement for your ATC facility should be contained within the local procedures manual.

PRIORITY OF SERVICE

First priority is given to the separation of aircraft to comply with the procedure and minima prescribed for the control of IFR traffic. Any other service or information is provided to the extent possible.

Radar procedures should be used in preference to nonradar procedures to the extent practicable, consistent with workload, communications, and equipment capabilities.

Air traffic control service is provided on a "first come, first serve" basis as circumstances allow. For example, it is solely the pilot's prerogative to cancel his IFR flight plan, but a retention of an IFR flight plan does not afford priority over VFR aircraft, and he may be required to adjust his flightpath to enter a traffic pattern in sequence with arriving VFR aircraft. Exceptions to the first come, first serve rule do exist for certain types of aircraft operations such as AIREVAC, SAFI, Presidential and Vice Presidential, FLYNET, and GARDEN PLOT aircraft. For more information on this subject, see Priority in chapter 10 of this training manual and the appropriate section of TATC Handbook 7110.8.

TRANSFER OF IFR CONTROL RESPONSIBILITY

Control responsibility must be transferred between facilities, or between controllers within a facility, at a specified time, fix, or altitude. Additionally, any potential conflict with other aircraft under the jurisdiction of the transferring facility or controller must be eliminated prior to the transfer of control responsibility.

TRANSFER OF RADIO COMMUNICATIONS

Transfer communications before an aircraft enters the receiving controller's area unless previously coordinated. To the extent possible, initiate the transfer at the time of handoff. Transfer communications after an Automated Handoff Accept, or where ARTS Modify Function and/or Quick Look function is used to transfer target identity. A facility directive shall specify communication transfer points.

FORMATION FLIGHTS

Formation flights are treated as single aircraft unless the formation leader requests that ATC separate individual aircraft.

IFR CLEARANCE DELIVERY AND RELAY

IFR clearances issued by a facility other than the originating facility must be relayed verbatim. A non-ATC facility would prefix the clearance with the prefatory phrase "ATC clears." Such facilities would handle a relay of advice or a request for information in the same manner; i.e., "ATC advises," or "ATC requests." When a clearance, information, or a request for information is issued to an ATC facility or to an aircraft by direct ATC communications, the "ATC" portion of the prefatory phrase is omitted.

To correctly apply this procedure, refer to the definition of an ATC facility and ATC service. These definitions are included in appendix I of this training manual.

When appropriate, specific delivery instructions may be issued with a clearance for relay, such as an "attempt delivery" time or a "cancellation" time which must be adhered to by the relaying facility. The ATC facility originating the clearance should be advised if the requirements of specific delivery instructions are not met.

IFR Clearance Items

Items and the sequence in which they should be issued to IFR traffic are as follows:

1. Aircraft identification.
2. Clearance limit or approach procedure.
3. Departure procedure or Standard Instrument Departure (SID).
4. Route of flight.
5. Altitude data in the order flown.
6. Holding instructions if a delay is anticipated.
7. Special or supplementary instructions as required.
8. Frequency and beacon code information.

SIGNIFICANT WEATHER

Significant weather information includes pilot reports or observed indications on radar concerning areas of strong frontal activity, squall lines, heavy thunderstorms, widespread fog, moderate to heavy icing, turbulence (including clear air turbulence) (CAT) of moderate or greater intensity, or similar conditions pertinent to safety of flight.

Every assistance should be afforded pilots to enable them to avoid areas of significant weather. When a requested deviation to avoid such areas cannot be approved due to traffic conditions, the altitude or route of the conflicting traffic may be changed to permit approval if there is reasonable assurance that the action will not place the conflicting aircraft in hazardous weather conditions.

Pilot-reported information about significant weather conditions should be relayed to other aircraft concerned and the appropriate weather service.

ALTIMETER SETTING INFORMATION

Altimeter settings issued to IFR flights must be current settings obtained from direct-reading instruments or received directly from weather reporting stations. All ARTS facilities shall keep the computer-entered altimeter setting current at all times.

When issuing an altimeter setting to an aircraft, a terminal facility must identify the source of the setting for a location other than at the facility. The time of the report must also be included if it is more than 1 hour old.

Aircraft operating below flight level 180 must be issued the associated altimeter setting of compulsory reporting points when reporting over such points. If in "radar contact," the controller issues the altimeter setting when the aircraft is observed passing or adjacent to compulsory reporting points. (Pilots discontinue making position reports when informed of "radar contact.")

When aircraft have been cleared to descend from a flight level to an altitude below the lowest usable flight level, the altimeter setting for the weather reporting station nearest the aircraft position must be issued to the pilot.

ALTITUDE VERIFICATION

Pilots should be requested to verify their altitude upon initial contact after you have received control jurisdiction from another facility or after communications are established with an aircraft departing from another airport under your facility's control jurisdiction unless verification is provided by either altitude readout or by the pilot at the time of initial contact.

EXAMPLE: VERIFY AT EIGHT THOUSAND.

You need not verify altitude when, on initial contact, you assign a new altitude to an aircraft that is climbing or descending.

NOTE: Altitude readout determining equipment will be discussed in the following chapter.

If the altitude readout indicates a discrepancy of 300 feet or more from the assigned altitude and the aircraft is in level flight, the pilot should be requested to verify his altitude.

In instances where the pilot confirms a discrepancy of 300 feet or more between his actual altitude and the transponder altitude readout, instruct him to secure the altitude reporting portion of his transponder and advise him of the reason.

In the event that you are unable to verify the altitude discrepancy, ensure that standard radar separation is applied between the affected aircraft and any other radar-identified IFR aircraft.

NONRECEIPT OF POSITION REPORTS

When a position report affecting separation is not received, action should be taken to obtain the report not later than 5 minutes after the aircraft was estimated over the fix.

RADIO COMMUNICATIONS FAILURE

When an IFR aircraft experiences two-way radio communications failure, air traffic control is based on anticipated pilot action. Pilot procedures are set forth in FAR 91.127 listed in chapter 3 of this Rate Training Manual. ATC facilities should take the following action, as appropriate, when two-way radio communications are lost with an IFR aircraft:

1. Broadcast clearances through any available means of communication, including the voice feature of navaids.

2. Attempt to re-establish communications by having the aircraft use its transponder (SIF) or make turns, both of which might be considered an acknowledgment when observed on radar.

3. Broadcast a clearance for the aircraft to proceed to its filed alternate airport at the minimum en route altitude if the aircraft operator concurs.

Restriction to Other IFR Traffic

Unless radar separation is applied, when an IFR aircraft is unreported, the facility responsible must restrict or suspend other IFR traffic for 30 minutes after whichever of the following is applicable:

1. The time at which approach clearance was delivered to the pilot.

2. The expected approach clearance time delivered to the pilot.

3. The arrival time over the navaid serving the destination airport.

4. The current estimate, either the control facility's or the pilot's (whichever is later), at the navaid serving the destination airport.

After the 30-minute traffic suspension period has expired, normal air traffic control may be resumed if the operators or pilots of other aircraft concur.

APPROACH CONTROL INFORMATION

Unless specific items listed in the following approach information have been broadcast via Automatic Terminal Information Service (and acknowledged by the pilot) they should be provided to aircraft at the time of first radio contact:

1. Approach clearance or type of approach to be expected if two or more approaches are published and the clearance limit does not indicate which will be used.
2. Runway in use.
3. Surface wind.
4. Ceiling and visibility if the ceiling at the airport is reported below 1,000 feet or below the highest circling minimum, whichever is greater, or the visibility is less than 3 miles.
5. Altimeter setting.

Detailed procedures utilized in providing approach control service will not be discussed at this time; however, as you advance in the Air Controlman rating you will have the opportunity to attend the Advanced Air Controlman Course. This advanced schooling, coupled with your past experience, is designed to assist you in preparing to accept the challenge of controlling aircraft under actual instrument conditions.

NONRADAR IFR SEPARATION MINIMUMS AND METHODS

Pilots are required to file IFR flight plans and obtain an ATC clearance prior to conducting flight under instrument flight rules of FAR 91 within controlled airspace. Special VFR flights must obtain an ATC clearance prior to operations within control zones. By this procedure, ATC facilities know of all IFR and special VFR traffic operating within controlled airspace for which they are responsible. Thus they are able to regulate traffic by issuance of clearances and instructions for the purpose of keeping such traffic separated.

There are three types of nonradar separation: vertical, longitudinal, and lateral. One of these must be in effect whenever separation is required. Exceptions to the above statement are instances when controllers or pilots are authorized to maintain visual separation between aircraft, or when pilots are authorized upon request to operate IFR in accordance with a VFR restriction (discussed later in this chapter).

Each type of nonradar separation has established minimums to which controllers must adhere for safe operation. These minimums and methods of establishing and maintaining them are discussed separately in this chapter.

Vertical Separation

IFR aircraft may be separated vertically by assigning different altitudes or flight levels (FL), using the following minimums:

1. Up to and including FL 290-1,000 feet.
2. Above FL 290-2,000 feet.

A previously occupied altitude/FL may be reassigned to another aircraft when the pilot of the aircraft that previously occupied the altitude reports leaving it. However, when severe turbulence is reported, such altitudes may not be reassigned until the pilot of the aircraft that previously occupied the altitude reports at or passing another altitude separated from the first by appropriate minimum vertical separation.

EXAMPLE OF PHRASEOLOGY: REPORT LEAVING/REACHING FIVE THOUSAND; or, REPORT LEAVING ODD ALTITUDES; or SAY ALTITUDE.

Aircraft in level flight reporting automatic altitude information that is less than 300 feet from the assigned altitude should be considered at the assigned altitude for separation purposes.

Altitude readouts which have been verified may be used in lieu of verbal reports for providing vertical separation between aircraft climbing or descending.

When pilots of aircraft in direct radio communication with each other during climb and descent concur, the lower aircraft, if climbing, or upper aircraft, if descending, may be authorized to maintain their own vertical separation.

Longitudinal Separation

Longitudinal separation is spacing of aircraft so that after one aircraft passes over a specific position, a succeeding aircraft occupying the same altitude will not arrive over that position with less than the minimum longitudinal separation prescribed for the particular situation.

Longitudinal separation may be established by requiring aircraft to do one of the following;

1. Depart at a specified time.
2. Arrive at a fix at a specified time.
3. Hold at a fix until a specified time.
4. Change altitude at a specified time or fix.

DME procedures and minimums may only be used when direct pilot-controller communications are maintained.

Aircraft on the same, converging, or crossing courses at the same altitude are separated by an interval expressed in minutes of flying time or a specified distance in accordance with the following minimums:

1. When a leading aircraft maintains a speed at least 44 knots faster than a following aircraft, and (a) a departing aircraft follows a preceding aircraft which has taken off from the same or adjacent airport, or (b) a departing aircraft follows a preceding en route aircraft which has reported over a fix serving the departure airport, the minimum is 5 miles between aircraft using DME/RNAV or 3 minutes between other aircraft. (See fig. 12-2.)

2. When a leading aircraft maintains a speed of at least 22 knots faster than a following aircraft, and (a) a departing aircraft follows a preceding aircraft which has taken off from the same or an adjacent airport, or (b) a departing aircraft follows a preceding en route aircraft which has reported over a fix serving the departure airport, or (c) an en route aircraft follows a preceding en route aircraft which has reported over the same fix, the minimum is 10 miles between aircraft using DME/RNAV or 5 minutes between other aircraft. (See fig. 12-3.)

3. Minimum separation between aircraft climbing or descending through the altitude of another aircraft is as follows:

a. 10 miles between aircraft using DME, provided that the descending aircraft is leading or the climbing aircraft is following. (See fig. 12-4.)

b. 5 minutes between other aircraft if all of the following conditions are met:

(1) The descending aircraft is leading or the climbing aircraft is following. (Up behind/down in front.)

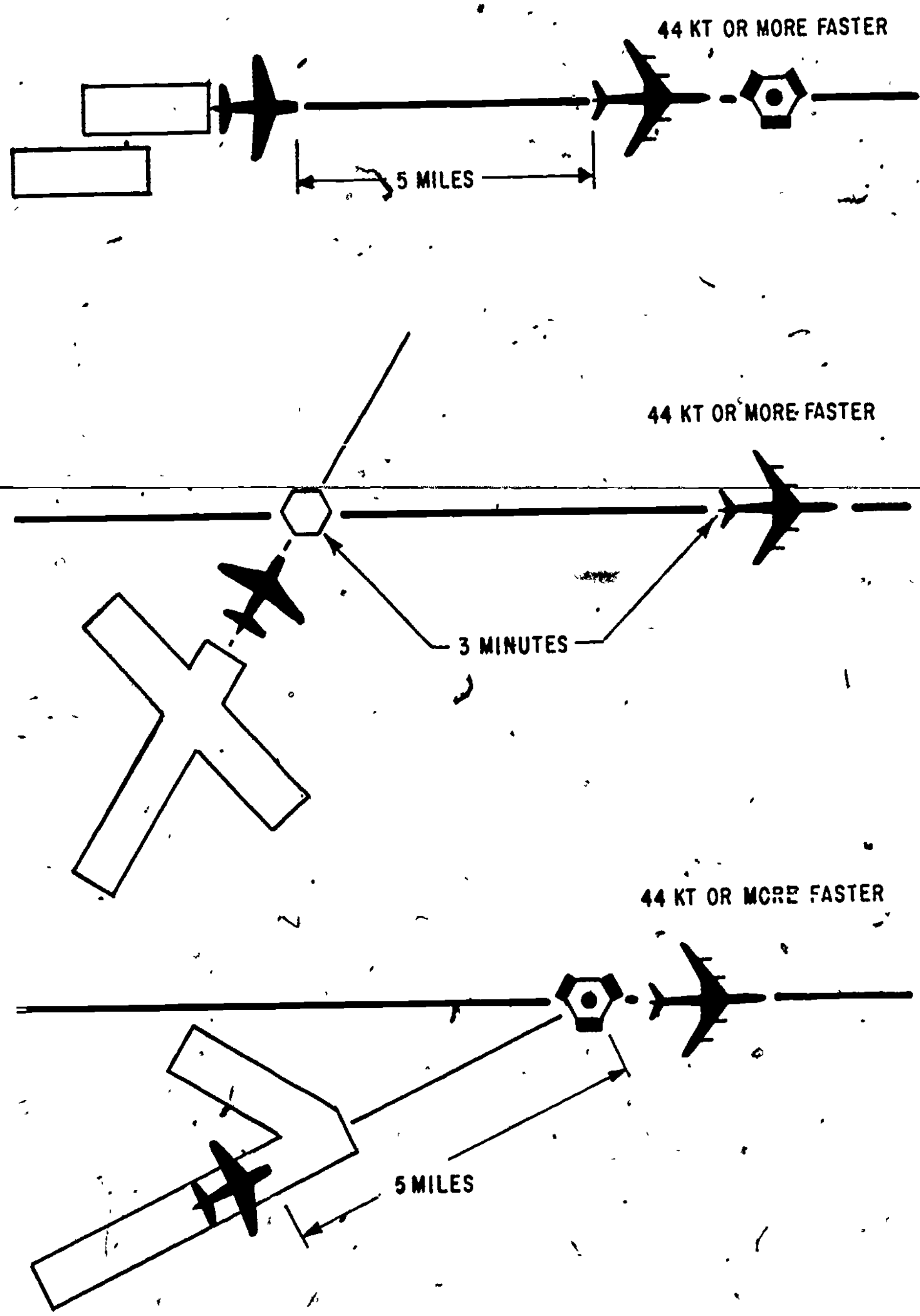

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Figure 12-2.—5-mile or 3-minute longitudinal separation.

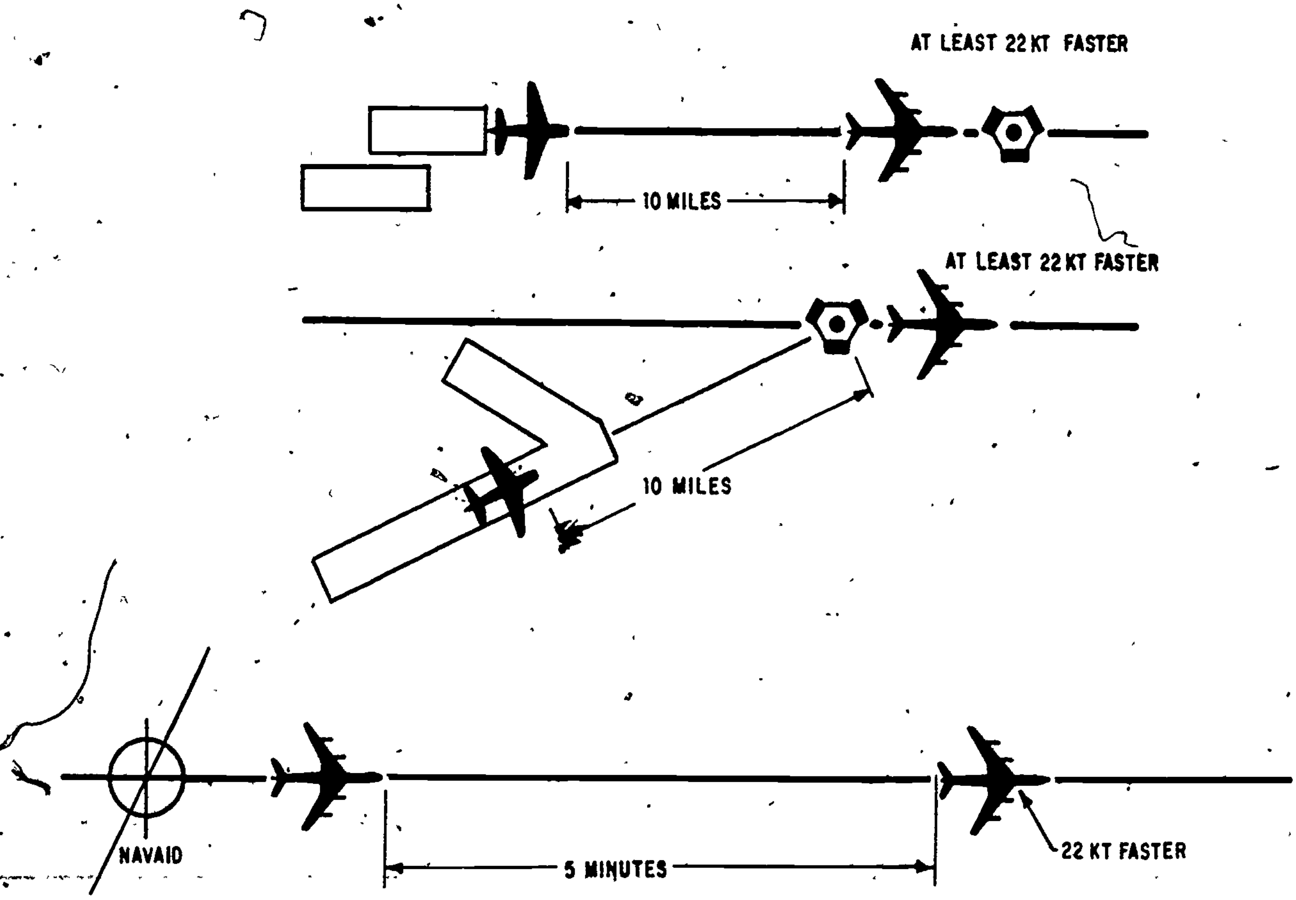

Figure 12-3.—10-mile or 5-minute longitudinal separation. 201.170

(2) The aircraft were separated by not more than 4,000 feet when the altitude change started.

(3) The change is started within 10 minutes after a following aircraft reports over a fix reported over by the leading aircraft or has acknowledged a clearance specifying the time to cross the same fix. (See fig. 12-5.)

4. When RNAV aircraft are operating along an RNAV route that is 8 miles or less wide, the minimum separation between aircraft is 10 miles if the following criteria can be met:

a. The descending aircraft is leading or the climbing aircraft is following.

b. They were separated by not more than 4,000 feet when the altitude change started.

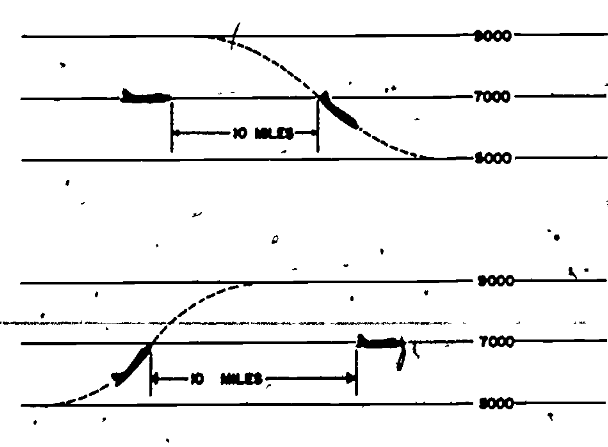

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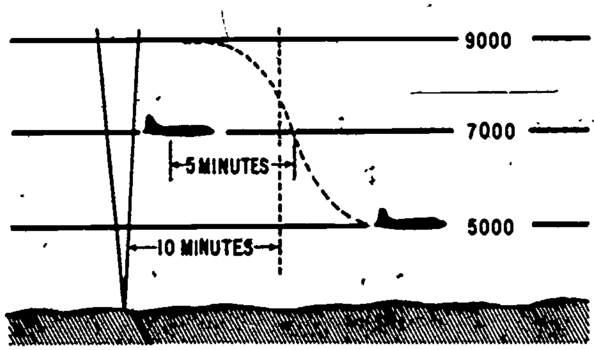
Figure 12-4.—Same direction altitude change using DME.



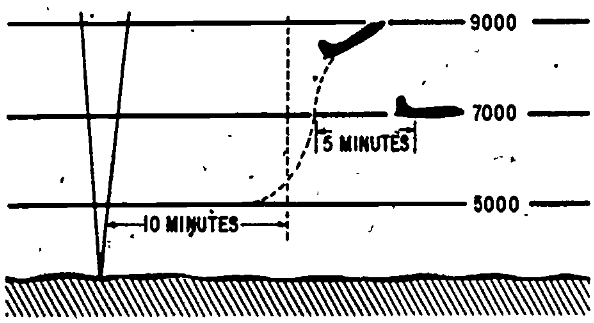


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Figure 12-5. — Same direction altitude change.

5. If the required conditions which allow 3-minute/5-mile or 5-minute/10-mile separation for aircraft assigned the same altitude or 5-minute/10-mile separation for same direction aircraft climbing or descending do not exist, then the minimum longitudinal separation is 20 miles between aircraft using DME/RNAV or 10 minutes between other aircraft.

6. The minimum between an aircraft using DME and an aircraft not using DME is 30 miles if both of the following conditions are met:

a. The aircraft using DME derives distance information by reference to the same navaid over which the aircraft not using DME has reported.

b. The aircraft not using DME is within 15 minutes of the navaid. (See fig. 12-6.)

7. The minimum between aircraft when one aircraft is using RNAV and the other is using neither DME nor RNAV is 30 miles.

Opposite direction traffic requesting a conflicting altitude change must be separated by minimum vertical separation from 10 minutes before until 10 minutes after they estimated to pass. (See fig. 12-7.)

Vertical separation may be discontinued after one of the following conditions is met:

1. Both aircraft have reported passing navaids or DME fixes indicating they have passed each other.

2. Both aircraft have reported passing the same intersection, and they are at least 3 minutes apart.

When pilots of aircraft on the same course and in direct communication with each other concur, the pilot of the following aircraft may be authorized to maintain longitudinal separation of 10 minutes, or 20 miles if they are using DME.

Lateral Separation

Lateral separation is the lateral spacing of aircraft at the same altitude. Aircraft may be laterally separated by one of the following methods:

1. Clear aircraft on different airways or routes whose airspace to be protected for one flight does not overlap airspace to be protected for the other. NOTE: Airspace protected for airways and routes is based on the width described in FAR 71.5 which is normally 4 miles either side of centerline.

2. Clear aircraft below 18,000 to proceed to and report over or hold at different geographical locations determined visually or by reference to navaids. (See fig. 12-8.)

3. Clear aircraft to hold over different fixes whose holding pattern airspace areas do not overlap each other or other airspace to be protected.

4. Clear departing aircraft to fly specified headings which diverge by at least 45 degrees. (See fig. 12-8.)

Lateral separation is considered to exist between aircraft established on radials of the same navaid that diverge by at least 15 degrees

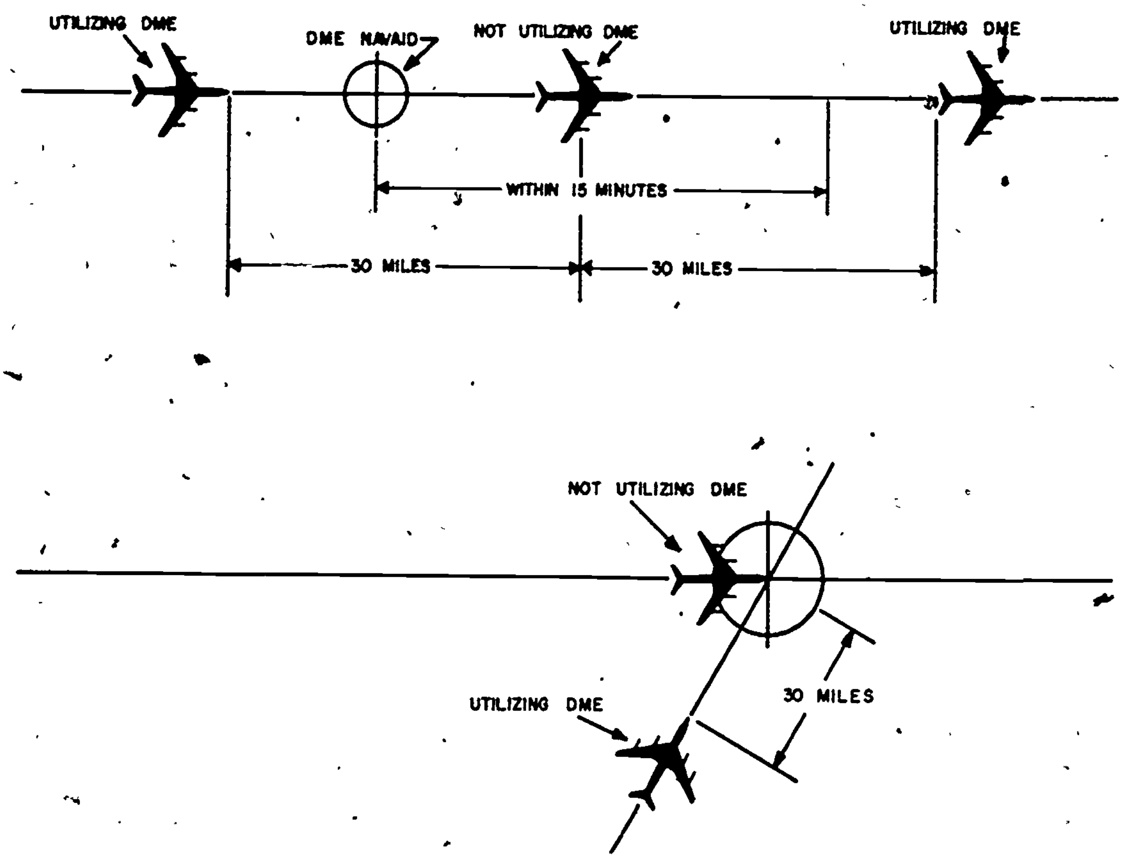

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Figure 12-6.—Separation of DME and non-DME equipped aircraft.

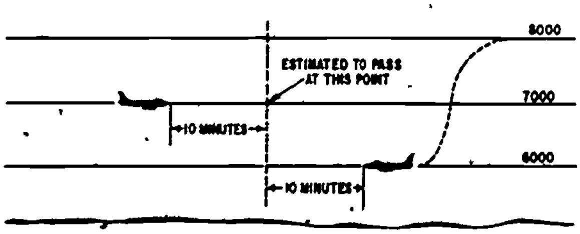

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Figure 12-7.—Opposite direction altitude change.

when either aircraft is beyond the airspace to be protected for the other aircraft. (See fig. 12-9.)

There is a table in TATC Handbook 7110.8 under the lateral separation section that shows appropriate distances necessary to clear the airspace to be protected for divergence angles from 15 to 90 degrees. Since this type computation is one which should be predetermined and shown on charts located at or near operating positions rather than an on-the-spot-type separation, the table is not included herein.

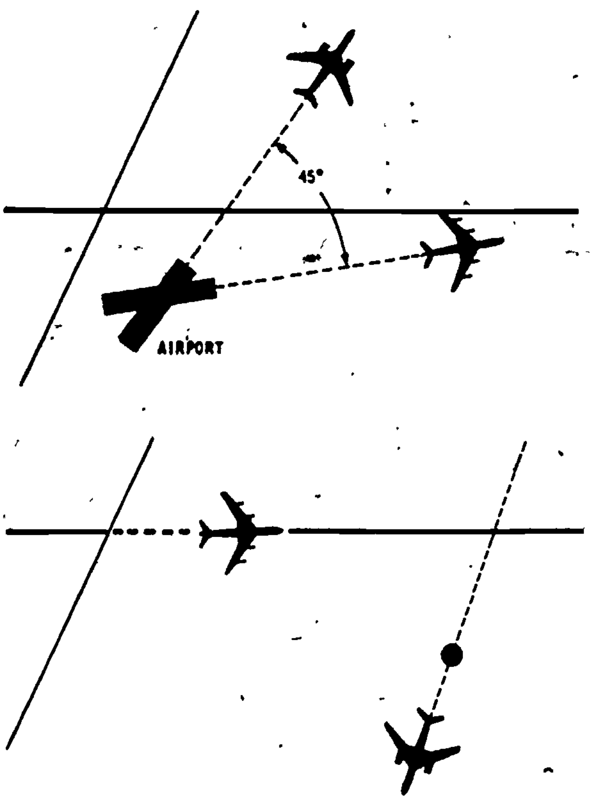
Lateral DME separation is applied by requiring aircraft using DME to fly an arc or arcs of a navigational aid.

The minimum is 10 miles between arcs of a navigational aid when aircraft are maintaining different specified arcs of the aid.

Between an arc of a navigational aid and the boundary of the holding pattern airspace area to be protected for an aircraft holding, the minimum is 5 miles. (See fig. 12-10.)

Airspace to be protected along other than established airways or routes is as follows:

1. For direct courses and course changes of 15 degrees or less at FL 600 and below, and



201.175
Figure 12-8.—Two illustrations of lateral separation.

any course change below FL 180, the width of the protected airspace is 4 miles on each side of the route to a point 51 miles from a navaid. Beyond the 51-mile point, the airspace increases in width, based on a 4.5-degree angle from the aid, to a width of 10 miles on each side of the route at a distance of 130 miles. (See fig. 12-11.)

2. For course changes of more than 15 degrees through 90 degrees, the airspace to be protected on the overflown side, beginning at a point where the course change begins, is as follows:

a. Below FL 180—same as paragraph 1.
b. FL 180 to FL 230 inclusive—14 miles.
c. Above FL 230 to FL 600 inclusive—17 miles.

3. For course changes of more than 90 degrees through 180 degrees, the airspace to be protected on the overflown side, beginning at a point where the course change begins, is as follows:

a. Below FL 180—same as paragraph 1.
b. FL 180 to FL 230 inclusive—28 miles.
c. Above FL 230 to FL 600 inclusive—34 miles.

4. After the course changes have been completed and the aircraft is back on course, the appropriate minima as specified in paragraph 1 apply.

5. For RNAV flights along other than established airways or routes utilizing degree/distance fixes, the width of the protected airspace is 10 miles each side of the route for flight above FL 450.

RNAV flights along other than established airways or routes utilizing degree/distance fixes at FL 450 and below are provided radar separation.

Initial Separation of Successive Departing Aircraft

Initial separation between successive departing aircraft may be considered an interim measure to expedite departures. The controller must plan ahead to insure that the initial separation applied will allow a smooth transition to at least minimum vertical, longitudinal, or lateral separation when the initial departure phase of the flight is complete.

Aircraft that will fly courses which diverge by 45 degrees or more after departing the same or adjacent airports may be separated by use of one of the following minimums:

1. Between aircraft departing from the same runway (fig. 12-12):

a. One minute until courses diverge when the aircraft will fly diverging courses immediately after takeoff.

b. Two minutes until courses diverge when the aircraft will fly the same course initially but will fly diverging courses within 5 minutes after takeoff.

c. Three miles until courses diverge when aircraft using DME will fly the same course initially but will fly diverging courses within 13 miles after takeoff.

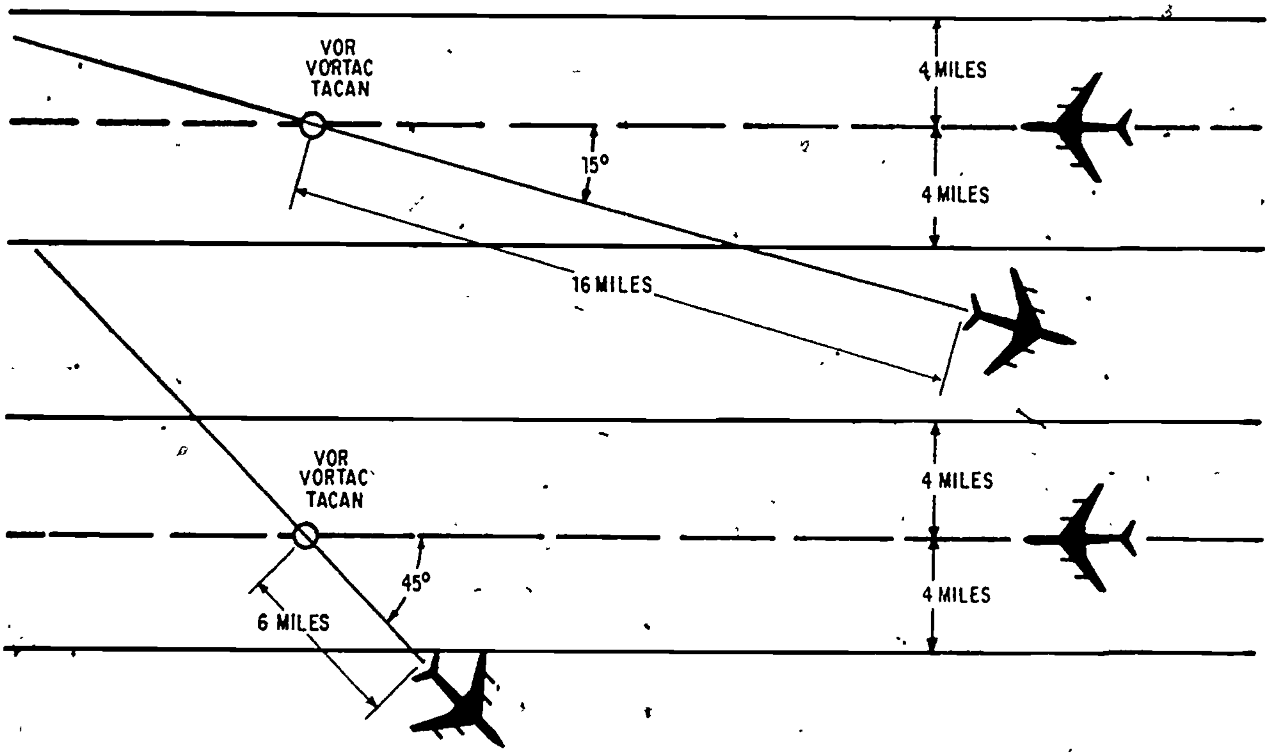


Figure 12-9.—Lateral separation using radials of the same navaid. 201.176

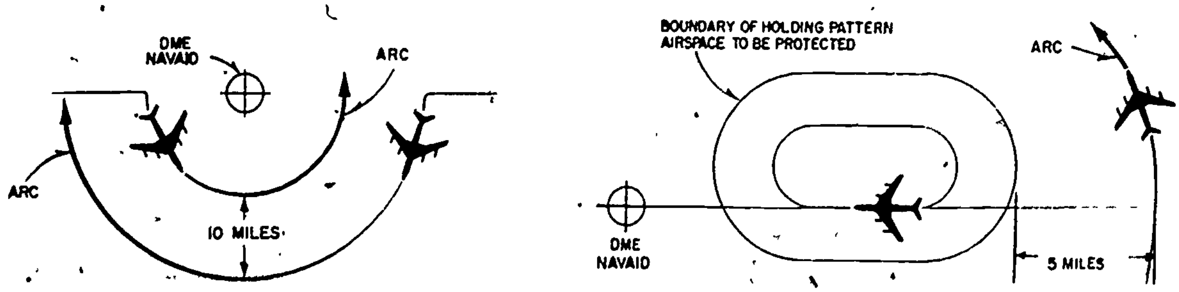


Figure 12-10.—Lateral DME separation. 201.177

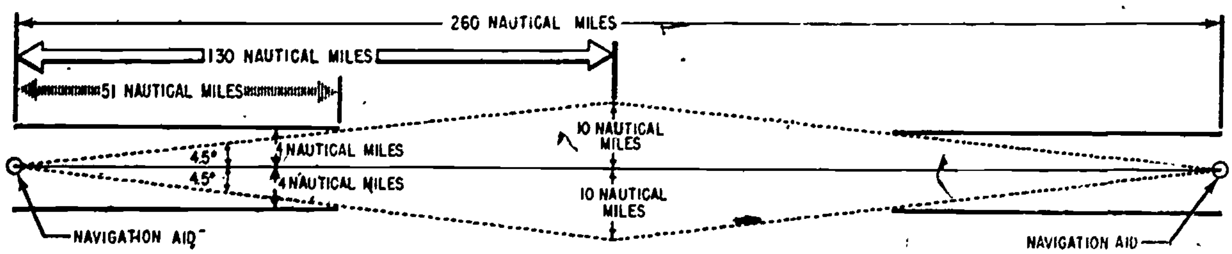


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Figure 12-11.—Airspace protected for other than established routes or airways.

2. Simultaneous takeoffs may be authorized when aircraft will fly diverging courses immediately after takeoff in the same direction from different runways whose centerlines are parallel and separated by at least 3,500 feet. (See fig. 12-13.)

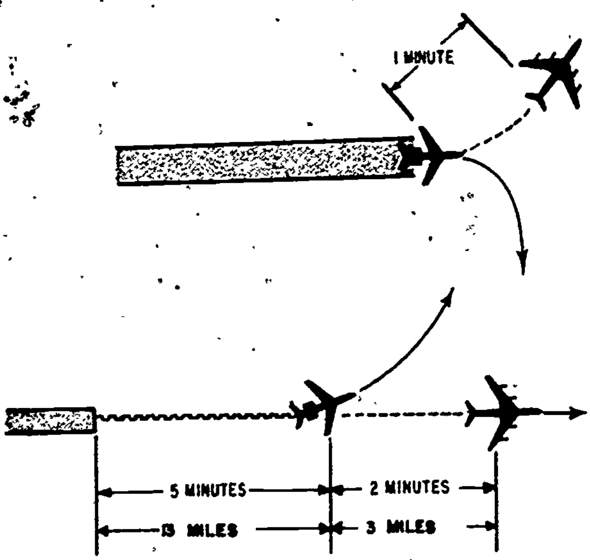

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Figure 12-12.—Separation of departing aircraft using the same runway.

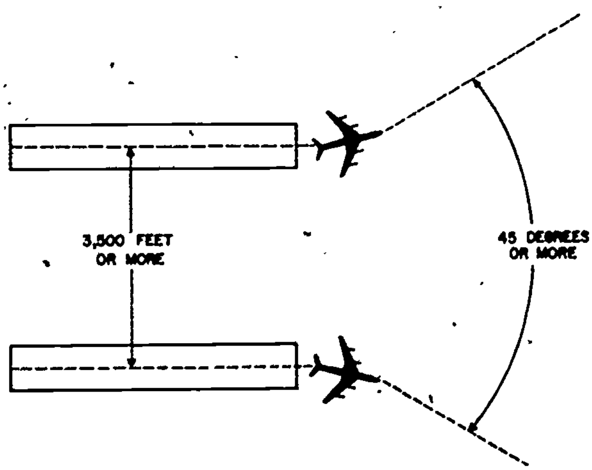

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Figure 12-13.—Simultaneous takeoffs from parallel runways.

3. Simultaneous takeoffs may be authorized from diverging, non-intersecting runways when aircraft will fly diverging courses immediately after takeoff and either of the following conditions exist:

a. The runways diverge by 30 degrees or more.

b. The distance between runway centerlines at and beyond the points where takeoffs begin is at least:

(1) 2,000 feet and the runways diverge by 15 to 29 degrees inclusive.

(2) 3,500 feet and the runways diverge by less than 15 degrees. (See fig. 12-14.)

4. On intersecting runways, a succeeding aircraft may be authorized to take off when the preceding aircraft has passed the point of runway intersection and the following conditions are met:

a. The runways diverge by 30 degrees or more.

b. The runways diverge by 15 to 29 degrees inclusive and the preceding aircraft has commenced a turn. (See fig. 12-15.)

Aircraft that will fly the same course, when the following aircraft will climb through the altitude assigned to the leading aircraft, may

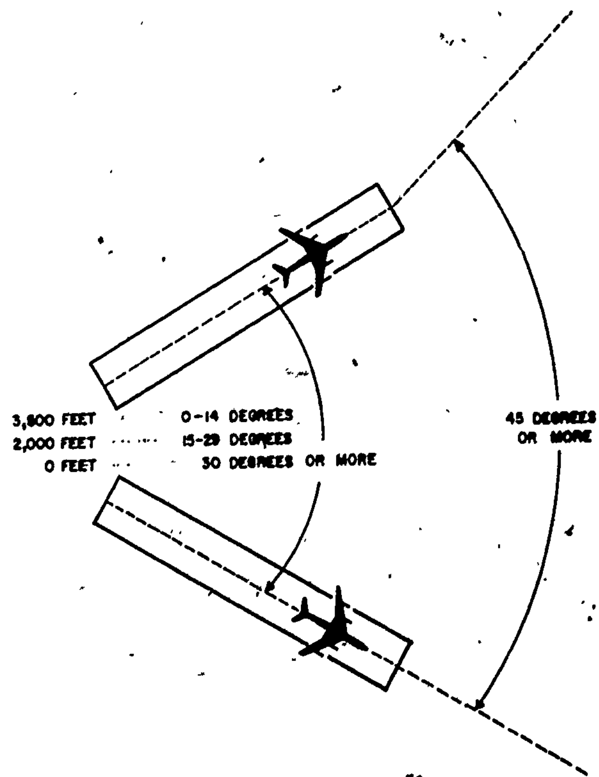

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Figure 12-14.—Simultaneous takeoffs from diverging runways.

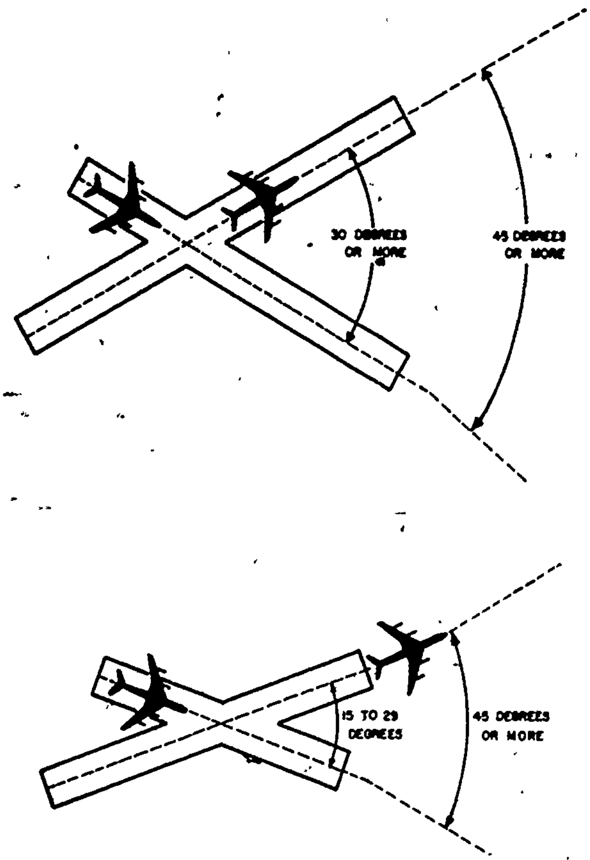

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Figure 12-15. — Takeoffs from intersecting runways.

be separated by a minimum of 3 minutes until the following aircraft passes through the altitude of the leading aircraft. The minimum separation is 5 miles if both aircraft are using DME. (See fig. 12-16.)

Initial Separation of Departing and Arriving Aircraft

At airports where approach control service is provided, a departing aircraft may be separated from an arriving aircraft making an instrument approach to the same airport by using one of the following minima until vertical or lateral separation is achieved:

1. When takeoff direction differs by at least 45 degrees from the reciprocal of the final approach course, the departing aircraft must take off before the arriving aircraft leaves a fix inbound not less than 4 miles from the airport.

2. When the takeoff direction is not different by 45 degrees from the reciprocal of the final approach course, the departing aircraft must take off so that it is established on a course diverging by at least 45 degrees from the reciprocal of the final approach course before the arriving aircraft leaves a fix inbound not less than 4 miles from the airport.

When the absence of an appropriate fix precludes the use of initial separation described in the preceding paragraph, and at airports where approach control service is not provided, a departing aircraft may be separated from an arriving aircraft making an instrument approach to the same airport by using one of the following minima until vertical or lateral separation is achieved:

1. When takeoff direction differs by at least 45 degrees from the reciprocal of the final approach course, the departing aircraft must take off 3 minutes before the arriving aircraft is estimated at the airport. (See fig. 12-17.)

2. When the takeoff direction does not differ by 45 degrees from the reciprocal of the final approach course, the departing aircraft must take off so that it is established on a course diverging by at least 45 degrees from the reciprocal of the final approach course 5 minutes before the arriving aircraft is estimated at the airport or before the arriving aircraft starts its procedure turn. (See fig. 12-17.)

Visual Separation

Aircraft within control zones may be separated by one of the following methods:

1. The controller sees them and can provide visual separation.
2. The pilot sees the other aircraft and says he will maintain visual separation from it.

A nonapproach control tower may be authorized to provide visual separation between:

1. An arriving and a departing IFR aircraft.

EXAMPLE PHRASEOLOGY: RELEASE SUBJECT YOUR DISCRETION WHEN (aircraft identification) IN SIGHT.

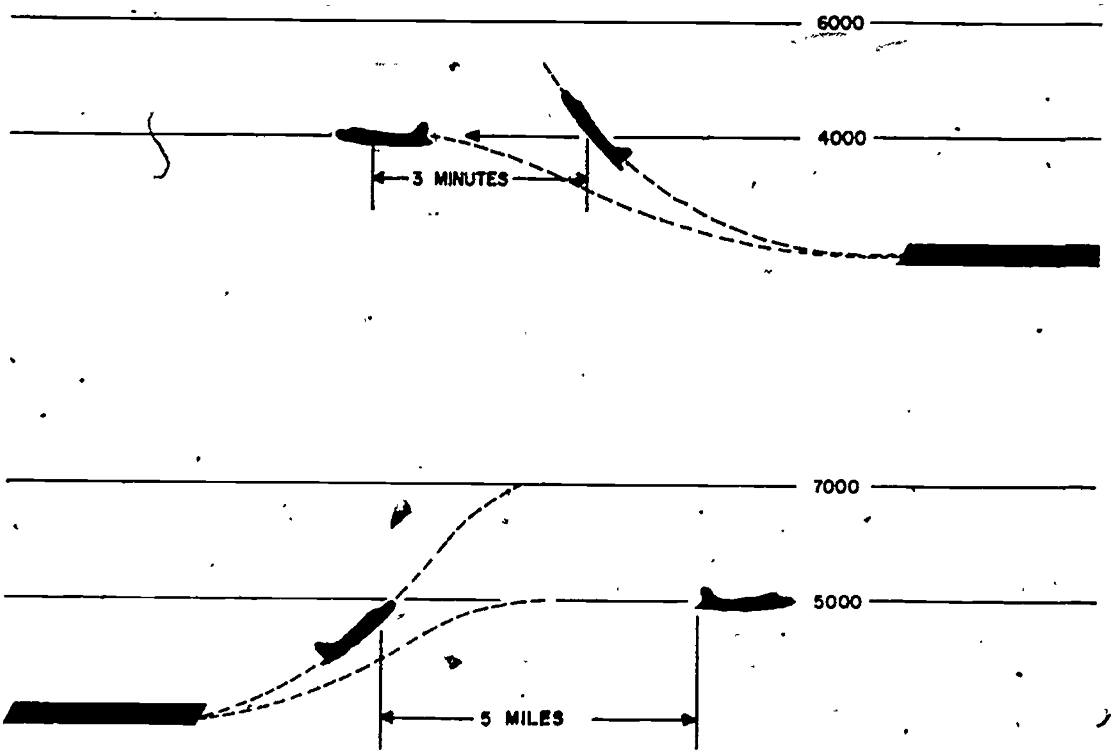

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Figure 12-16.—Takeoffs from the same runway when the succeeding aircraft climbs to the higher altitude.

2. Arriving IFR aircraft within control zones when the weather is at or above basic VFR minima and the tower has reported that it has them in sight and visual separation can be applied.

Use of VFR and
VFR Conditions on Top

An aircraft may be cleared to maintain VFR conditions when conducting flight under instrument flight rules if one of the following conditions exists:

1. A pilot requests such a clearance.
2. A clearance results in noise abatement benefits where part of the IFR departure route does not conform to an approved noise abatement route or altitude.
3. A pilot requests a practice instrument approach and is not on an IFR flight plan.

EXAMPLE PHRASEOLOGY: MAINTAIN V-F-R CONDITIONS UNTIL (Time or fix). CLIMB/DESCEND IN V-F-R CONDITIONS BETWEEN (Altitude) AND (Altitude). CLIMB/DESCEND IN V-F-R CONDITIONS ABOVE/BELOW (Altitude).

Aircraft may be cleared to maintain VFR conditions on top of a cloud, haze, smoke, or other meterological formation if the following conditions are met:

1. A pilot requests such a clearance.
2. The pilot is informed of the reported height of the top of the meteorological formation or that no report is available.

A VFR conditions-on-top type clearance may not be issued when pilot reports indicate weather conditions which are not suitable, or between sunset and sunrise, to separate holding aircraft from each other.

An alternative clearance must be issued to aircraft cleared to maintain VFR conditions when there is reason to believe that flight

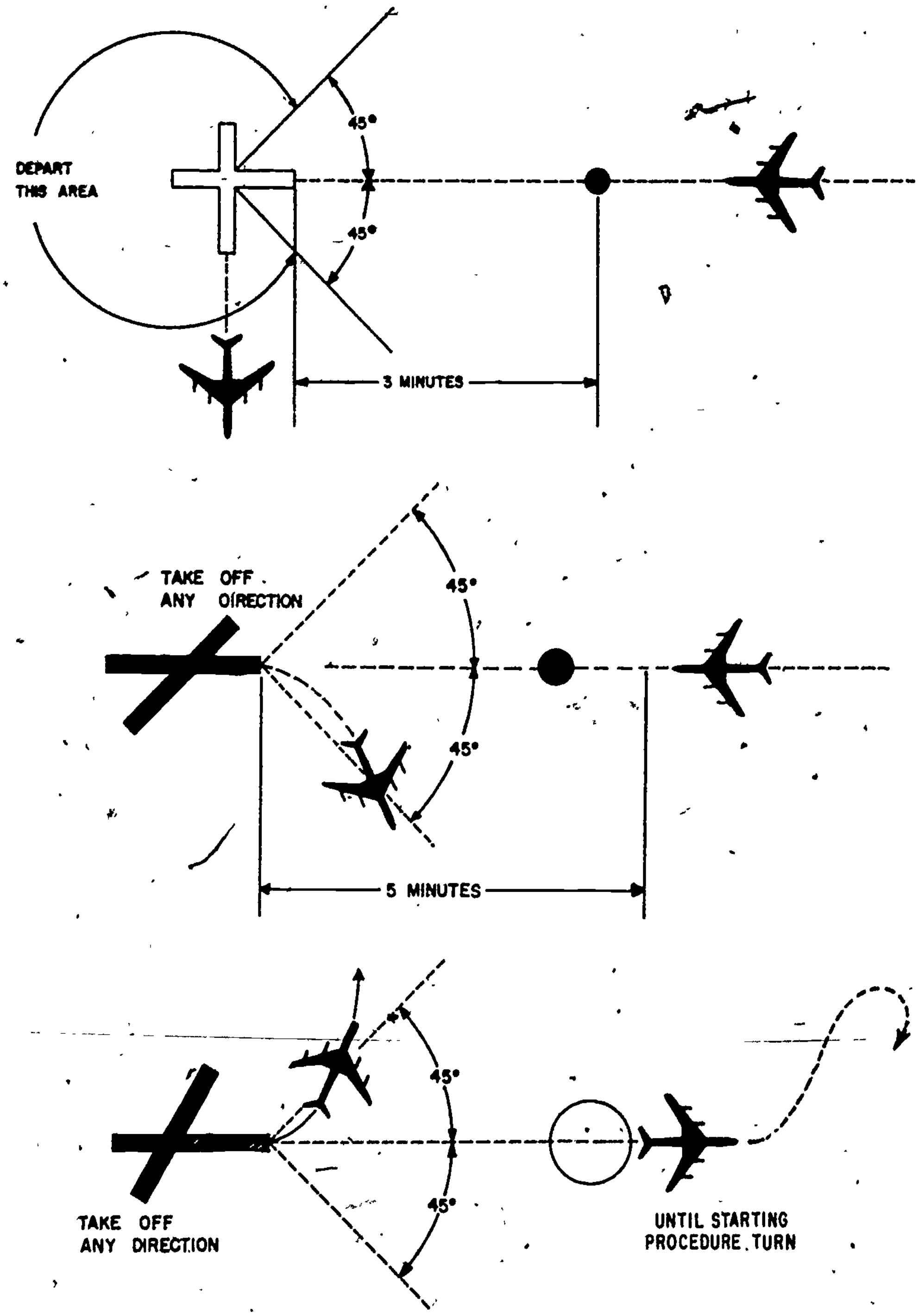

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Figure 12-17.—Separating departures from arrivals.

Table 12-1.—Appropriate VFR altitudes for direction of flight

Magnetic course	Altitude	Interval
0°-179°	FL 290 and above	4,000 feet commencing with FL 300 EXAMPLE: FL 300, FL 340
0°-179°	More than 3,000 feet above the surface to but not including FL 290	"Odd" cardinal altitudes plus 500 feet EXAMPLE: 3,500, 5,500, FL 255
180°-359°	FL 290 and above	4,000 feet commencing with FL 320 EXAMPLE: FL 320, FL 360
180°-359°	More than 3,000 feet above the surface to but not including FL 290	"Even" cardinal altitudes plus 500 feet EXAMPLE: 4,500, 6,500, FL 265

in VFR conditions may become impracticable, or to an aircraft cleared to maintain VFR conditions on top when the height of the tops is unreported.

A VFR or VFR condition-on-top type clearance may not be issued to aircraft operating in positive controlled airspace.

Aircraft that operate VFR conditions-on-top must maintain a VFR cruising altitude/flight level. If a controller becomes aware that an aircraft on such a clearance is not at an appropriate altitude for the direction of flight, the pilot of the aircraft should be informed of the discrepancy and advised of a correct altitude for his direction of flight.

Appropriate VFR altitudes for direction of flight are listed in table 12-1.

No separation is provided for IFR flights operating in accordance with a VFR condition restriction.

SPECIAL VFR OPERATIONS

Except where prohibited by FAR 93.113, authorize special VFR operations only on pilot request and only within control zones on the basis of weather conditions officially reported at the airport of intended operations. If weather conditions are not reported at that airport, authorize special VFR whenever the pilot advises he is unable to maintain VFR and requests special VFR.

PHRASEOLOGY: CLEARED TO ENTER/OUT OF/THROUGH CONTROL ZONE MAINTAIN SPECIAL V-F-R CONDITIONS WHILE IN CONTROL ZONE.

Fixed Wing Operations

PRIORITY.—Control zones other than those specified in FAR 93.113:

1. FW/SVFR flights may be approved only if arriving and departing IFR aircraft are not delayed.

2. When clearance cannot be granted for a FW/SVFR flight because of IFR traffic, inform the aircraft of the anticipated delay. Do not issue EAC, EFC, or expected departure time.

PHRASEOLOGY: EXPECT (number) MINUTES DELAY.

CLIMB TO VFR.—Authorize an aircraft to climb to VFR upon request if the only weather limitation is restriction to visibility.

PHRASEOLOGY: CLIMB TO V-F-R WITHIN THE CONTROL ZONE/WITHIN (a specified distance within control zone) MILES FROM (airport name) AIRPORT, MAINTAIN SPECIAL V-F-R CONDITIONS UNTIL REACHING V-F-R.

LOCAL OPERATIONS.—Authorize local special VFR operations for a specified period (series of landings and takeoffs, etc.) upon request, if the aircraft can be recalled when traffic or weather conditions require. Where traffic density and complexity of operations warrant, Letters of Agreement may be consummated with the local FSS, nonapproach control tower, airport manager, or local operator.

PHRASEOLOGY: LOCAL SPECIAL V-F-R OPERATIONS IN THE IMMEDIATE VICINITY OF (airport name) AIRPORT ARE AUTHORIZED UNTIL (time). MAINTAIN SPECIAL V-F-R CONDITIONS.

ALTITUDE ASSIGNMENT.—Do not assign a fixed altitude when applying vertical separation, but clear the special VFR aircraft at or below any conflicting IFR traffic but not below the minimum safe altitude prescribed in FAR 91.79.

PHRASEOLOGY: MAINTAIN SPECIAL V-F-R CONDITIONS AT OR BELOW (altitude).

GROUND VISIBILITY BELOW ONE MILE.—When the ground visibility is officially reported at an airport as less than one mile, treat requests for special VFR operations at that airport by other than helicopters as follows:

1. Inform departing aircraft that ground visibility is less than one mile and that a takeoff clearance cannot be issued.

2. Inform arriving aircraft, operating outside of the control zone, that ground visibility is less than one mile and that, unless an emergency exists, a clearance cannot be issued.

3. Inform arriving aircraft, operating within the control zone, that ground visibility is less than one mile, and ask if the aircraft can depart the control zone with a flight visibility of at least one mile. If the reply is "yes," issue a clearance out of the control zone. If the reply is "no" or an emergency exists, issue a landing clearance as soon as traffic conditions permit.

4. Clear an aircraft to fly through the control zone if he reports flight visibility is at least one mile.

FLIGHT VISIBILITY BELOW ONE MILE.—When weather conditions are not officially reported at an airport and the pilot advises the flight visibility is less than one mile, treat requests for special VFR operations at that airport by other than helicopters as follows:

1. Inform departing aircraft that a clearance cannot be issued.

2. Inform arriving aircraft operating outside of the control zone that a clearance cannot be issued unless an emergency exists.

3. Ask an arriving aircraft operating within a control zone if he can depart the control zone with a flight visibility of at least one mile. If the aircraft cannot depart the control zone accordingly, or an emergency exists, issue a clearance as soon as traffic conditions permit.

Helicopter Operations

The control of IFR helicopters is governed by the same rules and procedures as any IFR flight.

The control of special VFR helicopters is governed by the same special VFR procedures as any special VFR flight unless other procedures are covered in a Letter of Agreement.

At locations where the volume or complexity of helicopter operations warrants, a Letter of Agreement must specify the fact that special VFR helicopters are required to maintain visual reference to the surface and the traffic patterns, routes, and reporting or holding fixes necessary to achieve appropriate separation. This separation is based on specific criteria and is contained in TATC Handbook 7110.8 (Series).

RADAR IFR SEPARATION MINIMA

Radar provides an invaluable "tool" in assisting the AC to separate and expedite the flow of IFR traffic into and out of the airport to which he is assigned. However, without a thorough knowledge and understanding of the separation minima that must be applied, the controller cannot expect to obtain optimum results.

Therefore, a careful study and comprehension of the separation criteria set forth in this section will be necessary to the Air Controlman who aspires to becoming a qualified radar approach controller.

Radar separation may be applied between the following:

1. Radar-identified aircraft.

2. An aircraft taking off and another radar-identified IFR aircraft when the aircraft taking off will be identified within 1 mile of the end of the runway.

3. A radar-identified aircraft and an IFR aircraft not radar-identified when the identified aircraft is climbing or descending through the altitude of the nonidentified aircraft and the following conditions exist:

a. The performance of the primary radar system is adequate;

b. The airspace in which separation is applied is not less than 6 miles from the edge of the radarscope (10 miles if 40 miles or more from the antenna site).

c. Flight data on the unidentified IFR aircraft indicates it is a type which can be expected to give an adequate primary return in the area where separation is applied.

d. The identified aircraft is vectored on a flightpath different from the route of the unidentified IFR aircraft before descent or climb.

e. Radar separation is maintained from all observed primary and radar beacon targets until nonradar separation is established from the unidentified aircraft.

It should be noted that radar separation is provided to all RNAV aircraft operating on a random (impromptu) route at and below FL 450.

Application of Radar Separation

Minimum radar separation is applied as follows:

1. Between the centers of primary radar targets. The primary target must not be allowed to touch another primary target or a beacon control slash.

2. Between the ends of beacon control slashes.

3. Between the end of a beacon control slash and the center of a primary target.

Radar beacon targets may be used for separation purposes only if beacon range accuracy is verified by one of the following methods:

1. Correlation of beacon and primary targets of the same aircraft to assure that they coincide.

2. When beacon and primary targets of the same aircraft do not coincide, correlate to assure that any beacon displacement agrees with the specified distance and direction for that particular radar system.

If the beacon range accuracy cannot be verified, beacon targets may be used for traffic information only.

Separation Minima

Minimum radar separation between airborne aircraft radar targets is 3 miles if less than 40 miles from the antenna site, and 5 miles if 40 miles or more from the antenna site.

Vertical separation applied between aircraft may be discontinued when the targets are observed to pass each other and no longer touch each other and their courses diverge by at least 15 degrees.

For single runway operations, a departing aircraft is separated from an arriving aircraft on final approach by a minimum of 2 miles if separation will increase to a minimum of 3 miles (5 miles if 40 miles or more from the antenna site) within 1 minute after takeoff.

Simultaneous operations may be authorized on parallel runways, provided that the following conditions exist:

1. If the landing thresholds are even, the runway centerlines are separated by at least 3,500 feet. (See fig. 12-18.)

2. If the landing thresholds are staggered and one of the following conditions is met:

a. The approach is made to the runway nearest the arriving aircraft, the runway

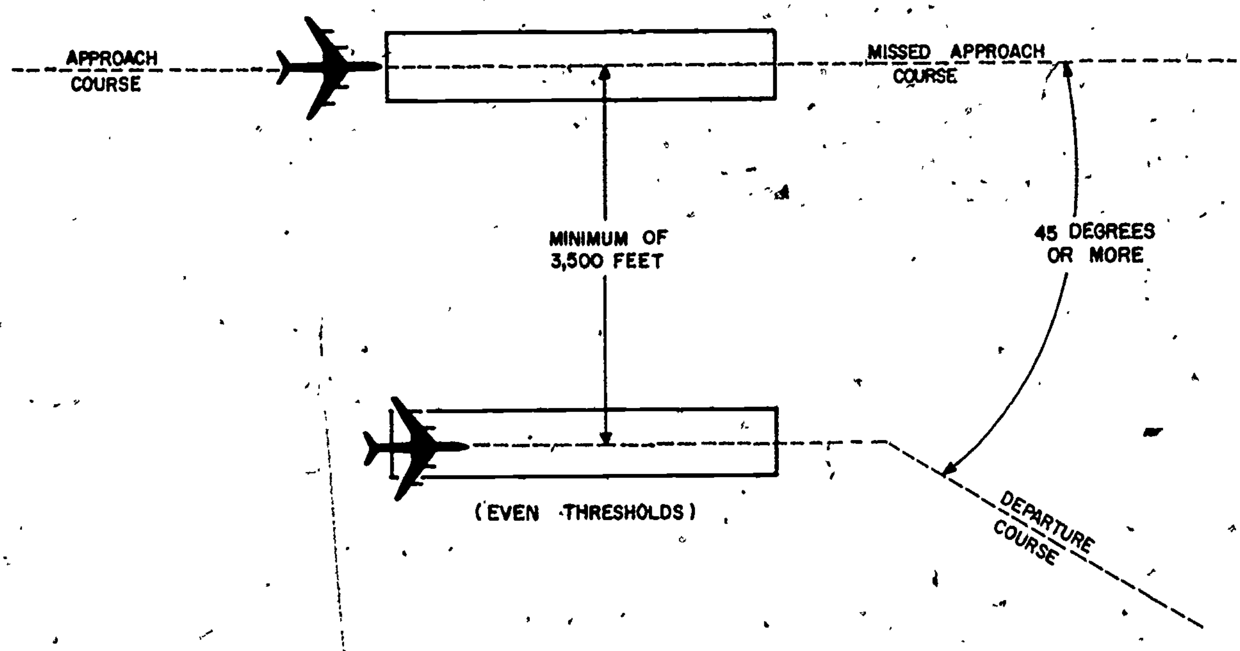

Figure 12-18.—Simultaneous operations from parallel, even threshold runways.

centerlines are laterally separated by at least 1,000 feet, and the thresholds are horizontally staggered at least 500 feet for each 100 feet of centerline separation below 3,500 feet. (See fig. 12-19.)

b. If the approach is made to the runway farthest from the arriving aircraft, the runway centerline separation exceeds 3,500 feet by at least 100 feet for each 500 feet of threshold stagger distance. (See fig. 12-19.)

3. The departure course will diverge immediately after takeoff from the missed approach course by at least 45 degrees until minimum radar separation is achieved and can be maintained.

4. Departing aircraft that have not commenced takeoff are held, or appropriate clearances issued to those committed to take off, when an arriving aircraft is observed to deviate from the approach/missed approach course sufficiently to cause a potential conflict.

Simultaneous operations may be authorized on nonintersecting, diverging runways (fig. 12-20) provided that the following conditions exist:

1. The departure course upon or immediately after takeoff diverges from the missed approach course by at least 45 degrees until minimum radar separation is achieved and can be maintained.

2. The distance between the centerline or extended centerline of the landing runway and the centerline of the takeoff runway (measured from the point where the takeoff is commenced) is as follows:

a. 1,000 feet if the runways diverge by at least 30 degrees.

b. 2,000 feet if the runways diverge by 15 to 29 degrees inclusive.

c. 3,500 feet if the runways diverge by 14 degrees or less.

3. Departing aircraft that have not commenced takeoff are held, or appropriate clearances issued to those committed to takeoff, when an arriving aircraft is observed to deviate from the approach/missed approach course sufficiently to cause a potential conflict.

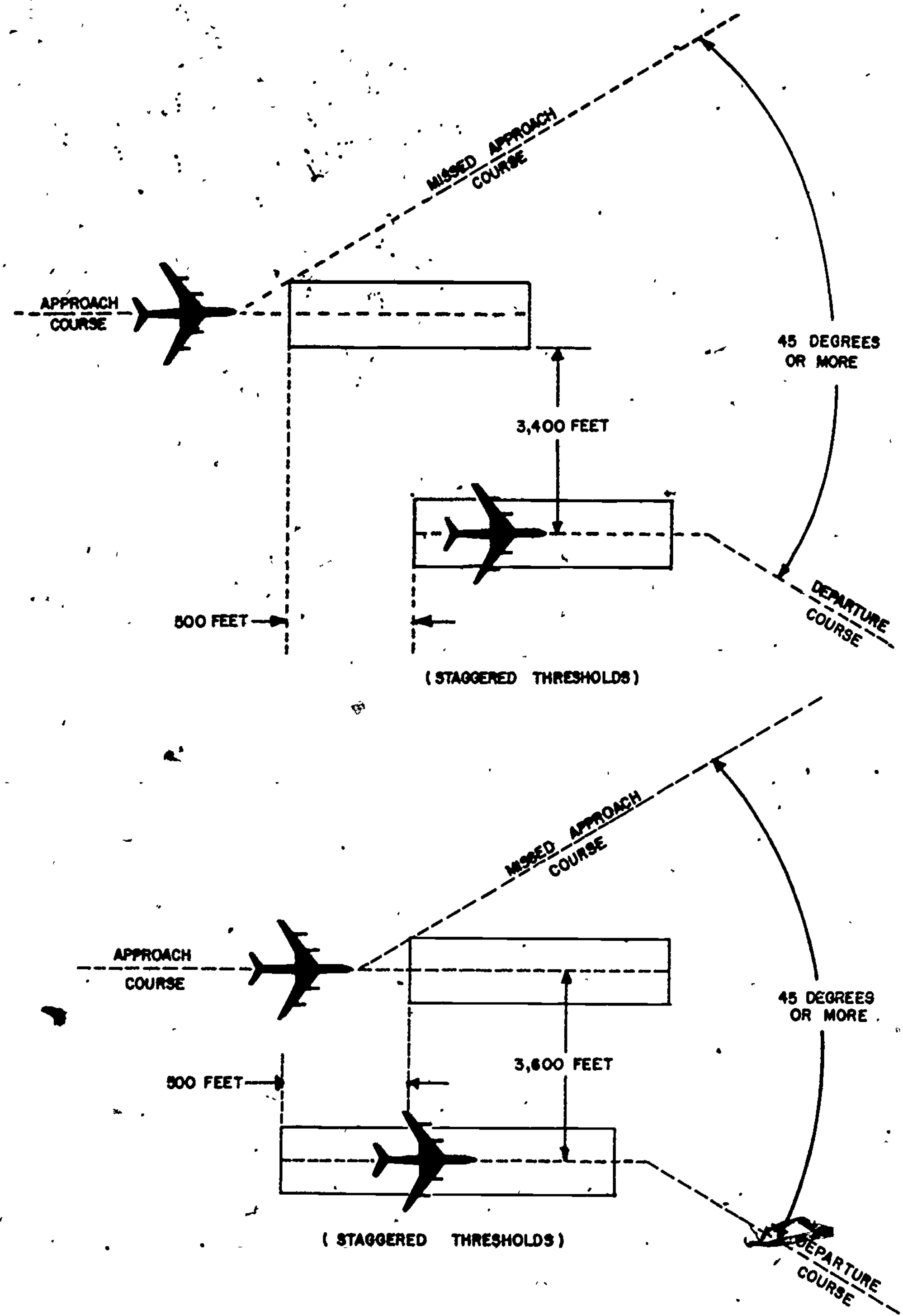

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Figure 12-19.—Simultaneous operations from parallel, staggered threshold runways.

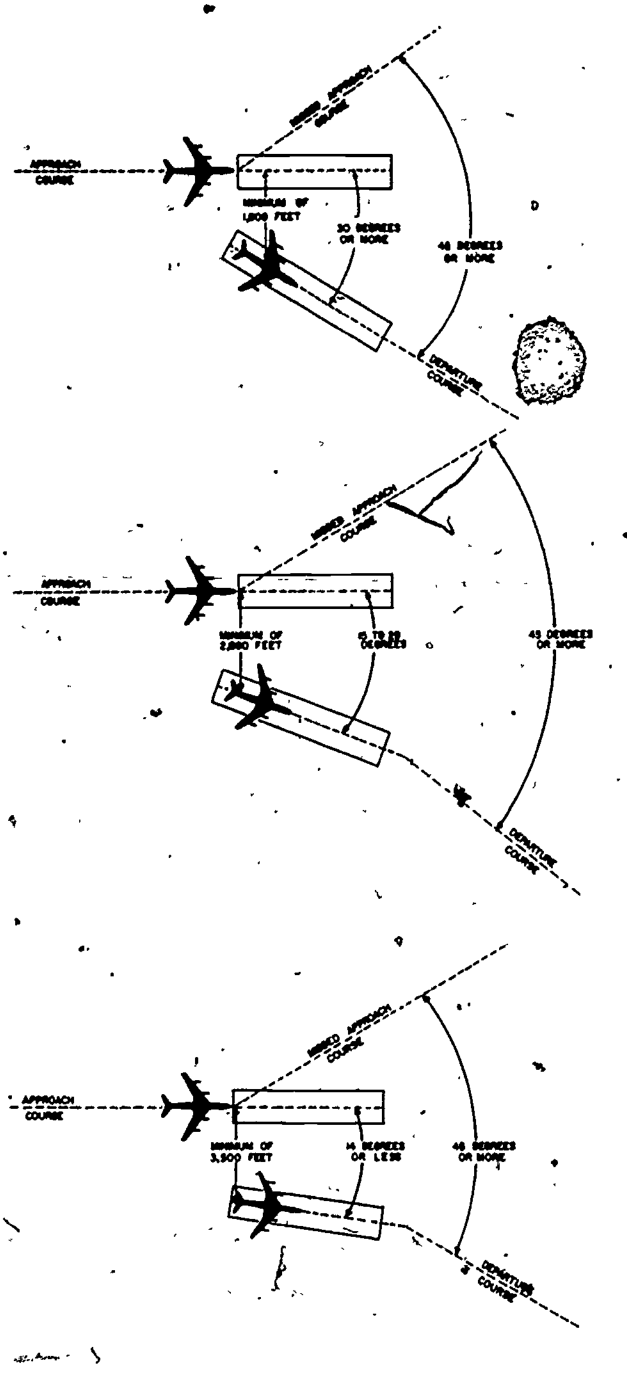

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Figure 12-20. — Simultaneous operations from diverging, nonintersecting runways.

Radar-controlled aircraft are separated from the boundary of adjacent airspace, in which radar separation is also being used, by 1.5 miles when less than 40 miles from the antenna site, and 2.5 miles when 40 or more miles from the antenna site.

Radar-controlled aircraft are separated from the boundary of airspace in which nonradar separation is being used by a minimum of 3 miles (5 miles when 40 or more miles from the antenna site). However, this separation is not required if the radar-controlled aircraft are either climbing or descending and they are definitely outside of the airspace in which nonradar separation is being used.

A radar-controlled aircraft that is climbing or descending through the altitude of an aircraft that has been tracked to the edge of the scope is separated by a minimum of 3 miles (5 miles when 40 or more miles from the antenna site) from the edge of the scope until nonradar separation has been established.

Radar controlled aircraft may be separated from prominent obstructions shown on the radarscope (displayed on the video map, scribed on the map overlay, or displayed as a permanent echo) by a minimum of 3 miles within 40 miles of the antenna site.

Vertical separation of aircraft above a prominent obstruction, which is displayed as a permanent echo, may be discontinued after the controller observes that the aircraft target has passed the obstruction.

When using a radar display with a previously specified beacon target displacement for radar separation purposes, 1 mile must be added to any minimum for a displacement of 1 mile or less between the primary target and the beacon target.

CHAPTER 13

RADAR AND ALLIED EQUIPMENT AND PROCEDURES

The name RADAR is formed from the initial letters of the words RAdio Detection And Ranging. Radar was developed principally for the purpose of detecting and ranging targets in wartime. This, of course, is still the primary purpose of military radar; however, the ability of radar to spot unseen objects has proven to be invaluable in the field of air traffic control. Civil and military aviation have grown to be a veritable giant compared to the days prior to World War II. The many departures and arrivals at major air terminals could not be effectively and safely controlled without the assistance of radar. Previous separation standards can be reduced, and this contributes to the expeditious and orderly flow of air traffic without any compromise of safety. In fact, safety is increased in many situations. Radar is used in many ways but, in this chapter, our main concern will be radar as applied in air traffic control.

Radar depends on a principle that energy emitted from one point and traveling at a uniform rate will be reflected by obstructing surfaces in its path, in which case a small portion of the original energy returns, at the same rate of speed, to the point of origin.

This is the old principle of the echo, which we have all had demonstrated to us by sound waves. For example, the man who shouts at the side of a cliff to hear his echo is, in effect, illustrating the basic principles of radar, using sound waves instead of radio waves. (See fig. 13-1.) Radio waves that travel at the speed of light (162,000 nautical miles per second) also have echoes.

The nautical mile is used in this chapter because it is standard for navigation purposes, radar work, and when calibrating facilities.

FUNDAMENTALS OF RADAR OPERATION

In radar, the shout of our sound analogy is a short pulse from an ultrahigh frequency

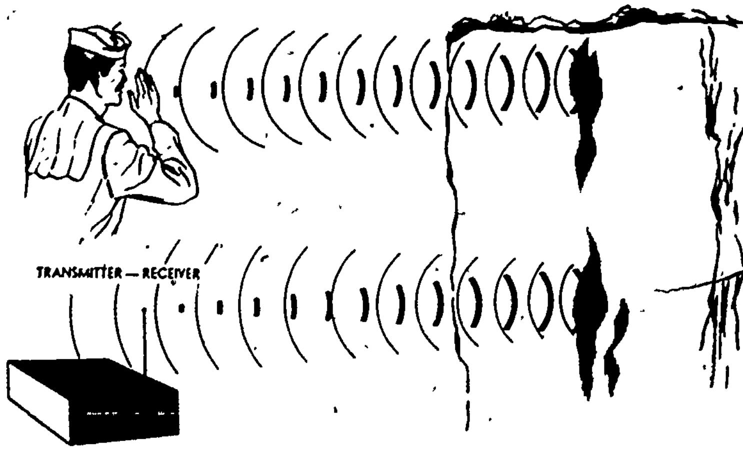

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Figure 13-1.—Reflection of sound and radio waves.

transmitter which generates electromagnetic waves that travel in very straight lines. (See fig. 13-1.) Upon striking an object, these waves are reflected and some of the energy returns to the transmitter sight where the waves are amplified by a receiver, and the elapsed time is measured very accurately. The Greek word "micro" means one-millionth of a unit; thus, one-millionth-second time unit is known as a microsecond. Despite the fact that radio pulses travel incredibly fast, electronic devices can accurately time these echoes.

Again, consider the man who shouts at the cliff. If he had cupped his hands around his mouth when shouting and around his ears when listening, he would have noted two improvements: First, the effective range of the echo would have been increased since the radiated sound waves were concentrated into a narrow beam and returning echoes were funneled into the ear; and second, he would have been able to more readily distinguish between two reflecting surfaces that were separated in azimuth from his position. This is of particular importance in radar if a high degree of accuracy of angular position is desired. The radar beam may be only one-half degree wide. Such a narrow beam can distinguish between two objects at the same range, differing by as little as 1 degree in angular position.

The radar antenna has two important tasks. It is not only required to radiate the radar pulse, but also has to catch the returning echo. The antenna array, or its size and shape, will vary with the performance requirements of the unit. Frequently some type of special directivity in the vertical or horizontal plane is required. In the airport surveillance system, for example, an ideal coverage would be from the ground to an elevation of 10,000 feet and ranges from 30 to 60 miles. Special antenna arrays have been designed to provide this coverage. The surveillance system of a ground controlled approach (GCA) unit is a prime example.

BASIC RADAR COMPONENTS

The basic components of a radar system are shown in figure 13-2. The function of each component is explained in the following paragraphs by tracing the sequence of events that go into the manufacture of a single blip on the indicator. (Part numbers used in this section refer to the number designation used in figure 13-2.)

Transmitting System

The transmitter power supply (1, fig. 13-2) provides a steady, high dc voltage to the modulator.

The synchronizer (2) furnishes a sharp, low power pulse to trigger the modulator and the sweep generator simultaneously. These pulses are repeated between 60 and 4,000 times per second, depending on the design of the set.

The modulator (3) acts as an electronic switch or valve to furnish high voltage dc to the transmitter in brief pulses. These pulses are extremely short (duration less than 1 microsecond) in some equipment. After each pulse the transmitter is off the air while the system waits for echoes from that pulse to be received.

The maximum rapidity with which this cycle can be repeated has a direct bearing on the minimum distance over which targets may be detected. To illustrate, let us suppose you are bouncing a rubber ball against a wall. You are throwing the ball (transmitting the energy) with your right hand and catching the ball (receiving the reflected energy) with your left hand. As you get closer to the wall, you reach a point where you are physically unable to catch the ball and throw it again immediately. Something very similar happens in the radar set when the receiver, which has been disabled during pulse transmission, has not had sufficient time to return to operation when the return signal from a close-in target is received.

The transmitter (4) converts the dc pulses received from the modulator into extremely high frequency radio energy. Frequencies used in aviation radar are:

BAND	FREQUENCY	USE
S	1,550-5,200 MHz	Airport Surveillance.
X	5,200-10,900 MHz	GCA Precision.
L	390-1,550 MHz	Long Range Surveillance.

Transmitter peak power of over 1,000,000 watts (1 megawatt) is possible with present long

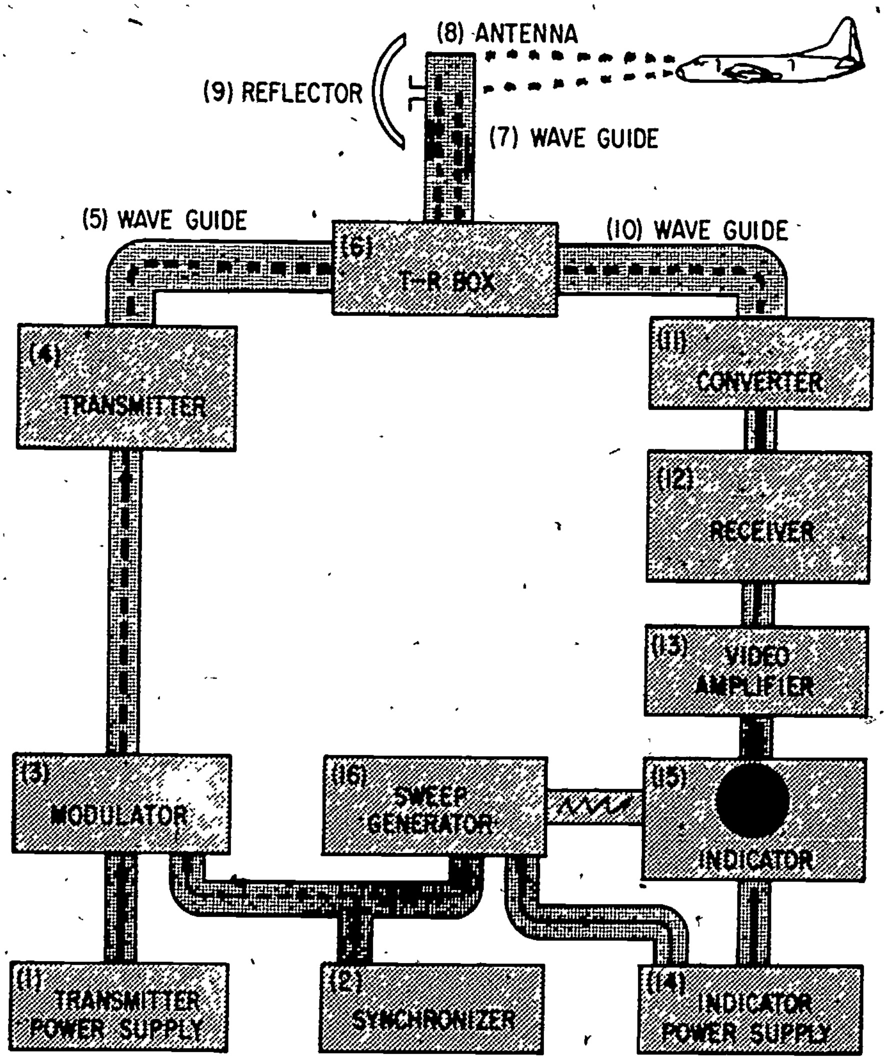

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Figure 13-2.—Basic components of radar system.

range radar. An appreciation of the large amount of power required for radar is evident if we compare this transmitter with commercial broadcast transmitters where 50 kilowatts is considered high power.

One factor which helps to make possible such high transmitter power in radar is that the transmitted signal is a surge of energy which lasts only for the very short interval that the pulse is being sent out. The high power components then have a period of rest during the time the receiver is in operation.

The waveguide (5) pipes the radiofrequency (RF) energy from the transmitter to the transmit-receive (T-R) box. "Pipes" is a descriptive term, inasmuch as waveguides are simply metal plumbing of rectangular cross section.

The T-R box (6) blocks the high power pulse of the transmitter from the receiver circuits. This is necessary to prevent the receiver system from being burned out by the extremely high-powered energy.

The waveguide (7) conducts the RF energy from the T-R box to the antenna.

The antenna (8) radiates the RF energy from the waveguide into the reflector.

The reflector (9) concentrates and shapes the RF energy into the desired beam.

Receiving System

The reflector (9), as well as directing the transmitted RF energy, catches the returning echo and concentrates this energy on the antenna.

The antenna (8) receives the echo energy from the reflector and transmits it to the waveguide (7).

Waveguide (7) pipes the echo energy to the T-R box.

T-R box (6) blocks off the transmitter circuits to allow all echo energy to be conducted into the receiver system.

The waveguide (10) pipes the echo energy into the converter.

The converter (11) mixes the RF echo pulses with a steady signal of a slightly different frequency, and transmits this combination to the receiver.

The receiver (12) converts the RF echo pulses to sharp video pulses. Video (from the Latin meaning "to see") output is analogous to the audio output of a conventional broadcast receiver.

The video amplifier (13) amplifies the video signals and feeds them into the control grid of the indicator.

The indicator power supply (14) furnishes relatively low voltages to the heaters, cathodes, and anodes of the sweep generator and the indicator.

The indicator (15) converts the video pulses received from the video into light indications and presents this information in the desired form. Practically all indicators are based on the use of the cathode-ray tube (CRT). The CRT, or "scope," is a conical glass bulb with an electron gun at the small end and a flattened glass disc at the other end. Its basic construction is somewhat similar to a television picture tube. (See fig. 13-3.)

The sweep generator (16, fig. 13-2) generates the variable current, which is applied to the deflecting coils, to sweep the electron beam back and forth inside the scope.

RADAR DISPLAY

There are numerous ways of displaying the radar data once it has been obtained. The manner of presentation depends upon the use to be made of the data. The most frequently employed type of presentation in air traffic control is a Plan Position Indicator, commonly referred to as the PPI-scope. In this type of display the time reference is at the center of the cathode ray tube face. Rangemarks are introduced into the system and show up as bright concentric circles on the display. Their spacing in terms of miles may be various values (1, 5, etc.), although at any one time the spacing will be uniform throughout the display.

The PPI-scope may be expanded for short ranges; for example, a 5-mile range may actually cover the same area on the face of the tube as a 30-mile range. The rangemark spacing inerval may be manually changed or the indicator equipment may be of the type that produces a certain rangemark spacing interval for a specific range selected.

The offcenter PPI display is one in which the start of the sweep is moved away from the center of the tube face. One advantage of this type of display is the increase in maximum range presented on the tube in a selected azimuth sector. If 30 miles were the greatest range on a range selector switch, it would be possible to extend the sweep out to 60 miles in any desired sector by offcentering to the edge of the tube face. Whether targets could be seen out to 60 miles depends on the radar system itself and the type of target. Figure 13-4 shows two PPI-scopes with the same range selected but with one offcentered to increase range.

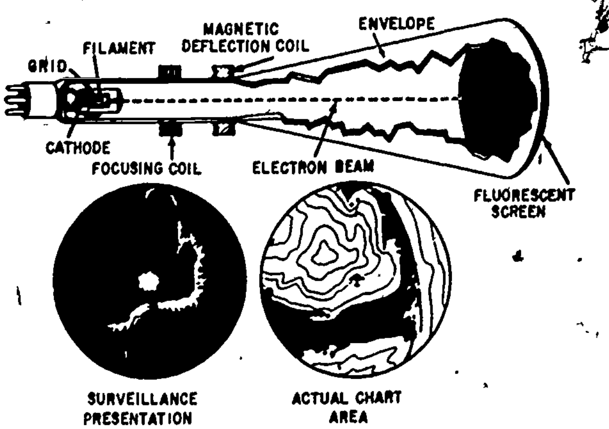

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Figure 13-3.—Cross section of cathode-ray tube with radar presentation.

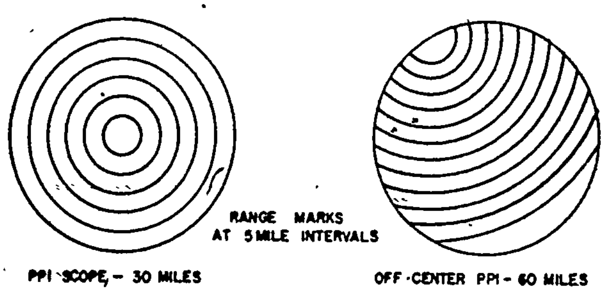

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Figure 13-4.—Advantage of offcenter PPI-scope.

Targets show up on the PPI-scope as bright spots at their respective range and bearing from the antenna site. An example of a PPI-scope presentation is shown in figure 13-5.

This type of display is commonly used for airport surveillance equipment which in conjunction with an aircraft's altimeter gives positive control of aircraft within the coverage of the radar equipment.

AUXILIARY EQUIPMENT

A basic PPI display shows all type of radar echoes, both fixed and moving targets. Ground targets are usually displayed as strong echoes, and they will mask echoes from aircraft flying over these areas. Any echo that is undesirable, or that prevents the controller from observing aircraft, is called clutter. The moving target indicator eliminates clutter resulting from fixed targets.

Moving Target Indicator

The principle of the moving target indicator (MTI) is that the phase of the echoes from one transmitted pulse is compared with the phase of the echoes from the next successive transmitted pulse. If the phases of the two returns from the same target are the same, the returns cancel each other. If there is a phase difference, resulting from the target moving, the returns do not cancel, and there is an indication on the scope of moving targets only. The ability of MTI to display any specific aircraft target depends on the radial velocity of the aircraft. Radial velocity is the speed an aircraft is making toward or away from the radar antenna, regardless of the heading or groundspeed. An aircraft target would not be displayed if it were flying a perfect circle around the antenna at a constant range; i.e., it would have no radial velocity.

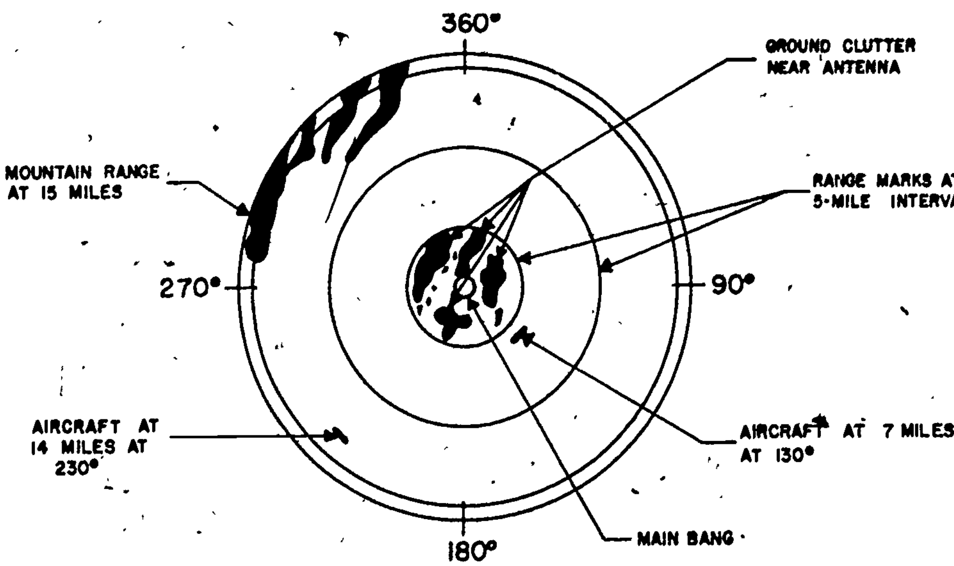

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Figure 13-5.—PPI-scope display.

The radar operator can control the video output from both normal radar and MTI. Normally, any of the following PPI displays can be selected by the operator (in some cases, the MTI range gate, or range of the MTI, is adjusted by a technician):

1. A completely normal radar display; signals from stationary and moving targets.
2. MTI display; uncanceled signals from moving targets only.
3. A display in which MTI signals are range-gated at any desired range with normal signals appearing beyond the MTI presentation.

Figure 13-6 is an example of a 20-mile PPI display with the MTI range adjusted to 10 miles and normal radar appearing beyond that. The lines on the scope in figure 13-6 comprise a mapping system discussed later in this chapter.

Circular Polarization

A factor that determines the effective range of radar is the manner in which the radar energy is radiated into space. The radiation of electromagnetic (radar) energy during normal weather conditions gives good target returns. However, during a heavy rainstorm, the individual raindrops act as targets and reflect the polarized electromagnetic energy which may completely illuminate or clutter the scope and obscure any target that may be in the area. This condition is undesirable and is overcome by radiating energy in a type of polarization that is designed to cancel returns from symmetrical targets, such as raindrops, while accepting returns from asymmetrical targets such as aircraft. This type of polarization is known as circular polarization.

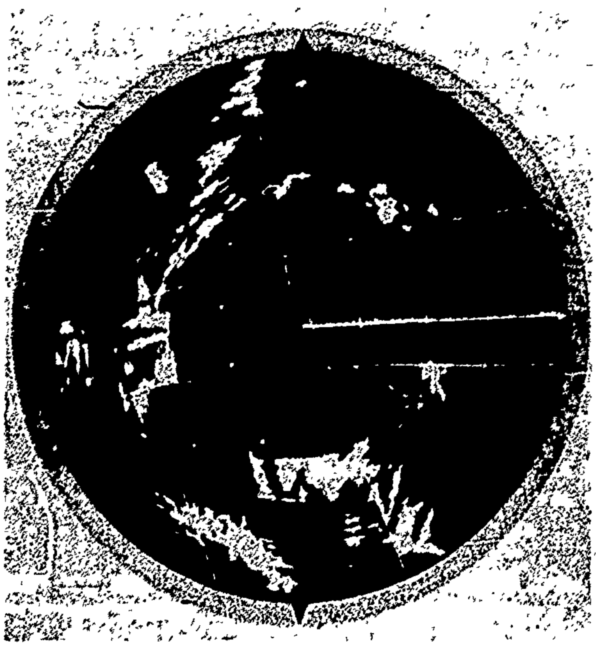

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Figure 13-6.—A 20-mile PPI display with MTI adjusted to 10 miles.

Operator control of polarization is normally a two-position toggle switch labeled LP-CP (linear-circular polarization). LP is selected for normal operation, and CP is selected when necessary to reduce clutter from precipitation. Figure 13-7 shows a comparison of linear and circular polarization used in conjunction with MTI. MTI will eliminate some precipitation clutter, but normally precipitation is moving fast enough to be displayed as a moving target.

Caution should be exercised when using circular polarization in the control of certain types of aircraft such as the F-5 which normally displays only a very weak return. The CP will also reduce the target strength of aircraft targets and in some cases may eliminate it altogether.

Mapping Systems

A radar controller uses the rangemarks on the PPI and the compass rose around the edge of the scope to obtain the position of an aircraft target. Information from these two sources only gives range and azimuth from the radar antenna, and does not depict the geographical location of the aircraft; therefore, some type of map display would be advantageous. Two types of mapping are available as integral parts of a PPI—a map overlay and video mapping.

The simplest solution is the map overlay. As the name implies, it is installed so that it covers the face of the cathode-ray tube. The overlay is made of transparent plastic, and necessary reference marks, location of navaids, runways, and obstructions are etched into the surface. The overlay is edge-lighted, and the controller can control the brilliance. The shape of the

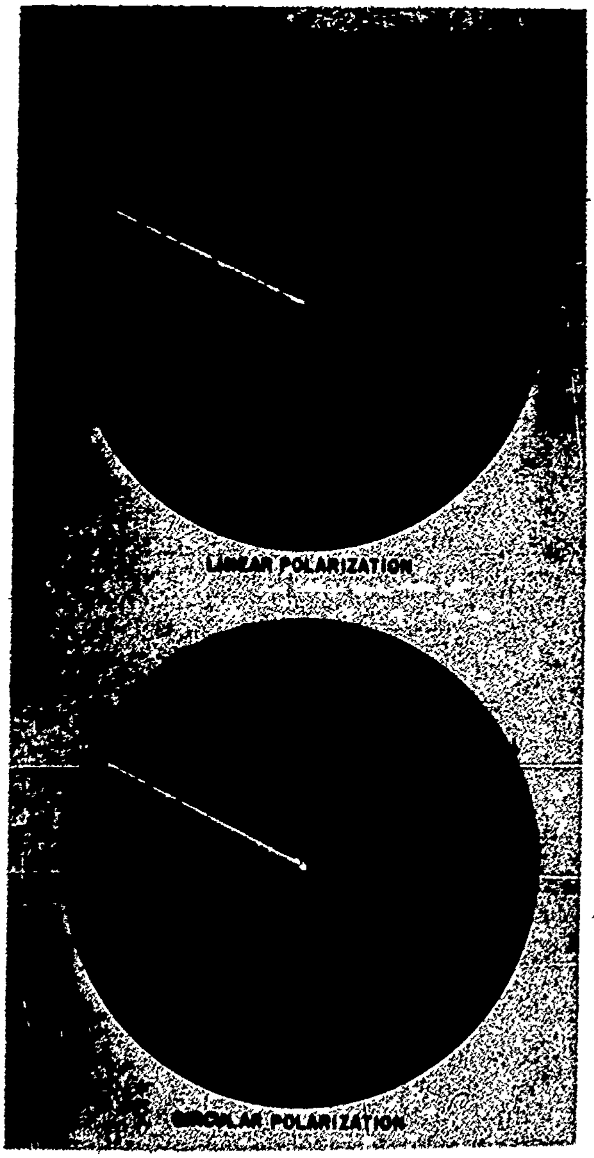

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Figure 13-7.—Comparison of linear and circular polarization with MTI employed.

overlay conforms to the surface of the CRT, but does not touch it.

There are two inherent disadvantages to the map overlay. Since the map is installed a short distance away from the tube, the targets do not appear in proper relation to the map unless the controller looks at the target from a point directly above the target. This is called parallax. Targets will apparently drift away from one of the etched courses, when the controller's viewing position changes. The controller must be extremely careful of his posture, so that he will observe the target correctly, and prevent parallax. The other disadvantage is that the map is only good for one range setting of the radarscope, since it does not expand with the display on the tube.

The video map is a great improvement over the map overlay. It is produced by a separate mapping unit rather than being installed on the radar console. A scale map of the desired features is drawn and then reproduced as a round photographic negative. This information is fed to the video amplifier ahead of the indicator tube and mixed with radar information from the receiver so that the resulting signals to the PPI will contain a combination of radar and map data. The antenna scan and the map scan are synchronized so the map is developed directly on the PPI as the sweep progresses. The result, and biggest advantage of the video map, is that the map expands or contracts as the range of the indicator is changed. The map coverage is in direct proportion to the area covered, and is accurate when the scope is offcentered.

Since the map is produced on the face of the tube along with the radar information, there is no parallax error. Thus, with a single map and mapping unit, a number of ranges with corresponding plotting information are available for display on several indicators operating independently of each other. Figure 13-8 is an example of a video map.

The video map is subject to some drift, but slight errors resulting from drift can usually be corrected by a radar technician. Another disadvantage of the video map is the possibility of failure of the mapping unit which would result in no map on the PPI.

SURVEILLANCE APPLICATION

Surveillance radar is a potent tool for all air traffic control use. It releases the controller from the restriction imposed by the uncertainty which formerly existed as to the actual position of the aircraft. Accuracies of the radar indications are superior to human vision, and a clear plan position of all aircraft and their approximate headings within the range of the radar is indicated. The many advantages of such a display are obvious.

It is evident that if a controller can continually see the position of the aircraft he is controlling, he can relay information which will enable the pilot to make the necessary corrections in heading to bring him to his destination.

In the case of terminal radar operations, lines are drawn to show runway extensions, and usually are marked to indicate distances from the runway. Using any suitable radiotelephone, a controller can then give the pilot heading instructions which will keep his radar target accurately on the approach lines, and inform the pilot of the exact distance from the runway at any time. Knowing the sea level altitude of the airport, and the fact that a normal rate of descent for the desired glide angle is 300 feet per mile, a controller can advise a pilot what his altitude should be each mile. Such an approach is perfectly practicable under ceiling conditions of 300 feet or higher.

RADAR PERFORMANCE CHARACTERISTICS

MTI Blind Speed

When a radar system is developed that will detect only flying aircraft, and nothing else, the radar controller will have a nearly perfect system for controlling traffic. Such a system has not been developed yet, but with the MTI system he has the next best thing. Nevertheless, radar systems do have limitations, and some of these are discussed in the following paragraphs.

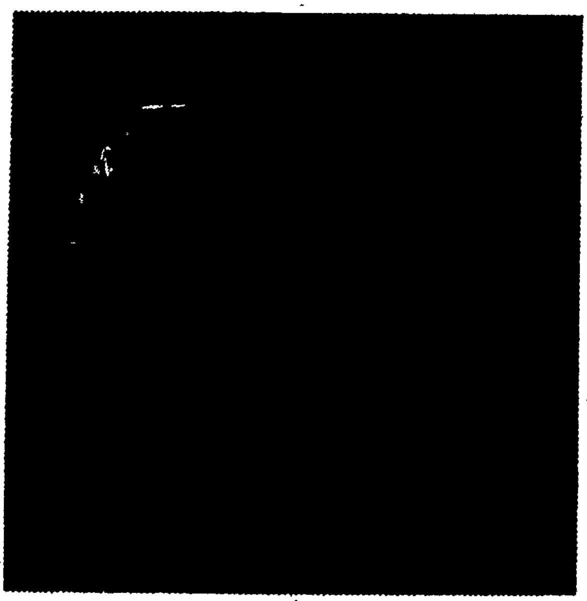

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Figure 13-8.—Video map.

If we review the principle of the MTI system, we find that the basic function of the MTI is to compare the phase of each signal received with that of the last signal return. The phase of each reply from a stationary target will be the same, and the system will cause the returned signal to be canceled. If, however, the target is moving with a radial component of velocity with respect to the antenna, the reflected wave will have a different time phase from pulse to pulse and will be indicated on the radarscope.

Should an aircraft be moving at a speed such that the distance covered between pulses is equal to half the wavelength, or multiple thereof, of the transmitting frequency, the phase relationship is unchanged. As a result, the signal will be canceled in the same manner as the fixed target signal. Such a condition is known as MTI blind speed.

Blind speeds differ with each type and model of radar according to the wavelength of the transmitted signal. Complete loss of targets is seldom experienced with conventional aircraft since the propeller rotation will rarely be synchronized with the radial velocity of the radar and a partial return will be received. Seldom will an aircraft be able to maintain a course which affects MTI blind speed for more than a few seconds due to wind or variations in altitude.

Target Fades

An inherent feature of all radar systems with which the controller should become thoroughly familiar is target fading. Target fades will vary with the type of equipment, antenna height, tilt angle of the antenna, atmospheric conditions, and the surrounding terrain. Target fades will be apparent when an aircraft is over the antenna site. The degree and length of such a fade will be determined by the amount of antenna tilt. It should be noted that the lower the tilt angle of the antenna, the better will be the low angle coverage. On the other hand, the higher the tilt angle of the antenna, the better will be the high angle coverage. Most antennas are set to give maximum coverage for the particular type of control being employed.

The coverage in range, altitude, and azimuth for a particular site is determined by means of a flight check evaluation, which is conducted by the FAA flight check team before the facility is commissioned. In the event that a previously unknown fade area is suspected, another flight check should be requested in order to verify or confirm its existence. The data obtained from the flight check gives the controller an indication of coverage and target fades inherent in the type of equipment being used. In order to understand the capabilities and limitations of the system, a controller should become thoroughly familiar with the coverage pattern and fade areas which were determined by the flight check.

NOTE: For further information and detailed procedures utilized in the conduct of these flight checks, refer to the United States Standard Flight Inspection Manual, NAVAIR 16-1-520, and NAVAIRINST 3721.1 (Series).

Anomalous Propagation

The atmosphere surrounding the earth is not uniform in density or moisture content; therefore, it is possible for local conditions to exist in which radar beams are bent upon passage through the atmosphere. Conditions under which the radar beam does not travel a straight line are called conditions of anomalous propagation. This condition is most apt to occur on days when there is little wind, and when air temperature is different from the ground temperature.

Anomalous propagation is most prevalent over water where water evaporation causes a temperature and moisture gradient to exist. The refraction of dry or dense air is greater than that of moist or less dense air; therefore radar beams will be bent in the direction of the dry or dense layers. Figure 13-9 depicts two conditions of anomalous propagation with the atmosphere causing a downward and upward bending of radar beams.

Under conditions depicted in figure 13-9, targets hundreds of miles away may be detected even though they are far below the horizon. On the other hand, relatively close targets may not be detected.

False Targets

The proficient radar controller must be quick to recognize a temperature inversion as a false target. Such indications are often secondary reflections of radar energy from isolated refracting areas in a temperature inversion level. Correlation of radar reports with the National Weather Service records indicates that a temperature inversion is usually present when unidentified flying objects appear on the scope. These inversions often travel across the radar at tremendous speeds and in changing directions. Apparently this phenomenon is produced by isolated refracting areas traveling with the wind at or near temperature inversion levels. Although the exact size, shape, and composition of these isolated areas are not known, it is believed that they may be atmospheric eddies produced by a shearing action of dissimilar air strata. It appears that such eddies may reflect and focus the radar energy with a lens effect to produce a small concentration of ground return with sufficient strength to show up on the radar display.

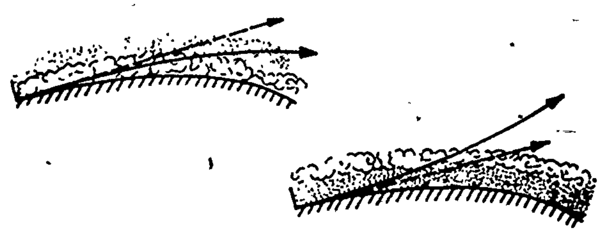

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Figure 13-9.—Anomalous propagation effect.

Radar Jamming

Jamming, as used in conjunction with radar, is defined as an introduction of false radiation into radar and radar devices. False targets produced by jamming may appear on the scope at varying ranges and bearings or in some cases may clutter large portions of the scope.

Jamming may be classified into two main categories, active and passive. Active jammers are those which generate radar energy producing interference. Passive jammers are those which act as parasitic radiators such as chaff. Chaff is thin strips of aluminum or other metal cut to a particular length. When released from aircraft at high altitudes, the strips float down to the ground slowly and the resultant echoes cause large areas of clutter.

The Air Force has equipped the ejection seats of some of their training aircraft with chaff dispensing bags. In the event of crew

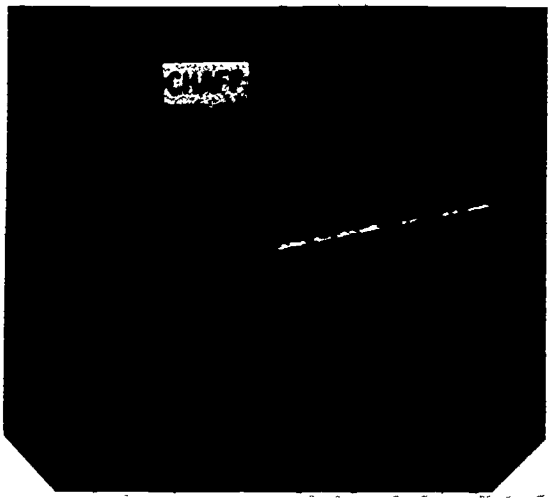

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Figure 13-10.—Chaff interference.

ejection, chaff will disperse over a wide area and will remain visible in the form of clutter on radarscopes for a period of 30 minutes or so depending on the altitude of ejection.

Controlled jamming is conducted by the military and regulated by the FAA to preclude interference with air traffic control radar. Controllers observing jamming operations, when no prior notification has been received, should notify appropriate authority. Figure 13-10 is an example of chaff interference.

Electronic Radar Interference

Interference from other radar installations operating on a simila frequency may be encountered when two or more radar installations are in close proximity. Such interference will appear as shown in figure 13-11. When this interference is encountered, nearby radar installations should be advised to check the frequency calibration of their equipment.

Also, most radar installations have dual channels so that a standby channel is always available. At times, the standby channel will transmit a signal that produces interference as shown in figure 13-12. In most cases, retuning by the technician will decrease the amount of interference.

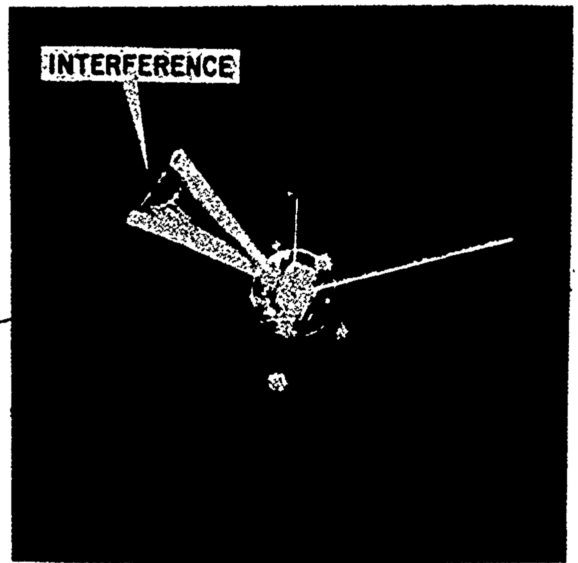

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Figure 13-11.—Interference from another radar set.

201.199
Figure 13-12.—Interference from the standby channel.

AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS)

Functions of the air traffic control radar beacon are as follows:

1. Reinforcement of radar target.
2. Rapid target identification.
3. Extension of radar coverage area.
4. Transmission of altitude and other data.

NOTE: The altitude reporting portion of the ATCRBS will be discussed later in this chapter.

Secondary surveillance radar is the international term for the air traffic control radar beacon system. This term refers to the form of secondary radar used only in air traffic control, and is not applicable to any other type of secondary radar. Secondary surveillance radar is a separate system, and is capable of independent operation; however, in normal air traffic control use it is slaved with surveillance radar. A display of both the primary and secondary radar targets is presented on the associated plan position indicator. The term radar beacon is commonly used in reference to secondary surveillance radar. This term should not be confused with the term RACON which is a contraction for radar responder beacon. The RACON is a ground-based navigational aid that emits a signal when activated by appropriate transmissions from an airborne unit. The operation of secondary surveillance radar is the reverse of a RACON.

The term radar beacon as used in this training manual will refer to a secondary surveillance radar system having as component parts a functioning interrogator on the ground, a functioning transponder in an aircraft, and a display on an air traffic control radarscope. When the word radar is used it will refer to a primary radar system. Primary radar differs from secondary surveillance radar in that it displays reflected signals rather than signals which have been transmitted by an airborne transponder.

Secondary surveillance radar effectively counteracts the following shortcoming of primary radar:

1. Aircraft reflection areas vary with size and configuration, thus limiting radar effectiveness.
2. The radar display may be degraded by weather conditions, especially precipitation.
3. Ground clutter frequently impairs the radar display, even though the radar is equipped with MTI.
4. Radar is more vulnerable to blind spots in the antenna coverage pattern.

Aircraft targets, unaided by airborne transponders, are not filtered but are displayed to controllers for all aircraft within the radarscope coverage. This includes those that are above, below, or beyond a particular area of control jurisdiction. Such targets clutter air traffic control displays and make the job of identifying one aircraft from another more difficult. Thus, the performance of essential air traffic control functions may be more complex and time consuming.

BASIC RADAR BEACON SYSTEM

The ground equipment of the system is made up of three major components—the I/R unit, the antenna, and the decoder. Included in the I/R unit are the interrogator (transmitter), the receiver, and the pulse pair generator. The major function of the interrogator is to generate distinctive radiofrequency transmissions in accordance with the mode in use. The action of the interrogator is similar to that of a primary radar transmitter as both transmit extremely short, powerful bursts, or pulses, of radio energy. In both systems the interval between transmissions is dependent upon the associated pulse repetition frequency (PRF); however, there is an essential difference in the transmission characteristics of the two systems. Radar transmits individual pulses while radar beacon interrogations consist of pulse pairs which are spaced in accordance with the interrogation mode. When a beacon system is used in conjunction with a primary radar, the interval between pulse pairs is related to the pulse repetition frequency of the primary radar equipment.

Simultaneous presentation of beacon and radar information requires that both system displays be correlated in range and azimuth. Range correlation is achieved by transmitting the beacon pulse pair a preset time before the radar pulse, in order to allow for the processing time in the transponder and in the decoder. A corresponding beacon pulse pair is not necessarily transmitted for every radar pulse. Azimuth correlation is accomplished by mounting both

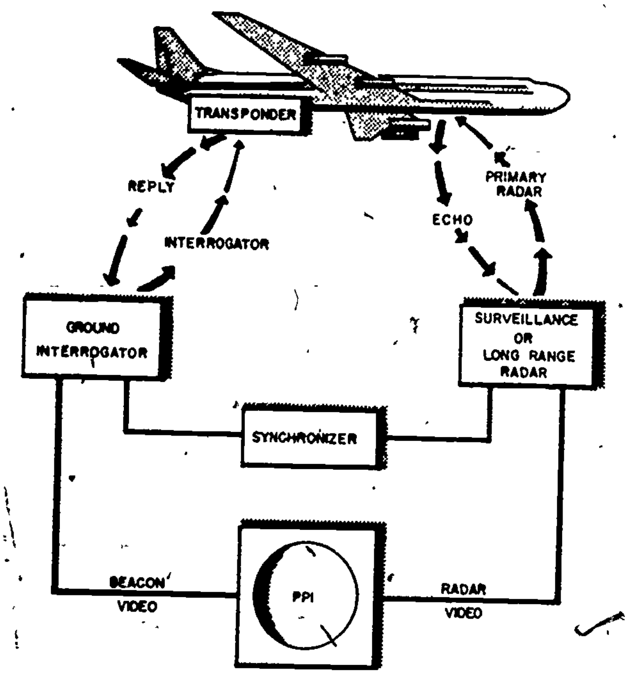

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Figure 13-13.—Primary and secondary surveillance radar systems.

the beacon antenna and the primary radar antenna on a common pedestal. Consequently both antennas scan the same area simultaneously.

The receiver section of the I/R unit receives the replies from the transponder and passes them on to the decoder.

The decoder accepts beacon video and beacon trigger signals from the I/R unit. The beacon video signals are processed in the decoder, and then passed to the radar PPI. Beacon video may go either to the radar video mixer or directly to the console, depending upon the primary radar equipment being used. In either case the beacon targets are displayed on the PPI with the primary radar targets. The decoder performs several functions depending on the control setting.

The transponder is the airborne unit of the system. The basic parts of a transponder are a receiver, a signal processing unit, and a transmitter. A transponder is an active device; however, it may be partially quiescent. Before the transmitter portion will reply to an interrogation, specially keyed pulses must have been received and processed. When actuated, or triggered, the transmitter will emit a series of specific reply pulses which are independent of and stronger than echoed radar signals. (See fig. 13-13.)

The response differs from an echo in several other respects:

1. The strength of the response is independent of the intensity of the interrogating signal received.
2. Interrogation and reply frequencies are not the same.
3. The response signal is different from the interrogation signal. (May be a coded or uncoded reply. This will be discussed later.)
4. A small delay is inherent between the receipt of an interrogation and the transmission of a reply. For standardization, this delay is adjusted 3 microseconds in duration.

A displayed transponder reply will appear as an arc of one or more concentric circles centered at the I/R site. The RAW VIDEO display appears as separate slashes (arc segments) for each of the framing pulses and information pulses. (See fig. 13-14.) The series of pulses

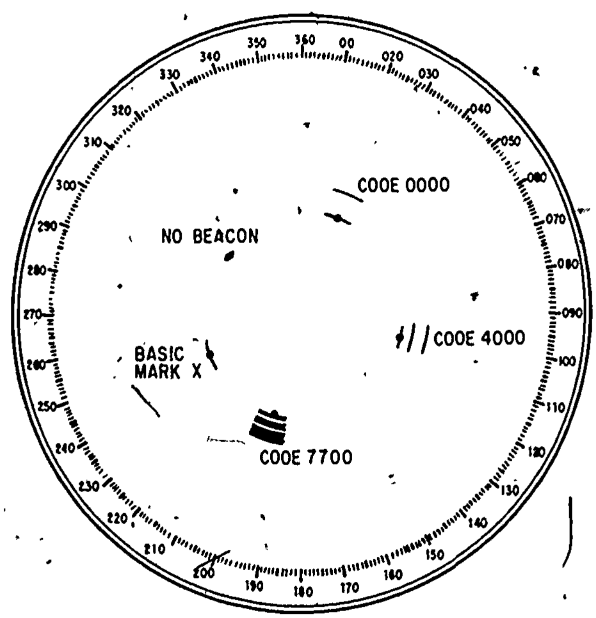

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Figure 13-14.—Examples of raw video displays, mode 3/A.

is called either a code train or pulse train. Identification pulses may be presented, and will be different depending on the transponder type. Complete code trains are displayed only if the decoder switch is set to RAW VIDEO (CODE on UPA-24). This allows the reply signals to proceed directly from the I/R to the scope without decoding action.

In order to eliminate the clutter of numerous code trains, the radar controller can select discrete displays which are abbreviated and different from a raw video display. With the decoder set to display selected common system replies, the controller observes beacon targets as a maximum of two slashes. As a result it is easier to monitor beacon targets under conditions of heavy beacon traffic. Normally the slash of the beacon target display that is closest to the I/R site (main bang) is centered on the primary radar target.

Factors Affecting Operation

Both primary and secondary radars are subject to variances, both internal and external, that may adversely affect the operational efficiency of the equipment. A radar controller must know when to expect such things as fades, false targets, and interference. He must be able to cope with these situations when they occur on either the radar or the radar beacon equipment.

Secondary surveillance radar and primary radar both operate with signals received within the line of sight. A target must be within the radiated antenna pattern and be within scope range in order to be displayed on a PPI.

Aircraft attitude will affect the quality of the display, since the transponder antenna is normally located on the underside of the aircraft. If the aircraft is in a turn, the wings or fuselage may block the pulse pairs transmitted by the interrogator, and the transponder may not be activated.

Buildings or other obstructing surfaces, usually within 2 miles of the beacon antenna site, will sometimes reflect either the interrogation or the reply. Reflections will cause a false target to be displayed at a different azimuth from that of the true targets. These reflected targets are sometimes different in appearance from true targets and may be pivoted from the normal display position.

When two or more displayed aircraft with operating transponders are within 3.3 nautical miles of each other on the same general radial from the I/R, the reply signals may garble and the decoder equipment can cause the generation of false targets between the aircraft. Also, it may cause cancellation of parts, or all, of either or both actual returns. False targets or cancellations may occur even though altitude separation exists. Targets that are more than 3.3 miles apart will not be subject to decoder garble. Killer circuits in the decoder equipment will cancel garbled transponder replies.

A beacon target close to the antenna will sometimes be displayed as a concentric circle around the main bang rather than a distinct target on a definite azimuth. This display, called ring-around, is caused by maladjustment of the interrogator sensitivity. This maladjustment will permit the display of transponder replies received from interrogation by the side lobes or reflections of the antenna pattern.

Benefit may be obtained through use of the transponder low sensitivity feature. With this, operation of a switch on the transponder control panel will reduce the sensitivity level of the receiver unit. Thus only the strongest interrogation signals will be accepted, generally the main lobes from I/R sites within 20 miles of the aircraft. Although most side lobes will be rejected, this feature should be used with discretion due to the greatly reduced effective range of the transponder.

Both primary and secondary radars display slant range. Slant range is the most direct line between the ground antenna and the aircraft. Thus the position of the aircraft, as displayed on a PPI, is only an approximate geographical position.

ATCRBS APPLICATION

The standard secondary surveillance radar designed for use by FAA air traffic control facilities is the Air Traffic Control Radar Beacon Systems (ATCRBS) with 10 channel decoders. This equipment is not a modification or adaptation of existing or surplus systems. It has been designed specifically for use in air traffic control and is versatile enough to handle present needs of both the domestic and international beacon program, as well as anticipated future expansion.

If optimum performance is to be obtained, the requirements of U.S. National Standard for

Common System Component Characteristics for the IFF Mark X (SIF)/Air Traffic Control Radar Beacon (Secondary Surveillance Radar) Systems, SIF/ATCRBS (SSR), must be met by all civil and military users of air traffic control radar systems under all expected operating conditions. The ATCRBS is in use at FAA facilities, and the Mark X (SIF) is in use at military facilities as well as RAPCONs and naval air traffic control facilities that are jointly operated by the military and the FAA.

The ATCRBS is capable of making interrogations in any four of the six different modes shown in figure 13-15. Mode A has been designated as the civil/military air traffic control mode. Since civil mode A is the same as mode 3 in military equipment, this common air traffic control mode is called mode 3/A. Modes 1 and 2 are military tactical modes; mode B has been designated a civil air traffic control mode but will not be used in the United States; mode C is used for automatic altitude transmissions. Mode D has been established, but its use has not been specified.

AUXILIARY EQUIPMENT

Standard Air Force secondary surveillance radar equipment is the Mark X selective identification feature (SIF). SIF equipment was designed for use by USAF facilities, but it is also used in RAPCONs which are jointly operated by the FAA and the Air Force. Secondary surveillance radar equipment used by the Navy is similar but different in capability as well as operation.

The abbreviation SIF is commonly used in referring to both the decoder and the transponder; SIF equipment is the basic Mark X

MODE APPLICATION

1	MILITARY IFF*
2	MILITARY IFF*
3/A	COMMON (ATC)
B	CIVIL (ATC)
C	CIVIL (ALTITUDE)
D	CIVIL (UNASSIGNED)

*(Identification friend or foe)

201.201

Figure 13-15.—Interrogation modes.

IFF beacon that has been modified to make the transponder capable of transmitting coded replies, and the decoder capable of presenting displays of the decoded replies on a PPI. These decoders are capable of single channel selection only.

UPA-24 Decoder

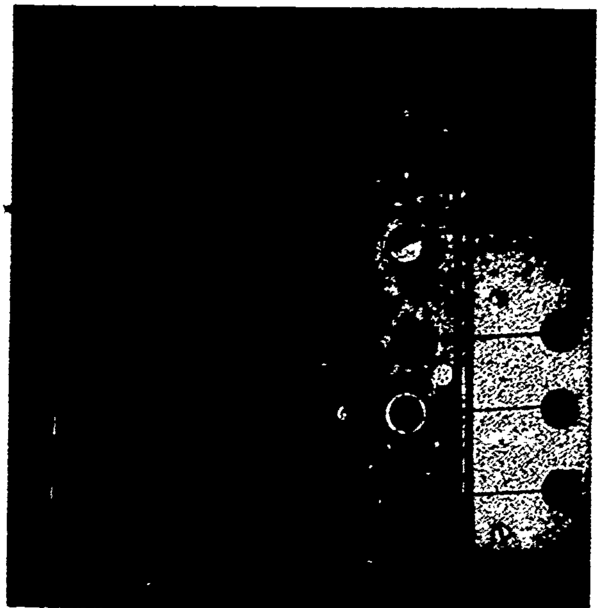
Radar controllers at naval ATC facilities are presently using radar beacon equipment with the decoder group UPA-24. This equipment, when interconnected with primary radar, provides interpretation of coded IFF signals. The UPA-24 accomplishes this by selecting a coded video pulse train in one of three modes. The coded pulse train is presented to the decoder circuitry and, if correctly coded, an indication in the form of a single decoded pulse is available for presentation on a radarscope. If the pulse train is not correctly coded, a decode pulse is not available for presentation.

The UPA-24 permits the presentation of the coded raw or decoded identification signal alone, the radar signal alone, or the radar signal mixed with either the coded raw or decoded identification signals. When used in conjunction with primary radar, the equipment provides decoding of IFF coded pulse trains in modes 1, 2, and 3. Thirty-two coded trains are available in mode 1; sixty-four coded trains are available in each of modes 2 and 3.

Most U.S. Navy radar beacon equipment, in its present form, is not compatible with the FAA ATCRBS in that it is not capable of providing all of the necessary features for the ATC common system. The equipment can only display one discrete code at a time—all other codes are not displayed. To display returns of all aircraft, it is necessary to utilize raw beacon video which clutters the radarscope and negates discrete decoding.

Figure 13-16 is a picture of the Radar Set Control (Decoder) C-1008/UPA-24 operational controls and functions. Refer to figure 13-16 for a description of the operational controls and functions of the UPA-24 decoder in the following corresponding numbered paragraphs.

1. Left-Hand Mode 1 Code-Selector Switch. This is a rotary switch having eight positions and is used to determine the desired first digit of a code pulse train for use in decoding mode 1 responses.
2. Right-Hand Mode 1 Code-Selector Switch. This is a rotary switch having four positions



1. Left-hand mode 1 code-selector switch
2. Right-hand mode 1 code-selector switch.
3. Left-hand mode 2 code-selector switch.
4. Right-hand mode 2 code-selector switch.
5. Left-hand mode 3 code-selector switch.
6. Right-hand mode 3 code-selector switch.
7. Mode selector switch.
8. Beacon assist.
9. GTC gate switch.
10. IFF gain control.
11. VID switch.
12. Challenge indicator.
13. Challenge switch.
14. IFF-RDR-MIX switch

201.203

Figure 13-16.—UPA-24 decoder.

and is used in conjunction with the left-hand mode 1 code-selector switch, to determine the desired second digit of a pulse code for decoding mode 1 responses.

3. Left-Hand Mode 2 Code-Selector Switch. This is a rotary switch having eight positions and is used to determine the first digit of the desired codes for decoding mode 2 responses.

4. Right-Hand Mode 2 Code-Selector Switch. This is an eight-position rotary switch and is used in conjunction with left-hand mode 2 code selector switch, to determine the desired second digit of the codes for decoding mode 2 responses.

5. Left-Hand Mode 3 Code-Selector Switch. This is an eight-position rotary switch and is used to determine the desired first digit of the codes for decoding mode 3 responses.

6. Right-Hand Mode 3 Code-Selector Switch. This is an eight-position rotary switch and is used in conjunction with the left-hand mode 3 code-selector switch to determine the desired second digit of the codes for decoding mode 3 responses.

7. Mode Selector Switch. This switch is used to select one of three modes of coded pulse trains (modes 1, 2, and 3). It should be noted that this equipment is not designed for mode interlace.

8. Beacon Assist Switch. This feature provides a means of readily identifying decoded SIF returns by adding an additional slash or "bloomer" to the return displayed on the PPI scope. This additional "bloomer" will appear only for those aircraft squawking the mode and code selected by the operator.

9. GTC Gate Switch. This switch is used to control the duration of the gain time control (GTC), which aids in preventing saturation of the recognition set receiver by responses from nearby targets. It also selects the preset width of the receiver enabling gate. This gate enables the receiver to operate only during desired actual IFF operation, thereby reducing the overall noise contributed by the receiver. The switch is a toggle type for selection of either of two preset positions, LONG and SHORT.

10. IFF Gain Control. This potentiometer controls the gain of the IFF amplifier of the receiver portion of the recognition set. It revolves 270° clockwise for maximum gain.

11. VID Switch. This switch is used to select either coded or decoded video signals for presentation on the radar indicator. It is a toggle switch with two positions, CODE and DECODE.

12. Challenge indicator. Lighting of this lamp indicates that the radar recognition set is challenging.

NOTE: The U.S. Navy definition of challenge is the transmission of the coded interrogator (IFF) signals.

13. Challenge Switch. This switch is used to select momentary or continuous interrogation

of the recognition set. It is a three-position toggle switch with a momentary ON position; the other positions are LOCK-ON and OFF.

14. IFF-RDR-MIX Switch. This switch is used to select the IFF signals alone, radar signals alone or mixed radar and IFF signals. It is a toggle switch with three positions, IFF, RDR, and MIX.

Table 13-1 shows the various possible combinations of switch selection and the resulting display on a radarscope.

TYPES OF ATC EQUIPMENT

Ever since naval aircraft operations began, the Navy has actively sought to develop reliability in all-weather landing systems both ashore and afloat. Research and development of such systems is a continuous process taking advantage of new equipment and ideas as they are introduced. Now, because of precision radar, high speed data processing, and microcircuit electronics, new equipment is being introduced at a fairly fast pace.

In this section, an attempt is made to briefly describe radar equipment in general use, leaning toward newer equipment. It is not intended to be all-inclusive or a substitute for familiarity with the equipment in use at your facility; neither is it a substitute for study of the operator's section of the applicable technical manual.

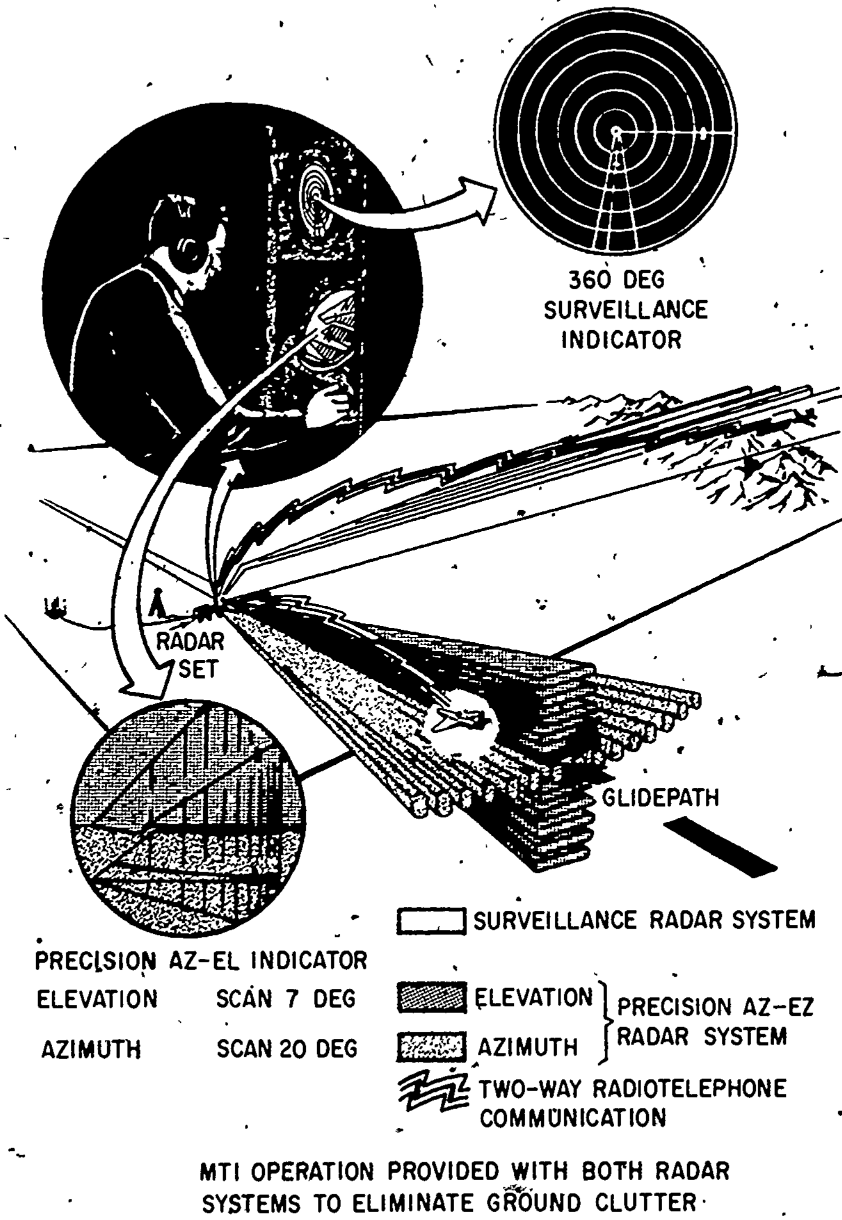
GROUND CONTROLLED APPROACH (GCA)

Ground controlled approach (GCA) is a radar system providing air navigation to an aircraft. Through the use of air surveillance radar, precision approach radar, and radio communications, a ground operator assists a pilot in his approach

Table 13-1.—Mark X (SIF) Transponder-UPA-24 decoder displays

Code VID Decoder	IFF RDR-MIX	Mode	Display
Code	IFF	3	One slash for each pulse in the code trains; two successive code trains for I/P (IDENT); four successive code trains for EMERGENCY. Only beacon targets will be displayed.
Code	RDR	3	Only primary radar targets will be displayed.
Code	MIX	3	One slash for each pulse in the code train; two successive code trains for I/P; four successive code trains for EMERGENCY. Both beacon targets and primary radar targets will be displayed.
Decode	IFF	3	One slash if transponder code has been selected on decoder. Only beacon targets will be displayed.
Decode	RDR	3	Only primary radar targets will be displayed.
Decode	MIX	3	One slash if transponder code has been selected on decoder. Both beacon targets and primary radar targets will be displayed.
ANY POSITION	ANY POSITION	2 or 1	Display will be same as for mode 3.

NOTE: Code 7700, I/P, and EMERGENCY will be characteristic display only when CODE-DECODE switch is in CODE (same as RAW VIDEO) position.



201.205

Figure 13-17.—Functions of a GCA unit.

during weather conditions of low visibility and ceilings. No special airborne electronic components are required. Thus, a two-way functioning radio is all that is necessary in the aircraft.

The GCA unit consists of a surveillance radar system and a precision approach radar system (PAR) for controlling the initial and final approach portion of an approach. The surveillance radar is displayed on a PPI scope. The PAR is displayed on an AZ-EL scope providing the controller with a precision radar picture of azimuth and elevation coverage in the final approach area. (See fig. 13-17.)

Figure 13-18 shows the AN/CPN-4 GCA unit. This unit is a self-contained, mobile radar unit designed for controlling and landing of aircraft during periods of reduced ceiling and visibility.

Also shown in figure 13-18 is an electrically operated turntable that facilitates the positioning of the GCA equipment to the desired runway. With this turntable, the time required to reposition the GCA unit to the duty runway is considerably reduced.

GCA QUAD RADAR AN/FPN-36

The FPN-36 is actually four radar sets in one. The operator sits before a single 12-inch scope and with a selector switch, displays the desired radar function—surveillance, precision, height finding, or airport taxi control.

Some of the advantages of this equipment are:

1. Small, light, and easily transportable.
2. Only one operator required.
3. Minimum cost.
4. All four systems on one scope.
5. Multiple runway coverage from one location.
6. Circular polarization.

The two main disadvantages of this equipment are: Only one aircraft can be worked at a time; and without two units, the search and precision system cannot be monitored simultaneously. No IFF/SIF capability is available.

Figure 13-19 shows the antenna system of the quad radar mounted on the transmitter assembly; the antenna to the left of the set scans in a vertical plane to provide altitude information within 40 miles, to a height of 50,000 feet, when the controller selects the HEIGHT FINDING feature. When the PRECISION feature is desired, this antenna provides glidepath (elevation) data.

The dish-shaped antenna to the right of the altitude antenna provides azimuth information to the controller whenever the PRECISION portion of the quad is selected. This antenna scans a predetermined sector left and right of the runway centerline. It should be noted that the two antennas operate simultaneously when the set is operated in the PRECISION mode.

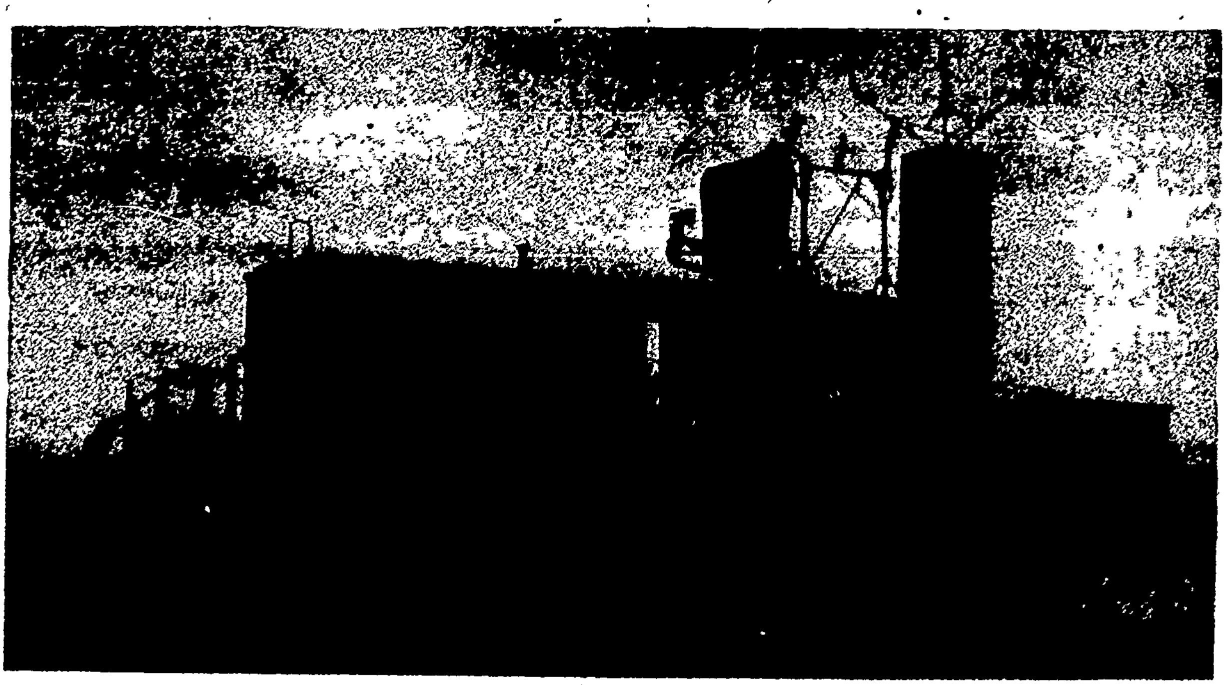
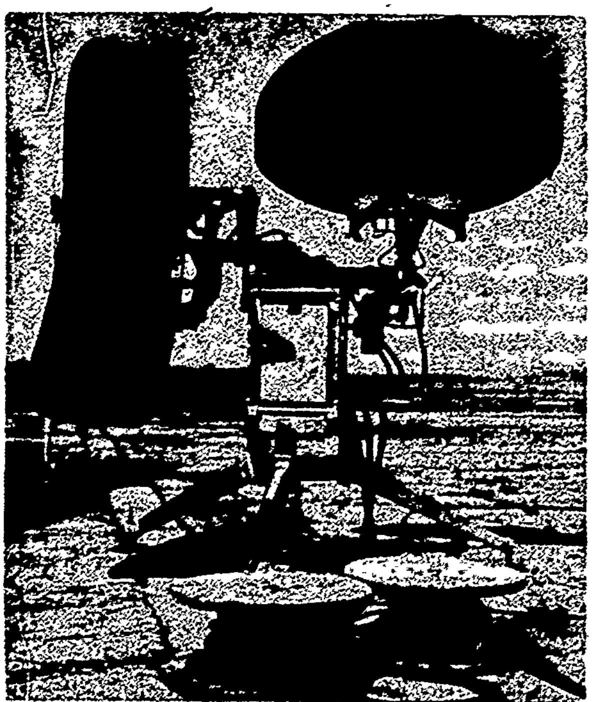


Figure 13-18.—AN/CPN-4 GCA unit. 201.204



201.206
Figure 13-19.—Quad radar (FPN-36) antenna.

The precision portion of the FPN-36 provides an AZ-EL display out to 40 miles; selective ranges of 5, 10, 20, and 40 miles are provided.

When the equipment is placed in the SEARCH mode, the azimuth antenna scans 360 degrees to provide surveillance coverage to a distance of 40 miles. Airport taxi control can also be accomplished by using this antenna in conjunction with a lower angle of antenna tilt to a maximum range of 3 miles.

The quad radar is normally remoted to a central control room where the indicator scope is located.

AN/FPN-47 (ASR-5) RADAR

The AN/FPN-47 is one of the surveillance radar systems in general use by the FAA, Air Force, and Navy in airport surveillance as part of the air traffic control system.

This system has a maximum radar video range of 60 miles and a maximum SIF/beacon range of 200 miles. The SIF/beacon video can be displayed in conjunction with the normal and MTI video on all sweep ranges except the 200-mile range. With the 200-mile range selected, radar and SIF/beacon video are displayed simultaneously for the first 60 miles of the sweep, and SIF/beacon video only is displayed from 60 to 200 miles. Six fixed ranges of 6, 10, 20, 40, 60, or 200 miles may be selected by the operator, and two variable sweep ranges are available for selection from 6 to 60 miles. The 6- and 10-mile ranges provide range marks at 2-mile intervals; the 20-, 40-mile, and first variable range at 5-mile intervals; the 60-mile and second variable range at 10-mile intervals; and the 200-mile range at 25-mile intervals. The altitude range of the FPN-47 is from 0 to 10,000 feet MSL.

An electronic cursor and range strobe are also provided with this equipment. The cursor origin may be selected as centered with the radar sweep or offcentered and manually positioned on any desired target and cursor azimuth aligned and range strobe positioned on any other target. Then the target range and bearing can be read from indicators on the front panel of the PPI console. This provides accurate range and bearing of targets from the antenna site (centered) or relative range and bearing between two targets (offcentered).

The surveillance display illustrated in figure 13-20 shows the PPI console used in the FPN-47 radar system. For detailed information on the capabilities and operating controls used by operators, refer to the appropriate technical manual for this equipment.

AN/FPN-52 RADAR

The AN/FPN-52 is the standard precision radar system in general use by the FAA, Air Force, and Navy.

The function of the FPN-52 is the same as that shown in figure 13-17 for the precision portion of a GCA unit. In order to track both the course and the glidepath of aircraft on approach, the antenna system of this radar scans or "looks" in both the vertical and horizontal planes. The two scans (elevation and azimuth) are shown on the map face of an AZ-EL scope as shown in figure 13-17.

The coverage of the FPN-52 is 7 degrees in elevation and 20 degrees in azimuth in the final approach area with a range of at least 8 miles.

Normal and MTI video range marks at 1-mile intervals, cursors (centerline and glidepath), and servo data information are displayed on the AZ-EL scope. A logarithmic time base sweep is used on the AZ-EL indicator to give greater emphasis to more critical, close-in targets. Thus the glidepath cursor appears slightly curved on the scope although it represents a straight line in space. The first few range marks are comparatively far apart, and the more distant ones are comparatively close to each other. An aircraft will appear to pick up speed on its approach as its range decreases. An approaching aircraft may be tracked by means of the antenna servo. Antenna servocontrol is used to move the azimuth antenna up or down and/or the elevation antenna right or left. This allows the controller to center the radar beam on the aircraft even though it may be considerably off the desired course or glidepath.

The precision display illustrated in figure 13-21 shows the AZ-EL scope used with the FPN-52 radar system. For more details on the capabilities and operating controls used by operators, refer to the appropriate technical manual for this equipment.

DIRECT ALTITUDE AND IDENTITY READOUT (DAIR) SYSTEM

The Direct Altitude and Identity Readout (DAIR) System evolved through an exhaustive research program that was conducted jointly by the DOD and the FAA. This program is identified as AIMS, which is an acronym for ATCRBS IFF Mark XII Identification Systems.

The two primary objectives of the AIMS program are to improve air traffic control through the utilization of ATCRBS and to provide a secure military identification system

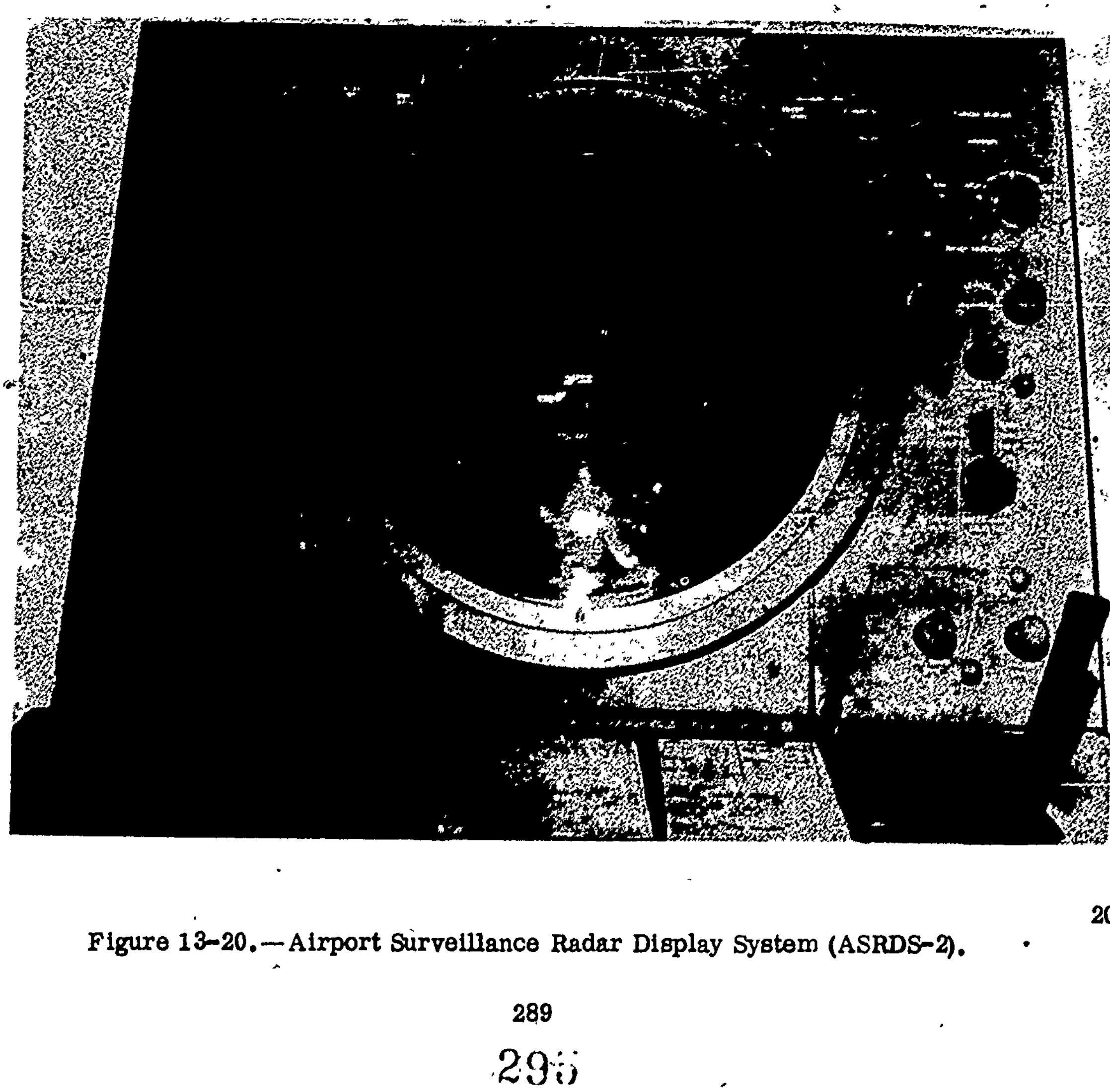


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Figure 13-20.—Airport Surveillance Radar Display System (ASRDS-2).

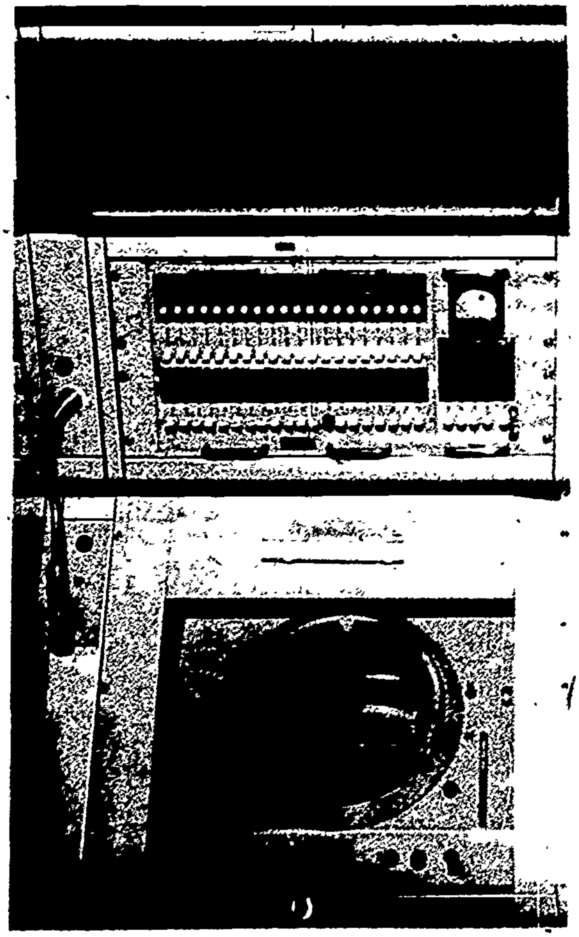

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Figure 13-21.—Precision radar display.

(Mark XII IFF). Other significant objectives of the program are to standardize equipment utilized by the services, coordination of implementation plans, and to make maximum use of existing facilities and resources of the services.

In order to achieve these objectives, the ATCRBS was expanded to 4,096 codes to allow the capability of automatically reporting altitude information directly to the controller's equipment. In addition to receiving altitude information from transponder equipped aircraft, the DAIR equipment presents easily readable, digitally derived synthetic display markers and numerical data blocks which do not fade from the scope as do primary radar targets.

Equipment Description

The interrogator equipment associated with the DAIR system is designated the AN/TPX-42. Figure 13-22 illustrates a simplified block diagram of the system.

A review of the fundamentals of radar operation discussed earlier in this chapter will assist you in obtaining a better understanding of the operating principles of this equipment. For a more detailed description of the individual components, refer to the appropriate technical manual at your facility.

It should be noted that the AN/TPX-42 equipment can be utilized with existing PPI consoles, either in a radar air traffic control facility room or in conjunction with a mobile GCA unit.

It is anticipated that future expansion of the system will include specially designed operator consoles.

There are several types of display markers generated by the AN/TPX-42 equipment; figure 13-23 shows these markers and provides a legend of their meaning.

The data block displayed adjacent to the centermark (aircraft's actual position) consists of the assigned beacon code that the aircraft is squawking and the altitude being flown; this altitude is indicated in 100-foot increments (MSL).

Altitude data is received through Mode C interrogations to aircraft transponders and can be filtered to display only aircraft targets within controller-selected altitude levels.

With the presentation of synthetic markers and numeric tags for beacon information, the controller also has the capability of displaying primary radar targets on his scope. In addition, the system possesses a backup feature which allows for the presentation of beacon bracket decode video to be superimposed on the primary radar targets.

Operating Procedures

Individual controllers may select any of the presentations available with the system (as noted in figure 13-23) by use of a remote control indicator (C-8625/T) shown in figure 13-24(A).

This control indicator is designed to be located at or adjacent to each PPI console. This indicator provides the controller with a selection of interrogation modes as well as the visual

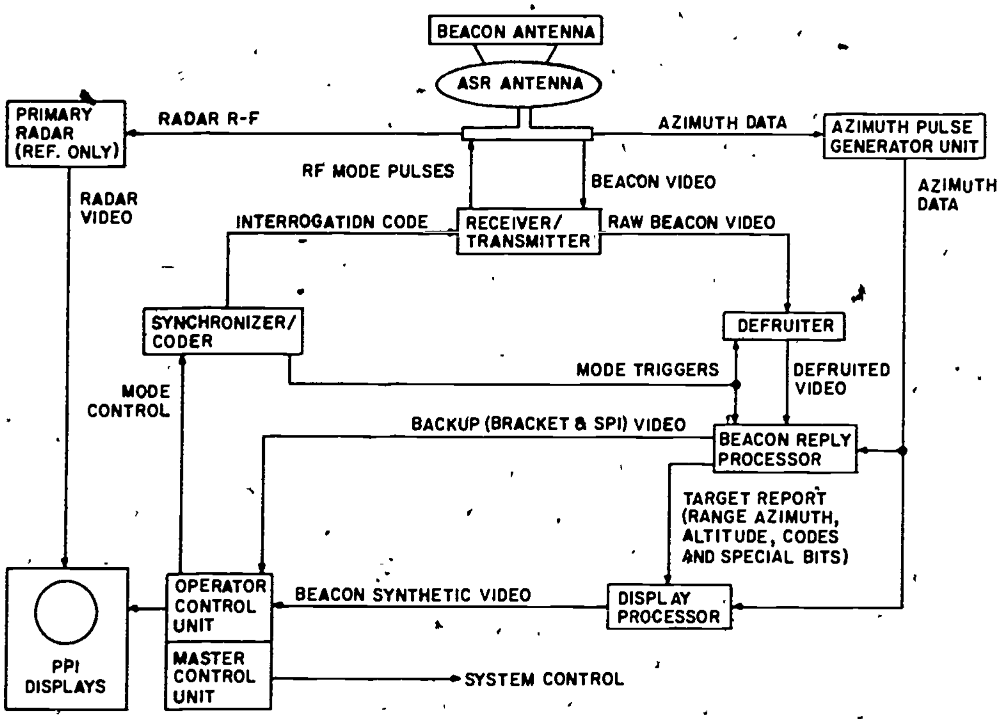

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Figure 13-22.—AN/TPX-42 block diagram.

system status indication and with audible as well as visual notification of aircraft emergencies and communication failures. (Discussed later in this section.)

The display of symbology and numerics is also controlled from this unit.

Figure 13-24 (B) illustrates the master control unit that is located at the supervisor's console. This unit need not be situated at a radar console but is designed to be located within the radar control room or GCA unit as appropriate.

Detailed operating procedures for both the remote control indicator and the master control unit will not be outlined here; ACs assigned to radar facilities which possess the DAIR system will receive detailed instructions in the operation of the equipment.

Several noteworthy features of the AN/TPX-42 system do, however, deserve mention at this time.

When a controller desires coverage within a particular altitude sector, he may set the desired upper and lower limits on the control indicator (see example in figure 13-24 (A)) and only replies from aircraft flying within these limits will be displayed; all others above or below the desired limits will be filtered out with the exception of aircraft experiencing an emergency or communications failure.

When pilots indicate by the appropriate code that they are experiencing an emergency (code 7700) or loss of communications (code 7600), a red light located on the operator's control indicator (EMER in fig. 13-24 (A)) will be activated and flash on and off. In addition to this visual alarm, an audible buzzer in the box will be heard in short bursts for approximately 5 seconds.

The select code position symbol X will indicate the location of the aircraft on the controller's scope, and the emergency or communications failure code and altitude (if available) will be presented adjacent to it.

To facilitate locating the target on the scope, the symbol and numerics will blink on and off at a rapid rate.

Another excellent feature of the system allows for the tape recording and playback of processed targets. This capability can be invaluable in the area of accident investigation and also to enhance controller training.

AIR TRAFFIC CONTROL FACILITY

With the establishment of ATC facilities at certain major air stations, the requirement to provide continuous service for IFR flight operations was recognized. To meet this requirement, radar facilities were constructed which encompass the control functions for all phases of flight under instrument flight rules for these terminal areas. Figure 13-25 illustrates a typical radar control room.

The central control room is located in the operations building and is accessible to the visual control tower. This room contains remote indicating scopes and control consoles for each of the following radar equipments: Medium Range Air Traffic Control Radar; Short Range Air Traffic Control Radar; Precision Approach Radar; Direct Altitude and Identity Readout (DAIR) equipment; and certain other maintenance and operational controls. Additional equipments located in the control room are large direct-view type situation display boards for the traffic control radars; DF equipment; IFF/SIF equipment; a selective communications and intercommunications system; wind direction and velocity indicators; as well as an altimeter setting indicator. At stations that utilize the closed TV circuit for weather briefings, a TV set may also be installed.

ATC facilities are normally manned on a 24-hour basis. Consequently, there is seldom any delay involved in taking control of inbound or outbound traffic.

The mission of a Navy Air Traffic Control Facility is to provide safe, orderly, and expeditious movement of air traffic within a facility's area of control, to and from operating areas, and into and from the national airspace system.

Services provided in accomplishing this mission include, but are not limited to the following:

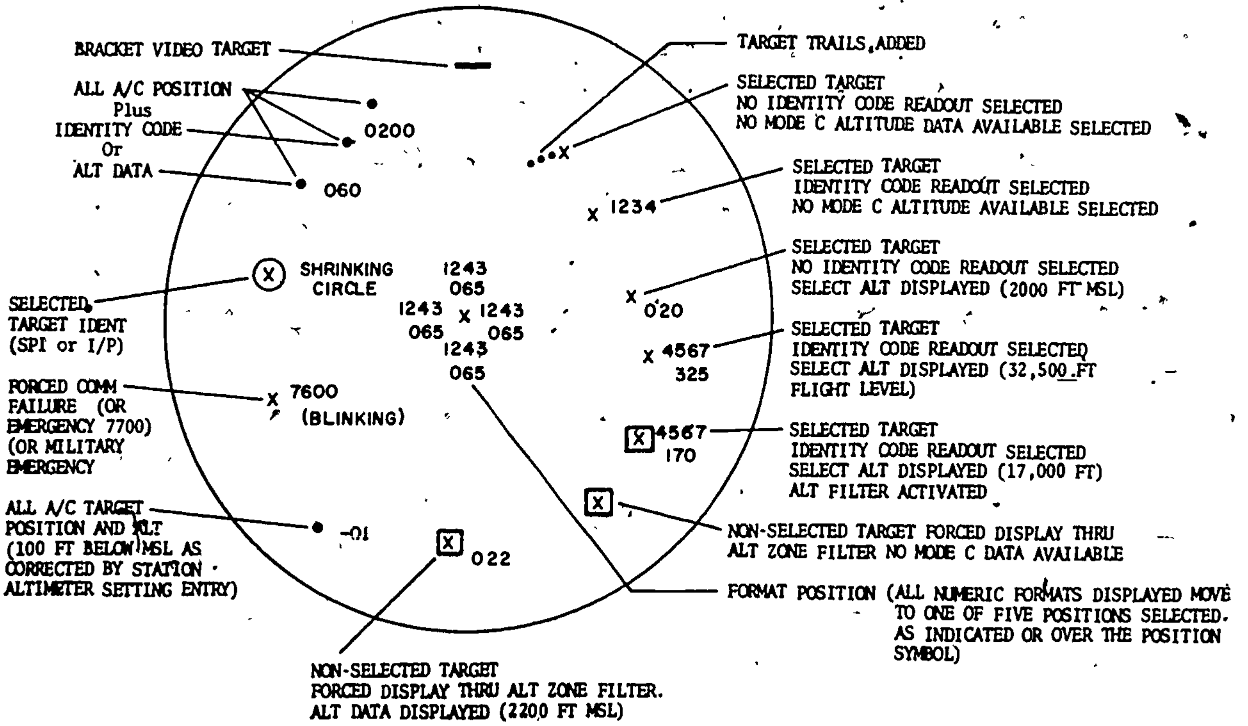

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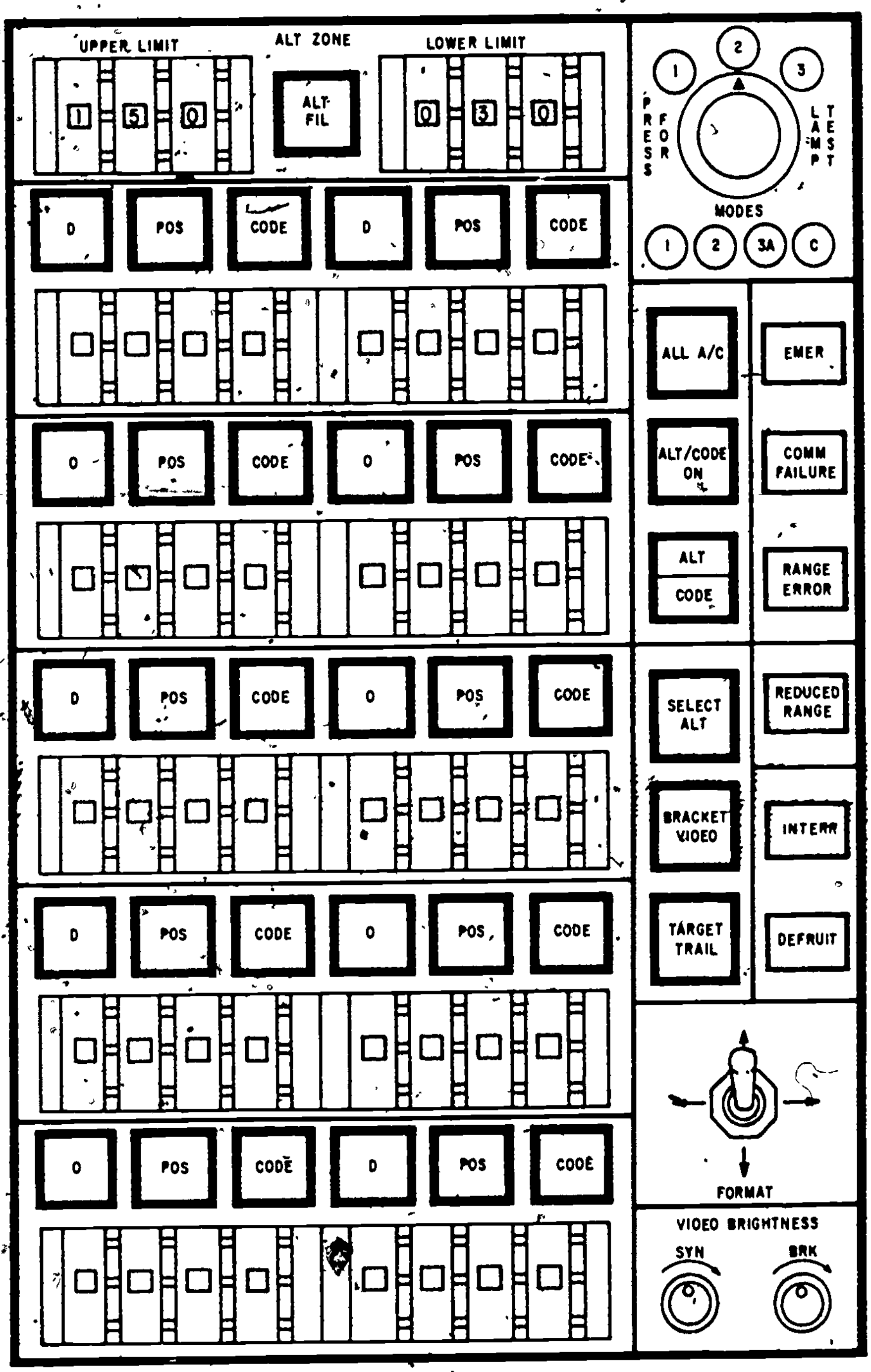
Figure 13-23.—DAIR display legend.



(A)

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Figure 13-24.—(A) C-8625/T remote control indicator.

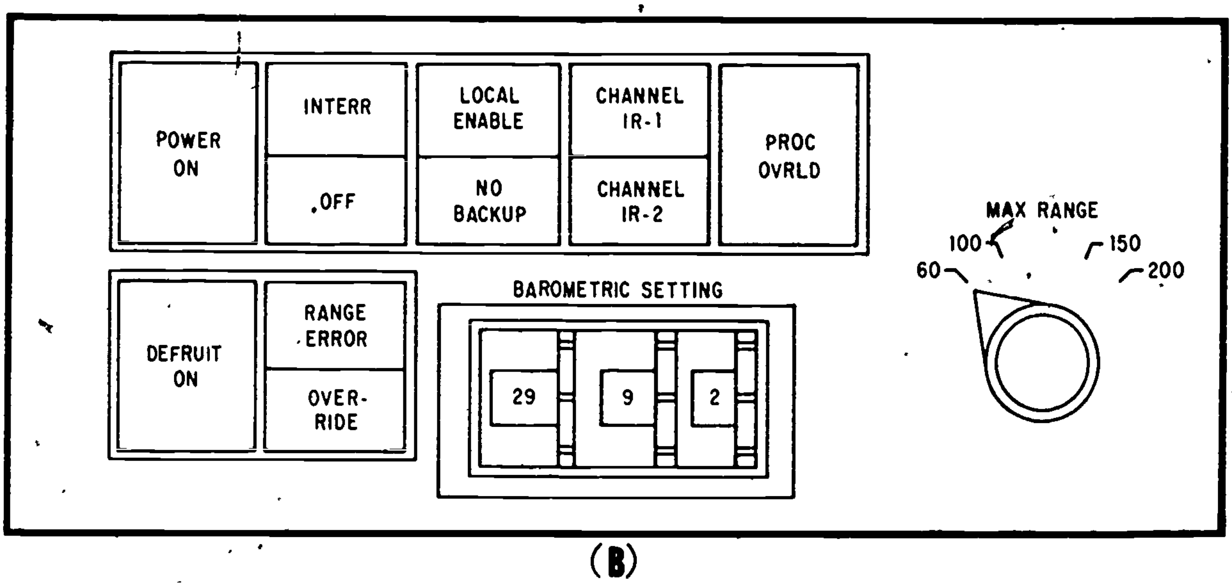

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Figure 13-24.—(B) C-8626/T master control unit.

departure control; the capability to effectively transition departing aircraft into the en route flight structure; provide approach control service to arriving aircraft, conduct and monitor instrument approaches during periods of IFR weather conditions, and provide assistance to aircraft in emergency situations.

Specific duties and responsibilities of individual controllers will be detailed later in this chapter.

INTERRELATIONSHIP OF OPERATING POSITIONS

In order that all phases of the air traffic control function at a Navy ATC facility be adequately manned by competent controllers at all times, general knowledge of the duties of all operating positions is a must. This policy is strongly recommended in current OPNAV Instruction 3721.1 (Series). This cross training of personnel at an ATC facility creates an extremely flexible air traffic control division. Also, when a controller transfers, he has undoubtedly gained valuable experience that should benefit not only himself but his next duty station as well. The instruction previously mentioned directs commanding officers to make suitable entries in the service record of a man considered properly qualified to control instrument traffic.

Certification and Qualification

Due to the nature of their importance to the Air Controlman, the qualifications and certificates necessary for the enlisted positions at an Air Traffic Control facility are printed verbatim from OPNAV Instruction 3721.1 (Series).

NOTE: Detailed information concerning the qualifications required for the attainment of a Facility Rating mentioned in the following operating positions can be found in chapter 3 of this manual.

WATCH SUPERVISOR.—Each ATC facility will have a watch supervisor on duty at the facility at all times the facility is in operation. He will normally be the senior enlisted (or civilian, where appropriate) air traffic controller on duty. He shall be qualified and FAA certified in all positions of the facility and be specifically designated by the commanding officer. His duties while on watch include the following:

1. Responsibility for the overall efficiency of the air traffic control services provided by the facility.

2. Directly monitor or operate the position involved with the most critical or complex air traffic control situation.

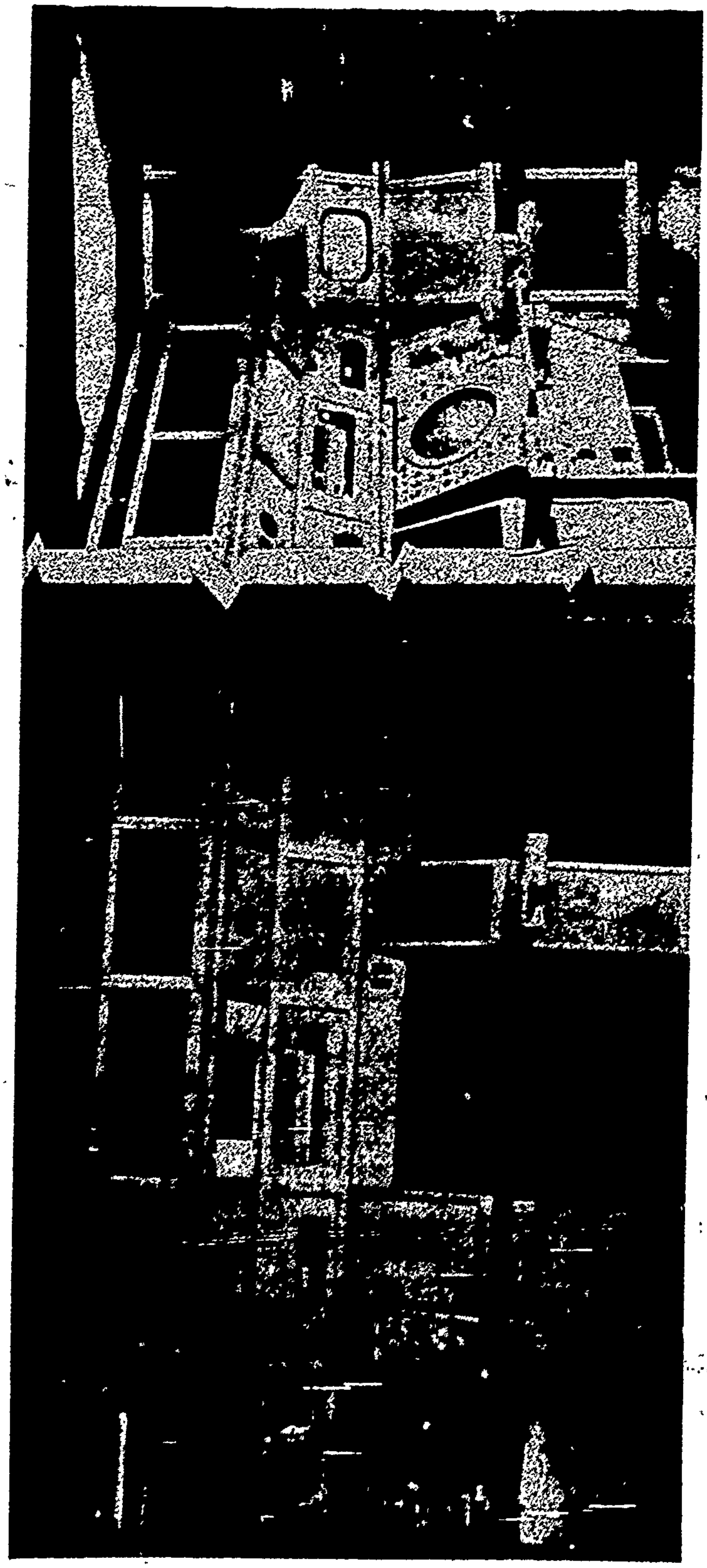

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Figure 13-25.—Radar control room.

3. Supervision of all in-rate and OJT of assigned personnel.

4. Provide technical assistance to the ATC Facility Duty Officer upon request.

APPROACH CONTROLLER.—His general duties, in addition to such supplementary duties as may be assigned, are as follows:

1. Coordinate and control the movement of all instrument traffic within the ATC Facility area of responsibility.
2. Issue air traffic control clearances and advisory information to aircraft under approach control jurisdiction.
3. When radar approach control is utilized, maintain radar surveillance of assigned area and provide radar assistance to air traffic as required.
4. Determine the interval to be used between successive approaches, taking into consideration all aspects of the air traffic control situation, including weather, runway in use, reliability of navaids and other approach aids, reliability and adequacy of communications, types of aircraft under control, runway acceptance rate, and any other factors which may affect operations.
5. Provide assistance and priority of services to aircraft in emergency situations.
6. Utilize any or all other operating positions necessary to assist in the control of air traffic.

ASSISTANT APPROACH CONTROLLER.—In order to provide the maximum flexibility of operations, the ATC Facility Officer is authorized to modify the duties of this position as the local situations dictate. His general duties are as follows:

1. Assist the Approach Controller in the control and coordination of instrument air traffic within the ATC facility area of responsibility.

2. Collect and post flight data for the Approach Controller.

3. Assist the other positions of operation in the facility as required.

SURVEILLANCE CONTROLLER.—Where required, this position may be divided into arrival controller and departure controller positions. His general duties are as follows:

1. Accept control of aircraft from the approach control and assume responsibility for the proper identification, control, and separation of the aircraft until they have reached surveillance minimums or control responsibilities are transferred to the final controller or another facility as applicable.
2. Provide radar vectors to arriving and departing aircraft to ensure safe and expeditious movement of air traffic.
3. When required, monitor instrument approaches made on other facility navaids and advise pilots of deviation from normal approach paths.
4. Provide radar assistance to aircraft in emergency situations.

FINAL CONTROLLER.—His general duties are as follows:

1. Provide range, azimuth, and elevation data to assist the pilot in a low visibility approach to the instrument runway in use.
2. When required, monitor approaches made on other facility navaids to runways served with precision radar and advise pilots of any deviation from normal approach paths.

NOTE: Personnel performing controller functions, except for controllers in training, must be facility rated and/or qualified for the assigned position of operation and function.

In addition, radar controllers (including radar approach control) must be graduates of the GCA Controller's Course.

FLIGHT DATA POSITION.—The duties of the controller operating the flight data position are as follows:

1. Receiving and relaying aircraft movement information through various communications media.
2. Preparing flight progress strips and transferring these strips to the proper position of operation.

COORDINATOR.—The duties of coordinator are as follows:

1. Coordinating and regulating the flow of traffic between operating positions of the facility.
2. Coordinating with the control tower on arrival sequencing and departure release.
3. Coordinating and directing the activities of designated positions of operation in radar approach control.

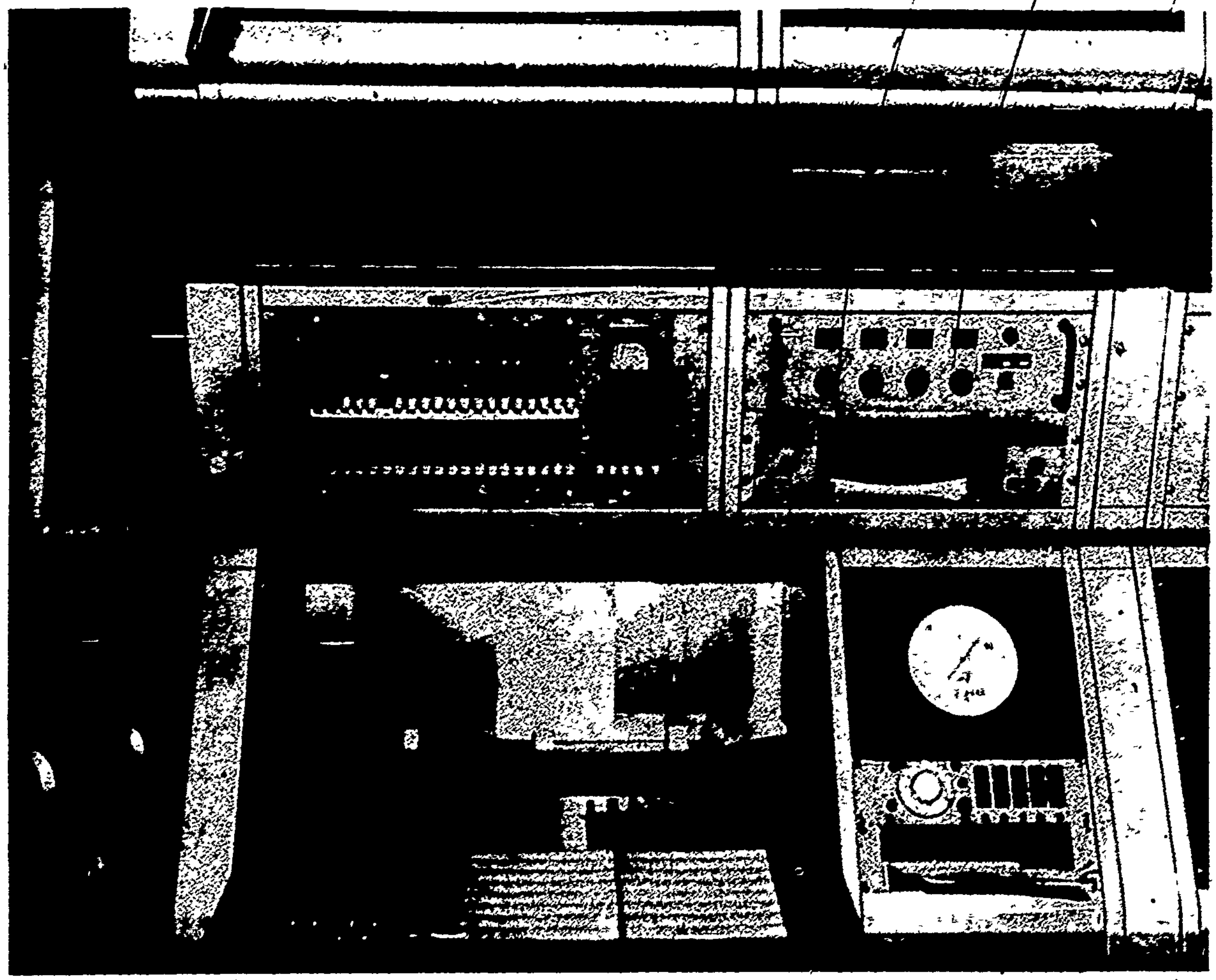

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Figure 13-26.—Clearance Delivery Position.

Supplementary Control Positions

At some ATC facilities, particularly during peak periods of traffic, control positions not previously listed have been established to provide better service to aircraft and to alleviate controller workload.

Two such positions are the Clearance Delivery Position and the Departure Control Position. Figure 13-26 is a typical Clearance Delivery Position. The primary function of this position is as the name implies—to relay flight clearances received from the local ARTCC to aircraft preparatory to flight. Normally, a discrete radiofrequency is utilized and the clearance is delivered to the aircraft prior to receiving taxi instructions.

Figure 13-27 illustrates the Departure Control Position at one of the Navy's busier air stations. This position is responsible for clearing aircraft out of the terminal area utilizing radar and Standard Instrument Departures (SIDs) via radio navigation aids whenever possible, to reduce the amount of coordination between the ATC facility and the ARTCC.

Conversely, during slack traffic periods some of the operating positions may be combined to allow one controller to perform the duties normally required of two men.

Dependent upon local operating conditions, other supplementary control positions may be established; information required to qualify at the various control positions will be included in the ATC facility training manual published by the facility to which you are assigned.

RADAR PROCEDURE

Radar procedure contained herein pertains in most part to the ATC program ashore. Basic control procedure applies to all areas of radar air traffic control; however, detailed procedures for shipboard operations are contained in the CVA/CVS NATOPS MANUAL or LPH NATOPS MANUAL.

ACs assigned duty in a CCA or GCA crew receive specialized training at a Class C school and upon completion and qualification are assigned a Naval Enlisted Classification Code indicating their specialty within the Air Controlman general rating.

A radar controller must be personally satisfied that the radar presentation and the equipment

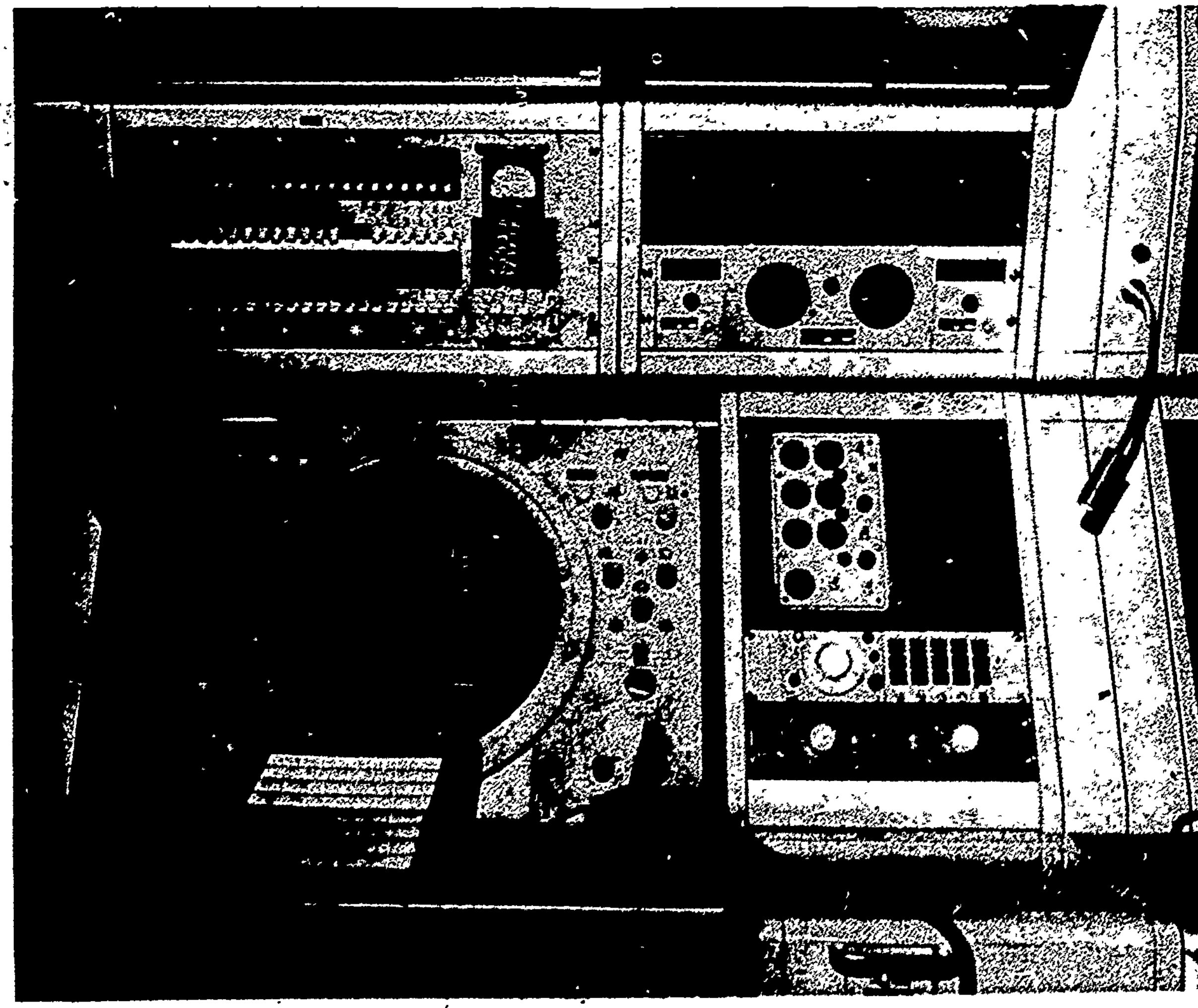

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Figure 13-27.—Departure Control Position.

performance are adequate for the service to be provided before attempting to provide such service.

Upon assuming responsibility for a control position, a controller should check radar alignment. This may be accomplished by assuring that the video map or map overlay in use is properly aligned relative to the true geographic position, or by correlating a permanent target of known range and azimuth with the radar display. A target in each quadrant should be checked where possible. A brief check should again be made at various times throughout the watch to ensure accuracy of the radar.

When radar mapping is not available, radar service is limited to separating identified aircraft targets, vectoring aircraft to intercept a PAR final approach course, and providing service in areas that ensure no conflict with traffic on airways or other ATC areas of jurisdiction.

RADAR IDENTIFICATION

Positive radar identification must be established before radar service is provided. There are instances where radar separation may be applied between two aircraft when only one aircraft is radar-identified. For example, this occurs when a radar-identified aircraft is separated from an aircraft taking off that will be identified within 1 mile of the end of the takeoff runway. It also occurs when a radar-identified aircraft is separated from an IFR aircraft not radar-identified by maintaining radar separation from all primary and secondary radar targets.

Primary and secondary radar identification may be established by one of the following methods:

1. Observing a departing aircraft target within 1 mile of the end of the takeoff runway.

2. Observing a target whose position with respect to a fix displayed on a video map, map overlay, as a permanent echo, or an accurately determined visual reporting point, corresponds with a direct position report received from the aircraft, and the observed track is consistent with the reported heading or route of flight. If a TACAN/VORTAC is located within 6,000 feet of the radar antenna, it may be used as a reference fix for radar identification without being displayed on the video map or map overlay. When such situations exist, a pilot reported radial/distance may be correlated with the main bang for establishing radar contact.

3. Observing a target, make an identifying turn or turns of 30 degrees or more, provided that, except in the case of lost aircraft, it is determined that the aircraft is within radar coverage, and only one aircraft is observed making the turns.

When using secondary radar (SIF) to identify a target, one of the following methods may be used:

1. Request the pilot to activate the IDENT feature of the transponder and observe the identification display.

EXAMPLE: IDENT; or, SQUAWK ONE TWO ZERO ZERO AND IDENT.

2. Request the pilot to change to a specific code and then observe the target display change.

3. Request the pilot to change the transponder to STANDBY. After observing the target disappear for a sufficient number of scans to assure that loss of target resulted from placing the transponder in STANDBY, request the pilot to return the transponder to normal operation and observe the reappearance of the target.

EXAMPLE: SQUAWK STANDBY, then, SQUAWK ONE TWO ZERO ZERO.

Where circumstances are present to cause doubt as to target identification, more than one method of identification should be used.

If identification of a radar target becomes questionable due to ring-around, scope clutter, etc., immediate action should be taken to maintain identity, re-identify the aircraft, or terminate the radar service.

The pilot must be informed whenever radar identification with his aircraft is initially established or re-established after radar contact being lost or radar service being previously terminated. He must also be informed when radar contact is lost.

Whenever radar identification is established by means of identifying turns or radar beacon procedure, the pilot should be advised of the aircraft's position. Position information need not be given when radar identification is established by position correlation or when a departing aircraft is observed within 1 mile of the end of the takeoff runway.

The pilot of an aircraft being provided radar service must be informed when the service is terminated except when any of the following conditions exist:

a. The aircraft conducts a visual approach.

b. Stage I, II, or III procedures (discussed later in this chapter) are employed.

c. The aircraft is vectored to the final approach course.

d. The aircraft conducts a radar approach.

NOTE: These exceptions allow reduction of transmission by eliminating the need to state the obvious to a pilot; for example, completion of a radar approach.

RADAR VECTORS

A radar vector is a heading issued to an aircraft to provide navigational guidance by radar. IFR and VFR aircraft may be vectored within controlled airspace, and special VFR aircraft may be vectored within control zones. An aircraft may be vectored outside controlled airspace only on request of a pilot. Radar advisories may be offered to the pilot of an aircraft operating within or outside of controlled airspace since an advisory is intended to assist pilots by offering advice or information and is not a clearance or instruction.

As soon as practicable after establishing identification, inform the pilot of the aircraft being vectored of the procedure to follow (proceed visually, execute a specified nonradar approach, or follow the missed approach procedure) if radio communications are lost for a specified time interval. This interval cannot be more than 1 minute during vectors to final approach.

When conducting a precision approach, the interval is 5 seconds; 15 seconds on a surveillance approach.

In the event that a transponder-equipped aircraft experiences two-way radio communications failure, the pilot should adjust his transponder to squawk code 7600; controllers should be alert and take action as outlined in the appropriate section of the TATC Handbook 7110.8 (Series).

IFR and special WFR aircraft may be vectored when it is necessary for separation purposes, when required for noise abatement considerations, when an operational advantage to the pilot or controller exists, or when requested by a pilot. When separation from other aircraft is based on vectoring special VFR aircraft, a controller must consider the pilot's requirement to conduct flight clear of clouds with at least 1 mile flight visibility.

VFR aircraft, other than special VFR aircraft, may be vectored only when one of the following conditions exists:

1. The pilot requests a vector.

2. A controller suggests the vector and the pilot concurs.

3. A special program is established and vectoring service is advertised.

4. In the controller's judgment, a vector is necessary for safety.

Vectoring aircraft for the purpose of separation can only be done if the aircraft to be vectored is within the airspace for which the radar controller has control jurisdiction.

A controller must ensure that an aircraft can be returned to its original route within radar coverage before providing radar vectors and should use one of the following vectoring methods:

1. Specify direction of turn and magnetic heading to be flown after completion of the turn.

EXAMPLE: TURN LEFT/RIGHT HEADING THREE FIVE ZERO.

2. Provide no-gyro vectors as follows:

a. Inform the pilot of the aircraft of the type of vector and the manner in which turns are to be made.

EXAMPLE: THIS WILL BE A NO-GYRO VECTOR.

b. Specify the direction of turn and when to stop the turn when issuing each turn instruction.

EXAMPLE: TURN RIGHT/LEFT. STOP TURN.

3. When the heading of the aircraft is not known and time does not permit obtaining it, specify, in group form, the number of degrees to turn and the direction of turn.

EXAMPLE: TURN THIRTY DEGREES LEFT/RIGHT.

4. Specify the magnetic heading to be flown.

EXAMPLE: FLY HEADING TWO SEVEN ZERO.

5. Specify that the present heading be maintained.

EXAMPLE: MAINTAIN PRESENT HEADING.

When an aircraft is vectored off a previously assigned nonradar route, the pilot should be informed of the purpose of the vector, including the airway, route, or point to which the aircraft is being vectored.

EXAMPLE: TURN RIGHT HEADING ZERO FIVE ZERO FOR VECTOR TO VICTOR THREE TWELVE, or FOR VECTOR TO RUNWAY THREE FIVE TRAFFIC PATTERN, etc.

An altitude to be maintained and all altitude restrictions should be issued to the pilot of such aircraft unless the aircraft is operating at an assigned en route altitude, or the aircraft is or will be climbing or descending unrestricted to the assigned en route altitude.

Radar navigational guidance must not be terminated until the aircraft being vectored is reestablished within the airspace to be protected for the airway or route being flown, on an assigned heading which will intercept the desired route within a reasonable distance, and the pilot of the aircraft is informed of his position.

EXAMPLE: OVER GEEDUNK TACAN, RESUME NORMAL NAVIGATION.

NOTE: The requirement to advise the pilot of his position prior to termination of radar navigational guidance does not apply to a DME-equipped aircraft that is on a vector towards a VORTAC/TACAN and is within the service volume for that navaid.

EXAMPLE: RESUME NORMAL NAVIGATION DIRECT HOMINY VORTAC.

When an aircraft will be vectored through a previously assigned nonradar route, the pilot should be so informed and given the purpose of the vector.

Whenever an aircraft is observed in a position and on a track which will obviously cause it to deviate from its protected airspace, the pilot should be informed and, if necessary, the controller should assist the pilot to return the aircraft to the assigned protected airspace.

Whenever radar identification is established or lost, or radar service is terminated, the pilot of the aircraft must be informed.

After the pilot receives the statement that his aircraft is in RADAR CONTACT, he discontinues reporting over compulsory reporting points. The pilot will resume normal position reporting when a controller informs him RADAR CONTACT LOST, or RADAR SERVICE TERMINATED. If necessary, a controller may request a pilot to provide an estimate or report over a specific fix even though RADAR CONTACT has been established. Additionally, the controller may inform the pilot of such aircraft of his position with respect to a fix or route when required.

RADAR HANDOFF

Radar handoffs should be made along regularly used routes to the maximum extent practicable. A controller effects a handoff by physically pointing out the target to the receiving controller, or informing the receiving controller of the distance and bearing of the target from a fix or transfer point shown on both displays, and if appropriate, the radar beacon code assigned. The receiving controller may consider that the target being transferred is identified on his display when the transferring controller has pointed out the target physically, or the target is the only one observed which corresponds with the information furnished.

Communications should be transferred to the receiving controller before the aircraft being handed off enters his area unless previously coordinated otherwise. To the extent possible, the communications transfer should be initiated at the time of handoff.

A receiving controller may assume control of an aircraft being handed off only after it enters his area of responsibility unless specifically coordinated otherwise at the time of handoff.

When a transferring controller transfers control of an aircraft by handoff before it leaves his area of responsibility, he must issue to, and coordinate with, the receiving controller any restrictions which may be necessary to separate the aircraft being handed off from other traffic in the transferring controller's area.

EXAMPLE: YOUR CONTROL AT POINT LOOKOUT, YOU MAY CLIMB TO FLIGHT LEVEL 350, AT YOUR DISCRETION, SUBJECT TO NAVY AIR EVAC 35879.

After a receiving controller accepts a handoff from another facility, he should confirm the identity of a nonbeacon target by advising the pilot of the aircraft's position. Alternatively, he may confirm the identity of a beacon target by observance of an IDENT, a code change, or a standby squawk, as appropriate. It is not necessary to require additional confirming transponder replies if one of these methods was used to remove doubt during the handoff.

RADAR BEACON CODE ASSIGNMENT

Controllers with equipment capability must monitor the beacon codes assigned for use by aircraft operating within their areas of responsibility. Specific codes are assigned to indicate a particular type of aircraft operation. Unless the use of another code has been specifically authorized, code assignments will be made as listed herein.

IFR Operations

Departures:

1. 0100—To aircraft which will operate under tower en route control.

2. 2000—To aircraft which will climb to FL 240 or above or to FL 180 or above, where the base of the Positive Control Area (PCA) and the base of the operating sector coincide at FL 180.

3. 1100—For aircraft that will remain below FL 240 or FL 180 as specified in the preceding paragraph.

En route:

1. 1000—To aircraft changing altitudes operating below FL 240 or when control is transferred to a controller whose area includes the level involved.

2. 1100—To aircraft operating at an assigned altitude below FL 240.

NOTE: Code 1300 may be assigned if an additional code is required.

3. 2300—To aircraft changing altitudes at or above FL 240 or when control is transferred to a controller whose area includes the level involved.

4. 2100—To an aircraft proceeding at an assigned altitude from FL 240 to FL 330 inclusive.

NOTE: Code 2100 may be assigned if an additional code is requested.

5. 2400—To aircraft operating at an assigned altitude from FL 350 to FL 600 inclusive.

NOTE: Code 2500 may be assigned if an additional code is required.

6. 4000—To aircraft when operational requirements dictate frequent or rapid changes in assigned altitude; i.e., "Olive Branch" missions, certain flight tests, aerial refueling, etc. Military aircraft operating VFR or IFR in restricted/warning areas will also utilize Code 4000 unless otherwise specified.

7. 4100/4200—To military aircraft participating in special exercises.

Arrivals:

1. 1500—To aircraft descending below FL 240.

NOTE: Code 0200 - 0700 may be assigned with prior coordination with the destination controller or the code previously assigned when the aircraft was issued descent clearance.

If holding is required prior to entry into the terminal area, the applicable en route code will be assigned; then, when appropriate, the code specified in the preceding paragraph.

VFR Operations (VFR or VFR conditions on top):

1. 1200—To an aircraft on an IFR flight plan that is cleared to operate VFR on top below 10,000 feet.

2. 1400—To aircraft specified in the preceding paragraph operating at and above 10,000 feet.

NOTE: The appropriate IFR code may be assigned to aircraft if within your area of responsibility or prior coordination has been effected, and an operational benefit will be gained.

Upon termination of advisory service, instruct aircraft to return to code 1200 or 1400 as appropriate.

Emergencies:

1. 7700—Utilized by aircraft declaring an emergency when they are not radar-identified.

NOTE: Upon establishment of radio and radar contact, pilots may be requested to change to another code. If the pilot agrees and conditions permit, the change observed by other ATC facilities signifies that the aircraft is under ATC control.

Radio Failure:

1. Code 7600—Signifies loss of two-way radio communications.

Hijacked Aircraft:

1. Code 3100—Utilized by aircraft being hijacked.

NOTE: If this code is observed, controllers should acknowledge and confirm receipt by asking the pilot if he is intentionally squawking code 3100.

If the pilot replies in the affirmative or if no reply is received, do not question the aircraft further but be responsive to requests from the aircraft.

Controllers should notify supervisory personnel of the situation, continue to flight-follow the aircraft, but do not initiate communications with the aircraft.

Military Operations Above FL 600:

1. Code 4400—Assigned to military aircraft conducting planned operations above FL 600.

NOTE: Aircraft in this category should not be requested to change codes except for emergency situations.

These codes may be considered as a basis from which the discrete coding procedure begins. Facilities or positions within a facility may be assigned a code not included herein by appropriate authority. With coordination between controllers concerned, various modifications of the basic procedure may be used when circumstances require. For more information the AC should refer to the appropriate section of the TATC Handbook 7110.8 (Series).

Pilots of aircraft with a transponder operating should be instructed to SQUAWK STANDBY when approximately 15 miles from destination if the transponder is no longer desired by the terminal controller. They may also be instructed to SQUAWK LOW (if properly equipped) when necessary to reduce clutter or ring-around, provided that the pilot is instructed to SQUAWK NORMAL as soon as possible after the problem is eliminated.

To instruct a civilian pilot to turn off his transponder, advise him to STOP SQUAWK. For military pilots, advise him to STOP SQUAWK MODE (mode in use).

DEPARTING AIRCRAFT

Standard departure routes and channelized altitudes should be used for radar departures whenever practicable to reduce coordination. However, such procedure should not be used solely to provide for possible radar or communications failure.

When an aircraft is to be vectored immediately after takeoff, the initial heading to be flown should be assigned before takeoff.

If a radar beacon reply is required immediately after takeoff, the appropriate mode/code, and if necessary a low sensitivity setting, should be assigned before takeoff.

An IFR departure, or a missed approach aircraft, within 40 miles of the antenna site, may be vectored before it reaches the minimum altitude for IFR operations provided that one of the following conditions is met:

1. The aircraft is vectored to maintain at least 3 miles separation from prominent obstructions shown on the radarscope when the takeoff path is 3 miles or more from the obstruction.

2. The aircraft is vectored to increase lateral separation from such obstructions until the 3-mile minimum is achieved when the takeoff path is less than 3 miles from the obstruction.

ARRIVING AIRCRAFT

Successive arriving aircraft may be handed off with only radar separation if previously agreed to between facilities concerned and the following conditions are met:

1. The receiving controller establishes communication with the first aircraft before the pilot of a second aircraft, cleared to or over the same fix, is instructed to change to the

receiving controller's frequency (unless an airport clearance limit is used).

2. The pilot of the first aircraft establishes communication with the receiving controller before it reaches the clearance limit fix.

3. The receiving controller does not delay the first aircraft at a fix to or over which a second aircraft is cleared.

Arriving aircraft may be vectored to intercept the final approach course of a precision approach. In such cases, the vectoring technique must allow for interception of the final approach course prior to reaching the point where interception of the glide slope is normally made.

If it becomes necessary to vector an aircraft through the final approach course of the approach the aircraft is executing, the pilot should be so informed. This will clarify your actions with the pilot and avoid confusion since the pilot is anticipating a turn inbound on final approach course and is naturally concerned when such instructions are not received as anticipated.

Prior to aircraft reaching the final approach gate, they should be advised of their position from the final approach fix, assigned a vector (if required) to intercept the final approach course, and issued an approach clearance unless a radar approach is to be executed.

In the event that terrain or traffic precludes the unrestricted descent to the lowest published altitude (prior to final descent) as indicated in the approach procedure, controllers are required to refrain from issuing approach clearance until the restriction has been fulfilled; or assign an altitude restriction with the clearance and specify when unrestricted descent can be accomplished.

When appropriate, additional information relative to the monitoring of the tower on the assigned frequency and reporting over the approach fix will also be issued prior to aircraft reaching the approach gate.

In the event that the aircraft will be provided a radar approach on a different frequency, this information should be provided prior to the aircraft passing the final approach fix.

When aircraft will execute a visual approach after being positioned by radar over the final approach fix, they should be instructed to contact the tower on the appropriate frequency when over the fix. This information is to be transmitted to the pilot prior to the aircraft reaching the fix.

An arriving aircraft may be descended to minimum vectoring altitude, vectored to the VFR traffic pattern, instead of the final approach course, and cleared for a visual approach if the following conditions are met:

1. The reported ceiling is at least 500 feet above the minimum vectoring altitude and the visibility is at least 3 miles.

2. Radar separation must be provided from any preceding IFR aircraft until visual separation can be provided.

3. The clearance for the visual approach is issued after the pilot reports sighting the airport and the tower controller is advised of the aircraft's position where there is no preceding aircraft; or, when following a preceding aircraft, the clearance is issued after the pilot reports sighting the preceding aircraft, is instructed to follow it, and the tower controller is advised of the aircraft's position in the landing sequence.

Speed Adjustment

To avoid excessive vectoring and provide for orderly radar handoffs, a radar controller may request arriving aircraft to adjust speed. This procedure should not be applied as a substitute for good vectoring technique. Speed changes should not be requested of aircraft in the following situations:

1. Aircraft operating at FL 290 or above without the consent of the pilot.

2. Conducting a published penetration.

3. After an aircraft has been cleared for approach. However, when subsequent circumstances require additional spacing, a request for a speed adjustment would be preferable to S-turns or a discontinuance of approach.

All speed adjustment requests should be expressed in terms of knots, based on indicated airspeed, using 10-knot increments or multiples thereof.

Consideration must be given to maximum speeds authorized by FAR 91 in particular airspace to ensure that speed adjustment requests are within those limits. Requests requiring alternate decreases and increases should be avoided.

For more information on speed adjustment minima and limitations, refer to the appropriate section of TATC Handbook 7110.8 (Series).

ADDITIONAL SERVICES

Several types of service available through the use of radar may be provided pilots, such as observed traffic information. These services should be provided to the extent possible. Many factors, such as controller workload, limitations of the radar, communications congestion, etc., may preclude providing these services. The controller himself must determine if he is able to provide them.

Traffic Information

Traffic information should be issued to all IFR flights unless omission is requested by the pilot or the aircraft is operating in positive controlled airspace.

Traffic information issued to radar-identified aircraft must include the following items:

1. Azimuth from the aircraft in terms of the 12-hour clock.
2. Distance from the aircraft in miles.
3. Direction in which the traffic is proceeding and/or relative movement of traffic.
4. Type of aircraft and altitude if known. Issue the assigned altitude, if known, or the automatic altitude readout if available.

EXAMPLE: TRAFFIC, THREE O'CLOCK, SEVEN MILES, WESTBOUND, DIVERGING, F-FOUR, FLIGHT LEVEL TWO FIVE ZERO.

NOTE: Relative movement includes closing, converging, parallel same direction, opposite direction, diverging, overtaking, crossing left to right, or crossing right to left.

Traffic information issued to aircraft that are not radar-identified must include the following items:

1. Distance and direction with respect to a fix.
2. Direction in which the traffic is moving.
3. Type of aircraft and altitude if known.

EXAMPLE: TRAFFIC, SIX MILES SOUTH OF SNARE VOR, NORTH BOUND, C ONE FORTY ONE, FLIGHT LEVEL TWO ONE ZERO.

Radar separation is provided between the aircraft receiving traffic information and the observed traffic only if the pilot requests it, and the aircraft to be vectored is within airspace for which the controller has jurisdiction.

The pilot of a radar-identified aircraft that reports he does not see the traffic as reported should be advised when the observed traffic is no longer a factor unless his aircraft is being vectored to provide separation from the traffic.

Whenever a controller observes a situation which, in his opinion, is likely to affect the safety of a radar-identified aircraft, an advisory should be issued to the pilot.

When it becomes known that an aircraft not under radar control is at the same altitude and in the same general area as a radar-controlled aircraft, the controller must take whatever action is considered necessary to separate the aircraft concerned.

Weather and Chaff Information

Weather and chaff information, when applicable, should be issued by stating its position with respect to the aircraft or a fix, as is traffic information. A vector or alternate route to avoid such areas may be suggested as appropriate.

Bird Activity Information

Advisory information on pilot-reported or radar-observed and pilot-verified bird activity should be issued. The position, and, if known, the size or species of the birds and their course of flight and altitude must be included in the advisory.

Surveillance of Outer Fix Holding

Radar surveillance of outer fix holding pattern airspace areas shown on the radarscope should be provided when aircraft are being held there. If a controller should detect an aircraft straying outside the area, he should assist the pilot to return it to the assigned airspace.

Terminal Radar Service

The FAA has established a national program for terminal radar facilities. The extent and complexity of the service provided is varied depending on the facility and whether or not a formal, approved program has been established for that facility. The variance is described in STAGES, i.e., STAGE I, II, or III. This service is in addition to the "Additional Radar Services" previously described.

Stage I service procedure is applicable to all approach control facilities utilizing radar and includes the following radar controller actions when arriving VFR aircraft are handled by approach control.

1. Wind and runway information is issued unless pilots indicate they already have received this information via the ATIS broadcast.

2. Traffic information is issued on a workload-permitting basis.

3. The time or place at which the pilot is to contact the tower for further landing information is specified.

4. Vectoring service is provided if the pilot requests, if the controller suggests it and the pilot concurs, or if controller judgment deems it necessary for safety.

5. When initial contact is made with the tower, it may be suggested that the aircraft contact approach control for landing and traffic information.

Stage II service is only applicable at facilities where a formal, approved program has been established for this purpose. It is in addition to Stage I service and generally includes identification, holding, sequencing aircraft in the landing pattern including IFR traffic, vectors to landing patterns for more than one runway, transfer of control procedure between the local controller and approach controller, missed approach aircraft resequencing, and departure information for VFR aircraft.

Stage III service is only applicable within a designated Terminal Radar Service Area (TRSA) where a program has been established for this purpose. It is in addition to Stage II service and in essence is positive control of aircraft that operate within the TRSA.

For detailed procedures concerning Stage II and III service, refer to the applicable section of TATC Handbook 7110.8 (Series).

EMERGENCY RADAR PATTERNS

Radar controllers must be on the alert for emergency radar flight patterns executed by pilots who experience two-way communications failure, and must render assistance to the extent possible to any aircraft determined by this method to be experiencing an emergency. If an emergency radar flight pattern is observed by a controller in a facility other than a center, the appropriate center must then be notified immediately. The center is then responsible for coordinating action pertinent to the emergency.

The emergency radar flight patterns designed to alert radar systems are as follows:

1. If the aircraft radio transmitter is inoperative, but the receiver is operative, the aircraft is flown in a triangular pattern to the RIGHT. The heading for each side of this pattern is followed for 2 minutes (1 minute for turbojet aircraft). After completion of at least two such patterns, the aircraft is returned to its original course. The pattern is then repeated at 20-minute intervals. In these circumstances, pilots ordinarily guard emergency radiofrequencies (121.5 or 243.0 MHz).

2. If the aircraft transmitter and receiver are both inoperative, the aircraft is flown in a triangular pattern to the LEFT in the same manner as above. (See fig. 13-28.)

CARRIER AIR TRAFFIC CONTROL CENTER (CATCC)

It is anticipated that a CV NATOPs manual will be published in the near future and the procedures currently contained in the CVA/CVS NATOPs manual will be incorporated in it. However, as an interim measure, the procedures contained in the CVA/CVS NATOPs manual will remain current for the purpose of this rate training manual.

To obtain maximum efficiency from men and equipment, carrier air operations must be precisely scheduled in every respect. CATCC is the scheduling and coordinating agency for all flights. The Air Operations Officer is responsible for collecting all required information and preparing the daily Air Plan. Normally the Air Plan will be distributed on the evening before the scheduled operations to allow personnel concerned to prepare for the next day's operations.

The Air Operations Officer is responsible to the Operations Officer for coordination of all matters pertaining to flight operations, and for proper functioning of the CATCC.

Since CATCC covers a wide area of responsibility, personnel must be properly indoctrinated in all phases of carrier air operations. Rotation of personnel in various operating positions is desirable, as personnel ability and qualifications allow, to provide individuals with a better understanding of the aspects involved. Additionally, the rotation may impress upon the AC the value of teamwork necessary within the CATCC.

Basically, CATCC can be broken down into two branches: Air Operations (Air Ops) and Carrier Controlled Approach (CCA).

AIR OPERATIONS

The mission of Air Operations is to serve as a coordinating and scheduling center for the ship's flight operations and to furnish pertinent flight information to pilots concerned.

The positions in Air Operations are as follows:

1. Air Operations Officer.
2. Assistant Air Operations Officer.
3. Air Operations Supervisor.
4. Section Leader.
5. Radio Operator-Ship/Shore Communications.
6. Land/Launch Recordkeeper.
7. Status Board Keeper.
8. Teletype Operator.
9. Dead Reckoning Tracer (DRT) Operator.
10. Sound-Powered Telephone Talker.

The duties and responsibilities of Air Operations personnel assigned the operating positions below the section leader level are discussed here.

Radio Operator

The radio operator establishes and maintains radio communications with shore activities on Raspberry, Air Defense Liaison, and intratype frequencies, as applicable. He ensures that the AIR OPS officer sees all messages received. He also is responsible for the following:

1. Maintains a routine message log and the message boards for the CATCC.
2. Makes sure that all messages are initialed and filed.

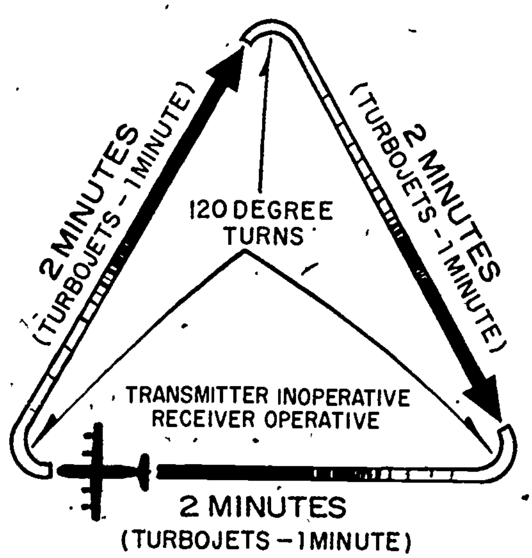
Land/Launch Recordkeeper

The person in this position mans the 2JG sound powered aircraft information circuit and uses it to relay information to pilot's readyrooms as a followup to the interior teletype. He also:

1. Maintains the ship's aircraft launch and landing log.
2. Ensures the accuracy of aircraft calls, side numbers, and pilots' names on the status boards.

Status Board Keeper

The status board keeper uses a split headset to man both the 2JG circuit and the land/launch



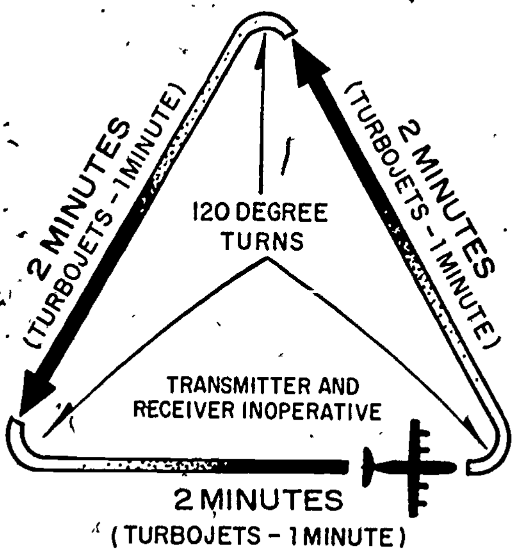


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Figure 13-28.— Emergency radar flight patterns.

frequencies. He also records pertinent information relayed to him on the status board including the fuel state of each aircraft.

Teletype Operator

This operator is in charge of the teletype transmitter for the CATCC. Receiver repeaters are located in pilots' readyrooms to promulgate information to pilots, such as changes in flight schedule, weather, ship's intended movement, etc.

DRT Operator

The operator of the Dead Reckoning Tracer:

1. Knows the location of maps, charts, and publications used in CATCC.
2. Provides bearing and distances of nearest land and airfields to CCA, CIC, Pri-Fly, and status board keeper every half hour, and at other intervals as specified by the Air Operations Officer.
3. Properly operates the DRT and periodically checks the ship's indicated position with the ship's navigator.
4. Makes sure the navigation information on the status board is accurate.
5. Keeps up-to-date information on danger areas, operating areas, firing areas, etc., on the chart in use.
6. Obtains path of intended movement (PIM) information from navigation personnel and checks its relation to flight advisory areas and other control areas.

CCA

The contraction CCA as used in this instance is expanded to include all those operating positions involved in the actual radar control of airborne aircraft under the Operations Officer's cognizance except those being controlled by the Combat Information Center (CIC).

In many instances some of these positions may be combined due to personnel shortages. However, an ideal arrangement is as follows:

1. One CCA Officer.
2. One Assistant CCA Officer.
3. One CCA Supervisor (normally a CPO).
4. One Departure Controller.
5. One Departure Status Board Keeper.
6. One Marshal Controller.
7. One Marshal Status Board Keeper.
8. Two Approach Controllers.
9. Two Final Controllers.
10. One CCA Approach Status Board Keeper.
11. Two Sound-Powered Telephone Talkers.

The duties and responsibilities of some personnel below the supervisor level assigned to CCA are discussed in the following paragraphs.

NOTE: For explanation of unfamiliar terms, refer to the list of definitions following this section.

Departure Controller

Primary responsibility for adherence to the assigned departure rests with the pilot; however, advisory control is normally exercised, with a shift to close control as required by weather conditions, upon request, or when the assigned departure is not being adhered to. In addition, the departure controller is responsible for the following:

1. Ensure that communications and positive track are established with all aircraft to the extent possible under existing electronic emission control (EMCON) conditions.
2. Request navaid checks as necessary.
3. Maintain advisory control of departing point-to-point flights until pilots shift to en route frequencies, and of other aircraft until control is accepted by CIC or another controlling agency.
4. Before releasing aircraft to another controlling agency, give each pilot (flight leader) any pertinent information such as changes in composition of flight, changes in PIM, or in mission.
5. When transferring control to CIC, give CIC the range and bearing of the aircraft being transferred, and ensure that CIC acknowledges assumption of control.

Departure Status Board Keeper

The Departure Status Board Keeper maintains the appropriate status board for the Departure Controller.

Marshal Controller

Upon entering the carrier control area, inbound flights are normally turned over to the marshal controller for further clearance to the marshal pattern. The marshal controller must provide the inbound flight with the following:

1. Marshal instructions.
2. Steer to marshal (if required).
3. Type of recovery.
4. Ramp time.
5. Altimeter setting and weather.
6. Expected final bearing.

The marshal controller must also ensure that the following information has been provided each aircraft prior to commencing approach:

1. Expected approach time.
2. Final control frequency.
3. Type of approach.
4. Final bearing.
5. Time check.
6. Other pertinent data such as changes in weather conditions, altimeter setting, etc.

To reduce frequency congestion, items of general interest may be transmitted to blocks of aircraft rather than make repetitious broadcasts to individual aircraft.

Approach Controller

The Approach Controller assumes control of the inbound aircraft from the Marshal Controller. Circuit discipline is essential because two controllers and several aircraft are on each frequency. Two Approach Controllers are normally used, each with a separate frequency and with a final controller being on the same frequency. Each controller controls every other aircraft and passes control of each aircraft to the final controller when the aircraft reaches approximately 6 miles inbound (4 miles when using SPN-42). This procedure will vary when the radar equipment used provides a complete PAR approach; i.e., glidepath as well as azimuth, such as the SPN-42 and the SPN-35. This equipment will be discussed later in this chapter.

In addition, the Approach Controller is responsible for the following:

1. Monitoring the aircraft's letdown and providing assistance as necessary on TACAN approaches.
2. Providing positive radar control during periods of TACAN failure.
3. Maintaining the proper interval between aircraft on all approaches.
4. Controlling the fouled deck holding pattern as necessary to maintain proper separation.
5. Ensuring that approach control information on the approach status board is current and correct.

Final Controller

The Final Controller assumes positive control as soon as radar contact is established, normally at 6 miles from the ramp (4 miles on SPN-42). There are normally two Final Controllers, each of whom will be on a frequency with an Approach Controller.

Bolter/Waveoff Controller

The type of final approach radar installed will determine control responsibility for the bolter/waveoff pattern (e.g., those aircraft whose previous approaches did not result in an arrested landing).

This operator directs aircraft around the bolter/waveoff pattern to a point astern of the ship, from which another landing attempt can be made.

Close coordination is required with the approach controller to ensure that aircraft approaching from the bolter/waveoff pattern are positioned properly with respect to other arriving aircraft.

Approach Status Board Keeper

The Approach Status Board Keeper monitors the approach and final frequencies utilizing a split headset and ensures that the latest information is displayed on the approach status board.

It is mandatory that personnel assigned duty as a status board keeper remember that the CCA officer and supervisor rely on the information displayed on the status boards to maintain the delicate teamwork balance required to make successful efficient approaches. Each operator also relies on the status board for pertinent information required for his respective position. Current and correct status boards provide CCA supervisors with a comprehensive display of the entire recovery, thereby eliminating interruption of operator personnel for progress reports.

Sound-Powered Telephone Talkers

The X1JG Sound-Powered Telephone Talker is assigned to provide for direct communications to Pri-Fly and the LSO. The 2JG Sound-Powered Telephone Talker is assigned to receive and transmit general aircraft information to and from other offices concerned, such as CIC.

DEFINITIONS OF CATCC TERMS

ADVISORY CONTROL.—A form of air control in which the controlling agency monitors radar and radio contact with aircraft under its control and provides traffic advisories. Traffic separation is the responsibility of the individual pilot, with the assistance provided by the control agency.

AIR OPERATIONS.—That section of the Operations Department responsible for coordinating all matters pertaining to air operations including the proper functioning of the CATCC.

APPROACH CONTROL.—A control station in CATCC responsible for controlling air traffic from marshal until handoff to Primary Fly or the final controller.

ACLS.—Automatic Carrier Landing System.

LOCKON.—a verbal report from the final controller when SPN-10/42 radar acquires the aircraft and commences tracking. Mode I/II equipped aircraft should receive ACL READY/LOCKON discrete light.

ACLS WINDOW.—an area in space (normally 3.5 to 5 miles from touchdown point) in which aircraft is acquired by radar for ACLS control.

COMMAND CONTROL.—acknowledgment that aircraft being controlled by data link signals.

COUPLED.—aircraft automatic flight control system engaged and linked to data link commands.

DATA LINK ADDRESS.—discrete identification assigned to data link equipped aircraft.

DATA LINK EQUIPMENT.—automatic transmission device capable of very high data rate.

DLM.—data link monitor for use in visually observing data being sent to aircraft under ACLS control.

MODE I APPROACH.—fully automatic approach to touchdown.

MODE IA APPROACH.—automatic to 200 feet—half mile minimums with manual takeover to touchdown.

MODE II APPROACH.—manual approach using ILS (crossed needles) instrument presentation.

MODE III APPROACH.—CCA PAR talkdown approach; no special aircraft configuration required.

NEEDLES.—acknowledgement that ILS needles in aircraft responding to data link signals.

TEN SECOND DISCRETE LIGHT.—illuminates approximately 10 seconds prior to touchdown, indicating Deck Motion Compensation (DMC) is being transmitted from Mode I certified ships. Illuminates approximately 10 seconds prior to reaching minimums on ships certified only for Mode IA/II.

UNCOUPLING.—aircraft being disengaged from data link commands.

UNIVERSAL TEST MESSAGE (UTM).—utilized to ensure proper operation of aircraft data link equipment.

BASE RECOVERY COURSE (BRC).—The ship's magnetic heading during flight operations.

Note

BRC should always be used when giving heading to aircraft during flight operations vice using any other terminology.

BINGO.—An order to an aircraft to proceed immediately to a divert field. Bearing, distance and destination will be provided.

BOLTER/WAVEOFF CONTROL.—A control station in CATCC responsible for all CCA bolter/waveoff traffic. The Bolter/Waveoff controller will vector assigned traffic under close control until responsibility is assumed by another control station.

CARRIER AIR TRAFFIC CONTROL CENTER (CATCC).—The centralized agency responsible for the status keeping of all carrier air operations and control of all airborne aircraft under the Operations Officer's cognizance except those being controlled by CIC.

CARRIER CONTROL AREA.—A circular airspace with a radius of 50 miles for CVAs and 25 miles for CVSs around the ship, which extends upward from the surface to unlimited altitude and is under the cognizance of CATCC.

CARRIER CONTROL ZONE.—The airspace within a circular limit defined by 5 miles horizontal radius from the carrier, extending upward from the surface to and including 2500 feet unless otherwise designated for special operations, and is under the cognizance of the Air Officer during VFR conditions.

CARRIER TERMINAL INFORMATION SERVICES (CTIS).—A pre-recorded broadcast on radio beacon frequency. It provides advance information to arriving and departing pilots concerning operational, meteorological, and other pertinent data. This information is updated as required, and successive broadcasts are identified by alphabetical suffix.

CCA.—Carrier Controlled Approach.

CENTER.—A collective radio call prefixed by a ship's code name which is used in the same manner as the shore-based counterpart.

CHARLIE.—Signal for aircraft to land aboard the ship. A number suffix indicates time delay before landing.

CLARA.—A pilot transmission meaning he does not have the meat ball in sight.

CLOSE CONTROL.—A form of air traffic control in which the controlling agency has radar and radio contact with the aircraft being controlled and (1), published approach or departure procedures are complied with or (2), where specific assignments regarding heading and altitude are issued by the controller. While altitude separation is provided by pilots maintaining assigned altitude, lateral and time separation is the responsibility of the Air Controller. Speed changes may be directed by the Air Controller.

DELTA.—Hold and conserve fuel at altitude and position indicated.

DEPARTURE CONTROL.—A control station in CATCC responsible for the orderly flow of assigned departing traffic.

EMERGENCY EXPECTED APPROACH TIME (EEAT).—The future time, assigned prior to launch, at which an aircraft is cleared to depart inbound or penetrate from a pre-assigned fix under lost communication conditions.

EMERGENCY MARSHAL.—A marshal established by CATCC and given to each pilot prior to launch with an altitude and an EEAT. The emergency marshal radial shall have a minimum of 30 degrees separation from the primary marshal.

EXPECTED APPROACH TIME (EAT).—The future time at which an aircraft is cleared to depart inbound or penetrate from a pre-assigned fix. Aircraft depart and commence approach at assigned time if no further instructions are received.

FINAL BEARING.—The magnetic bearing assigned by CATCC for final approach. It is an extension of the landing area centerline.

FINAL CONTROL.—A control station in CATCC responsible for controlling traffic in instrument conditions from acquisition until pilot reports "Meat ball" or reaches approach minimums.

FLIGHT LEVEL.—Density altitude expressed in hundreds of feet determined by setting 29.92 in the aircraft pressure altimeter, i.e., FL 230 equals 23,000 feet density altitude.

HELICOPTER AIRSPACE.—That airspace extending from the surface to 400 feet between the 030 degree and 135 degree relative bearing and extending out to 5 miles.

HERO.—Hazards to electromagnetic radiation to ordnance.

INBOUND BEARING.—The magnetic heading assigned by CATCC to pilots descending directly to the carrier. It may be, but is not necessarily the final bearing.

INBOUND HEADING.—The magnetic heading assigned by CATCC that will ensure interception of the final bearing at a specific distance from the carrier.

KILO REPORT.—A pilot coded report indicating aircraft mission readiness.

MARSHAL.—A bearing, distance, and altitude fix designated by CATCC from which pilots will orient holding and from which initial approach will commence.

MARSHAL CONTROL.—A control station in CATCC responsible for the orderly flow of inbound traffic.

MEAT BALL.—A pilot report indicating that the visual landing aid is in sight.

MONITOR CONTROL.—The monitoring of radar and radio channels for emergency transmissions.

NON-PRECISION APPROACH.—Radar controlled approach or an approach flown by reference to navigation aids in which glide slope information is not available.

PLATFORM.—A point at 5000 feet altitude in the approach pattern at which all jet and turboprop aircraft will decrease their rate of descent to not more than 2000 feet per minute, continuing letdown to the ten mile gate.

PRECISION APPROACH.—An approach in which range, azimuth, and glide slope information are provided the pilot.

RAMP TIME (READY DECK).—Anticipated time specified by pri-fly that the deck will be ready to recover aircraft and the first aircraft of a Case III recovery is expected to be at the ramp.

SIGNAL DELTA.—The signal indicating a delay in landing.

SIX MILE GATE.—A check point in a CCA located on the final bearing 6 miles from the carrier through which all jet and turboprop aircraft will pass in level flight at an altitude of 1200 feet in landing configuration. Propeller aircraft will pass through the 6 mile gate at 1200 feet and 140 knots and normally commence transition to the landing configuration.

TEN MILE GATE.—A check point in a CCA, normally located on the final bearing 10 miles from the carrier. All jet and turboprop aircraft will pass through the 10 mile gate in level flight at an altitude of 1200 feet, 250 KIAS, and will normally commence transition to the landing configuration.

THREE MILE GATE.—A check point in a CCA on the final bearing 3 miles from the carrier through which all propeller aircraft and helicopters will pass in a landing configuration.

ZIP-LIP.—A condition that may be prescribed for flight operations during daylight VFR conditions under which positive communications control is waived and radio transmissions between aircraft, and between pilots and control agencies, are held to the minimum necessary for safety of flight.

LPH PROCEDURES

Because of the numerous similarities between CVA/CVS and LPH procedures, we will only discuss the major differences between operations.

Glossary of Terms

The following terms are in addition to those discussed in DEFINITIONS OF CATCC TERMS:

1. Air Operations Control Center (AOCC). This is the centralized agency, responsible for the status keeping of all LPH Air Operations, and the control of all airborne aircraft assigned to them.

2. Control Area. A 10-mile radius of airspace around the ship extending from the surface to the upper limit, which is assigned, and is under the cognizance of AOCC.

3. Control Zone. A 5-mile radius of airspace around the ship, extending from the surface to and including 2,000 feet, unless otherwise specified for special operations. Under visual flight rules the air officer shall exercise control of all aircraft.

4. Three mile gate. A check point in a carrier controlled approach, located 3 miles from the ship, on the final bearing, in which all helicopters will pass in a landing configuration.

Departure Procedures

The primary responsibility for adherence to assigned departure instructions rests with the pilot; however, advisory control shall normally be exercised with a shift to close control as required by weather conditions, upon request, or when the assigned departure instructions are not being adhered to.

During VFR weather conditions, helicopters shall clear the control zone at an altitude of 200 feet or less, or as directed by Pri-Fly, and will not cross within one mile of the ship's bow or stern without clearance from Pri-Fly.

During IFR conditions, helicopters shall climb straight ahead to 300 feet and intercept the three-mile arc, then fly the three-mile arc until intercepting the assigned departure radial. Departure interval shall not be less than one minute.

Arrival Procedures

On entering the LPH control area, inbound flights shall report to AOCC for clearance into the control zone. At 5 miles or as directed, the flight will be transferred to Pri-Fly control for approach and landing instructions.

If, due to low ceiling and visibility, marshaling becomes necessary, helicopters shall be marshaled on the 180-degree radial, relative to the base recovery course, at a distance of 5 miles. Should a secondary marshal become necessary, marshal on the 270-degree radial relative to the base recovery course at a distance of 5 miles. The marshal pattern shall be a right-hand racetrack pattern, holding between 5 and 7 miles. Helicopters holding in the marshal pattern shall be separated vertically by 500 feet.

Helicopters letting down from marshal shall fly at an indicated airspeed as specified in the aircraft NATOPs Flight Manual. The rate of descent shall be 500 feet per minute from marshal to an altitude of 500 feet. Helicopters shall pass through the 3-mile gate at 500 feet in a landing configuration. For a precision approach, maintain 500 feet until interception of the glidepath; and for a nonprecision approach, descend to and maintain 360 feet until sighting the ship.

NOTE: For a detailed study of CATCC procedure, ACs should refer to the latest edition of the CVA/CVS NATOPs MANUAL.

Procedures applicable to the control of aircraft (helicopters) aboard Amphibious Assault Ships (LPH) are contained in the LPH NATOPS MANUAL.

CCA EQUIPMENT

Models of radar equipment will vary somewhat from ship to ship; however, two basic types of radar are common—air search and precision. In addition, automatic systems are also in use; their function and operating characteristics will be described in this section.

SEARCH RADAR

Generally speaking, most carriers have a variety of air search radars on board; although the majority of these are better suited for the air control functions of the ship's CIC, some of these radars are readily adaptable for use in CCA.

SPS-30

The SPS-30 is a combination air search and height-finder radar. This equipment is normally used by CIC for air intercept work, but the air search portion can be selected by CCA and displayed on radar repeaters in the control room.

The SPS-30 possesses a maximum range of 240 miles with a low minimum usable range. IFF is also available.

SPS-43

The SPS-43 is a good air search radar which has many desirable features. It provides good target definition and excellent range accuracy; maximum range is 240 miles with a minimum usable range of approximately 482 yards. IFF is also available.

SPN-6

This radar equipment was designed specifically for CCA; it is used for the approach and bolter/waveoff phases of a CCA recovery, including backup control for final in the event of precision radar failure.

Maximum range is 90 miles with the minimum usable range being 300 yards. Antenna rotation speeds of 15 and 30 rpm are available; the faster rotation speed is desired for close-in control. Operating controls are located in the CCA control room, which allows tuning of the receiver, antenna angle adjustments, and other required adjustments to be made locally.

SPN-43

The SPN-43 is a modification of the SPN-6 air search radar; the maximum usable range is 50 miles, using an antenna similar to the CPN-4 GCA antenna which provides improved target definition.

This equipment has IFF capability and also displays a ship's heading marker (strobe) on the radarscope to automatically indicate any changes in the ship's course.

It should be noted that when the SPN-6, SPN-43, or other air search radar is used in lieu of a precision radar for final control, a step-down method of descent for aircraft is utilized.

PRECISION RADAR

While controlling a CCA approach, it is the responsibility of the CCA final controller to position each aircraft on final as near as possible to the centerline of the carrier angle deck by giving right or left corrections. The final controller should have the aircraft on the course-line and holding a good heading prior to reaching a point 1 1/2 miles from the carrier.

Large azimuth corrections, to get back to the oncourse, should be avoided in the final stages of the approach. Carrier approaches are a critical phase of aircraft operation, and erratic maneuvers at slow speeds usually prove ineffectual, if not disastrous.

The secret of a smoothly controlled approach is to assign large heading changes, as required, while the aircraft is at least 3 miles or more from the ship. If this technique is used, only small corrections should be needed when the aircraft gets closer.

When the pilot has the meatball in sight and is prepared to complete the approach visually, he will transmit MEATBALL. The controller ceases transmission, and the pilot then adjusts his descent to put the meatball in line with the datum lights and makes any necessary azimuth corrections. The pilot continues to visually fly the meatball to an arrested landing.

The most versatile CCA precision radar in service today is the SPN-35; this equipment is comparable to the quad radar FPN-36 discussed earlier in this chapter. Figure 13-29 illustrates the radar indicator utilized with the SPN-35 equipment. Two indicators of this type are installed in the CCA control room — one being the MASTER indicator and the other the SLAVE indicator. An important feature of the SPN-35 is the controller's capability to select simultaneous scan, that is, one indicator displays precision while the other displays surveillance.

With a stabilization system as an integral part of the equipment, any pitching or rolling of the ship is compensated for, thus maintaining a constant glide slope.

The azimuth portion provides two choices of scan: normal (30 degrees) and 60° AZ. In the normal position the azimuth sweep scans 25 degrees to the portside and 5 degrees to the starboard side of the ship as viewed by the pilot. This sweep is more desirable as it allows the controller to see aircraft turning to final from the downwind position during a bolter/waveoff pattern.

When the 60° AZ scan is selected, the additional 30 degrees of azimuth coverage is to the starboard side of the ship, requiring twice the length of time to complete this coverage. Therefore, this position of operation is the least desirable.

AUTOMATIC CARRIER LANDING SYSTEM (ACLS)

The ACLS is a combination of several systems developed independently, each of which performs a significant function in the complexity of automatic landings. The ACLS consists of precision tracking radar, coupled to a computer data link to provide continuous information to the aircraft, and independent beam scanning transmitters which provide the pilot with a monitoring capability and a backup approach system.

AN/SPN-10

The AN/SPN-10 was the first radar system developed to provide the carrier landing capability described in the preceding paragraph. Since its development, system reliability has continuously improved through testing and newly acquired technology. The latest improvement concerns the conversion of the AN/SPN-10 to a digital system using solid state radar. This converted system has been designated the AN/SPN-42.

AN/SPN-42

In addition to precision tracking radar, the AN/SPN-42 consists of the necessary electronic equipment to provide a completely automatic landing capability. When an aircraft is approaching a carrier, the precision tracking radar monitors

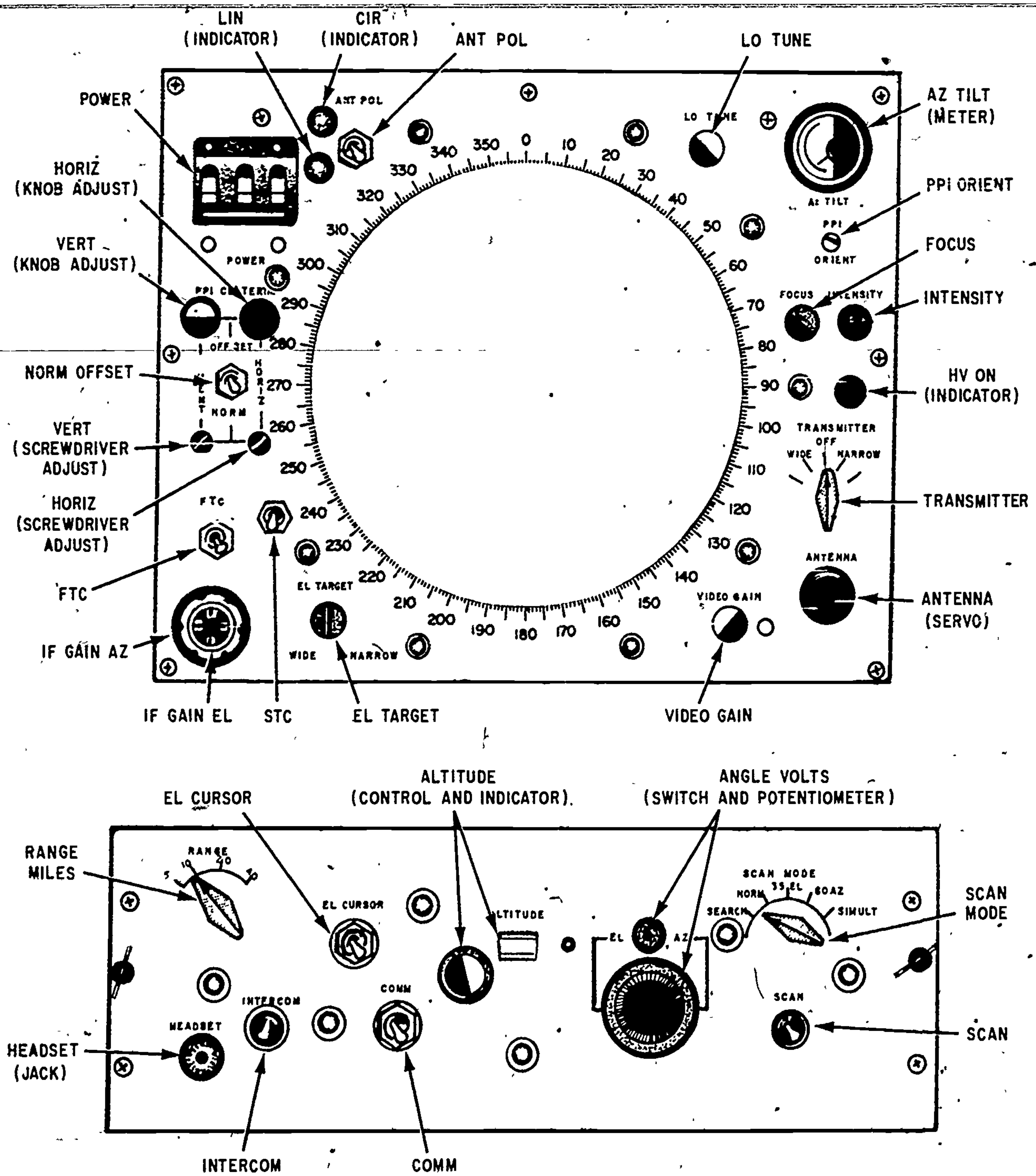

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Figure 13-29.—SPN-35 radar indicator.

the aircraft's progress and feeds position information to a computer. There the aircraft's position is measured in relation to a preselected approach path. The computer determines what corrections are necessary to maneuver the aircraft to the desired path and transmits this information to the aircraft by radio. Equipment in the aircraft feeds the commands through an autopilot to the aircraft's control surfaces and throttle, and the aircraft reacts accordingly. (See fig. 13-30.) This same information, in addition to intelligence concerning the distance from the ship to the aircraft, is also fed to the CCA operator's console.

An example of the operator's console is shown in figure 13-31. The information may also be presented on an ILS-type instrument display for the pilot as a visual presentation of error information and corrections to be made. Thus, three modes of operation are available for landing approaches—(1) fully automatic, (2) manual approach similar to a conventional ILS-type approach, and (3) conventional CCA approach in which the aircraft is talked down by the controller.

AN/SPN-41

The need for the pilot to monitor his progress during a fully automatic approach was recognized early in the development of ACLS. To provide the pilot with this capability, the AN/SPN-41 was developed. This is a completely independent guidance system which, in addition to providing a means for monitoring, affords the pilot another method of making an instrument approach to the ship. In this system, shipboard transmitters scan coded microwave signals aligned on the desired approach path. On the aircraft's instrument panel, the information from this system is displayed on an ILS-type instrument. This is illustrated in figure 13-32. The AN/SPN-41 provides guidance information in excess of 20 miles. This type of approach requires the pilot to transfer to a visual landing aid, such as the Fresnel lens system, prior to touchdown as would mode 2 or 3 approaches using the AN/SPN-42.

With both the AN/SPN-41 and AN/SPN-42 installed in aircraft and ships, the SPN-41 serves as a feeder and monitor system for the ACLS. The SPN-41 furnishes the pilot with information on the same ILS-type instrument as does the SPN-42 for a mode 2 operation. Since modes 1 and 2 may be lost or the data link system could possibly fail in the SPN-42 system, the SPN-41 provides backup for continuation of a mode 2 type of approach should an equipment failure occur while an aircraft is on an approach.

Of course, the ever-present CCA controller monitors the entire system on the operator's console and is always there to transition to a mode 3 or conventional talkdown approach when necessary or desired.

Ancillary Equipment

Ancillary equipment that is normally located in the CCA control room includes the following:

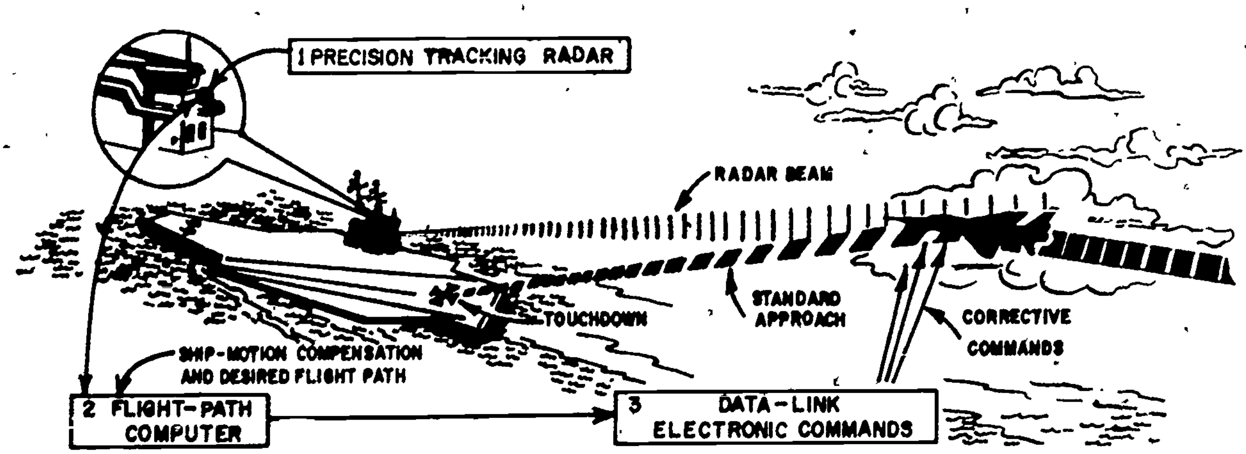

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Figure 13-30.—ACLS method of operation.

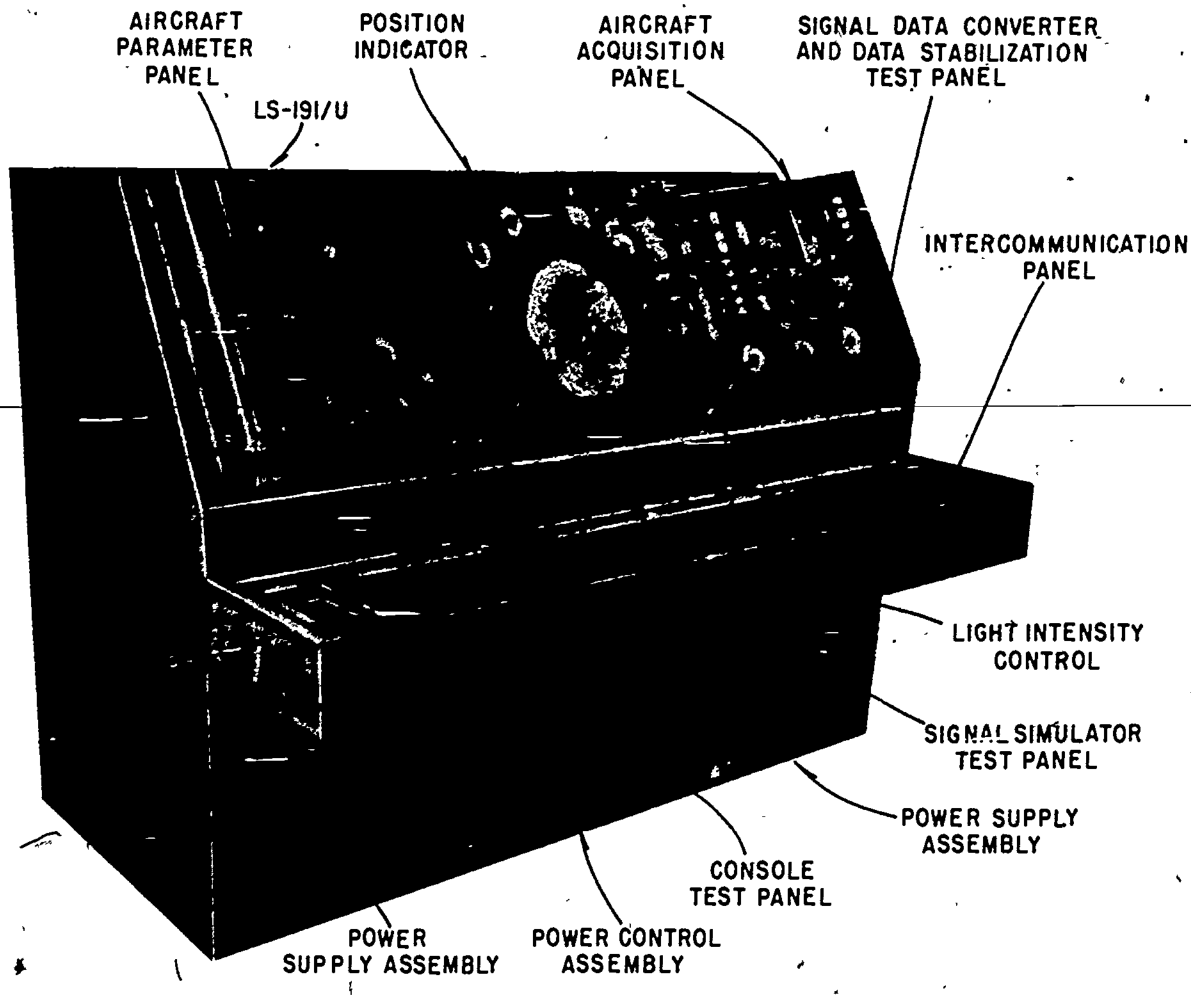

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Figure 13-31.—ACLS operator's console.

1. Communications consoles—models of equipment will vary but their function is equivalent to those consoles discussed in chapter 5.
2. Direction finding equipment (URD-4).
3. Gyro repeater—indicates ship's true course.
4. Deck condition lights—indicate ready or fouled deck.
5. SPN-12 radar—indicates airspeed of aircraft on final, either true or closing, as selected by CCA or the LSO.
6. Pilot Landing Aid Television (PLAT) receiver.

NOTE: This equipment is discussed later in this chapter.

7. Vertical edge lighted status boards—their purpose was outlined under the duties of the status board keepers.

OPTICAL LANDING SYSTEMS

FRESNEL LENS LANDING SYSTEM

The purpose of the lens system is to provide the pilot with a visual indication of his relative position with respect to a prescribed glide slope. This glide slope, as determined by the lens settings, is designed to bring the aircraft down to the deck, within the cross-deck pendant pattern, with a safe arresting hook clearance above the stern ramp of the carrier. Figure 13-33 illustrates the Fresnel lens unit.

A yellow bar of light is displayed over the full width of the lens box. The lens box may be considered a window through which the pilot views the bar of light. The bar of light appears as though it were located approximately 150 feet beyond the window. When viewed from anywhere on the prescribed glide slope, this bar of light (meatball) will appear in line with the green datum lights. The meatball will rise above the datum lights as the pilot rises above the glide slope, eventually sliding off the top of the lens box when the pilot is more than three-fourths of a degree above the glide slope. The same holds true as the pilot drops below the glide slope. The meatball will drop below the datum lights and finally slide off the bottom of the lens box. To sum up, when the meatball is high (above the datum lights), the pilot is above the glide slope. When it is low the pilot is below the glide slope. In either case, the object is to line up the meatball with the datum lights.

At great distances from the lens unit, it is difficult to distinguish the relative position of the meatball with respect to the datum lights, because the meatball can be distinguished before the green datum lights become visible. Pilots are therefore provided with a warning of low meatball by installing a RED lens in the bottom cell of the lens box. Thus, regardless of distance, when the meatball is RED instead of YELLOW, a pilot will know he is too low.

PILOT LANDING AID TELEVISION (PLAT) SYSTEM

PLAT is a completely integrated system of electronic picture and sound recording designed to monitor and simultaneously record aircraft landing operations from approach through final touchdown, under both day and night conditions, and to immediately play back the recording for postflight analysis and evaluation.

The PLAT system consists of four television cameras. Two unmanned centerline cameras (one regular, one emergency), stabilized to the

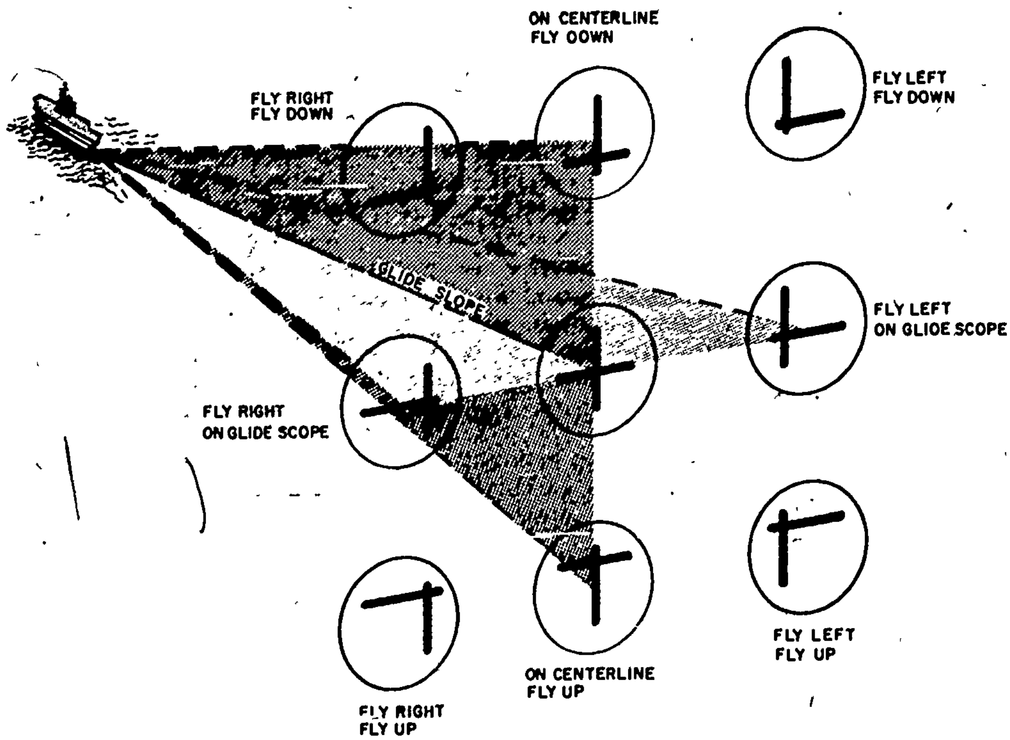

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Figure 13-32.—AN/SPN-41 approach system.

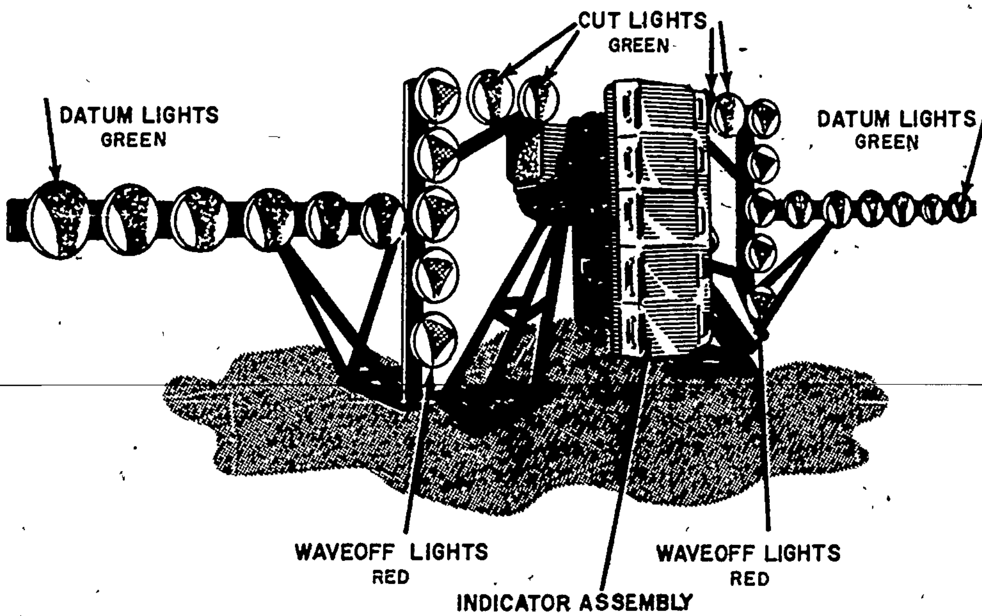

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Figure 13-33.—Fresnel lens unit.

ship's optical landing system, pick up and follow aircraft through final approach and landing. Aircraft attitude and glide slope are displayed on picture monitors in combination with the output of a special effects camera focused on a data board carrying time, date, wind velocity, and aircraft landing speed. During the lanuch and the recovery, and after touchdown, the aircraft can be monitored by a fourth (manned) camera on the ship's island structure as it passes over the centerline cameras and the information is again displayed with the output of the data board camera. The entire operation is recorded on video tape at the same time it is monitored by the television cameras.

Television receivers are located at various places throughout the ship. There is a receiver in each pilot's readyroom, in air operations, in the CCA control room, and on the bridge.

In addition to the benefits afforded in the later study of a pilot's landing technique, PLAT is also helpful as a viewing aid for personnel (air operations and CCA) that previously were unable to view the flight deck activity. It reduces somewhat the sound-powered phone conversation. In the past, certain information had to be collected over the phone circuits that can now be seen on the television receiver.

SAFETY PRECAUTIONS

ACs in the performance of the majority of the duties of their rating, are operating electric or electronic equipment. They may also be called upon to assist maintenance personnel with that portion of preventive maintenance which requires the equipment to be kept free of potential problem-causing dust and dirt. There are many dangers to personnel who operate and maintain electronic equipment. Among the possible dangers in the Air Controlman's work are high voltages, breakage of cathode-ray tubes, volatile liquids, electrical fires, and noxious gases. Because of these dangers the Air Controlman should regard the formation of safe and intelligent work habits as being equally as important as development of the technical knowledges and skills of the Air Controlman rating.

GENERAL SAFETY PRECAUTIONS

Because of the possibility of injury to personnel, the danger of fire, and possible damage to material, all repair and maintenance work on both electronic and electrical equipment should be performed only by duly authorized and assigned persons.

When any electronic equipment is overhauled or worked on, and there is danger of personnel coming into contact with it, always tag the equipment to show that work is being performed. After the work has been completed, the tag should be removed by the same person who placed it on the equipment.

Safety devices such as interlocks, overload relays, and fuses should never be altered or disconnected except for replacement. Fuses should be removed and replaced only after the circuit has been completely deenergized. When a fuse blows, it should be replaced with a fuse of the same current rating. When possible, the circuit should be carefully checked by maintenance personnel before making any replacement since the burned-out fuse is often the result of a faulty circuit.

High Voltage Precautions

Personnel should never work alone near high voltage equipment. Tools and equipment containing metal parts, such as brushes and brooms, should not be used in any area within 4 feet of high voltage circuits or any electric wiring having exposed surfaces. The handles of all metal tools, such as pliers and cutters, should be covered with rubber insulating tape. (The use of plastic or cambric sleeving or of friction tape alone for this purpose is prohibited.)

Before a worker touches a capacitor which is connected to a deenergized circuit, or which is disconnected entirely, he should short-circuit the terminals to make sure that the capacitor is completely discharged. Grounded shorting prods should be permanently attached to workbenches where radar equipment and other types of electronic devices are regularly serviced.

Do not work on any type of electrical apparatus with wet hands or while wearing wet clothing, and do not wear loose clothing. The use of thinsoled shoes with metal plates or hob-nails is prohibited. Safety shoes with nonconducting soles should be worn if available. Flammable articles, such as celluloid cap visors, should not be worn.

When working on electronic or electrical equipment, personnel should first remove all rings, wristwatches, bracelets, and similar metal items. Care should be taken that the clothing does not contain exposed zippers, metal buttons, or any type of metal fastener.

Warning signs and suitable guards should be provided to prevent personnel from coming into accidental contact with high voltages.

Transmitter adjustments should not be made while the equipment is energized unless the adjustments can be accomplished from the front control panel. Similar precautions should be taken with oscilloscope circuits, which employ voltages corresponding to those used in transmitting equipment.

Energized Circuits

Insofar as is practicable, repair work on energized circuits should not be undertaken. When repairs on energized operating equipment must be made because of emergency conditions, or when such repairs are considered to be essential, the work should be done only by experienced personnel. Every known safety precaution should be carefully observed. Ample light for good illumination should be provided; and the worker should be insulated from the ground with some suitable nonconducting material such as several layers of dry canvas, dry wood, or a rubber mat of approved construction. The worker should, if possible, use only one hand in accomplishing the necessary repairs. Helpers should be stationed near the main power source or circuit breaker so that the equipment can be deenergized immediately in case of emergency. A man qualified in first aid for electrical shocks should stand by during the entire period of the repair.

Volatile Liquids

Volatile liquids such as insulating varnish, lacquer, turpentine, and kerosene are dangerous when used near electronic equipment which is operating, because of igniting the fumes by sparks. When these liquids are used in compartments containing nonoperating equipment, be sure that there is sufficient ventilation to avoid an accumulation of fumes and that all fumes are cleared before the equipment is energized.

Alcohol should never be used for cleaning in locations where a spark is possible. Neither should carbon tetrachloride be employed as a cleaning agent. Unlike alcohol, the use of carbon tetrachloride does not create a fire hazard; however, it is dangerous because of the injurious effects of breathing its vapor. The careless use of carbon tetrachloride may result in headache, dizziness, and nausea. If a sufficient amount of these fumes are breathed (as might happen in poorly ventilated compartments), the effect will be loss of consciousness or even death. For these reasons, the use of carbon tetrachloride as a solvent or cleaner has been specifically prohibited in Navy maintenance operations. When cleaning electrical or electronic equipments or parts, always use the new approved cleaning agent trichlorethylene.

Electrical Fires

In case of electrical fire, the following steps should be taken:

1. Deenergize the circuit.

2. Call the Fire Department.

3. Control or extinguish the fire, using the correct type of fire extinguisher, if at all possible.

4. Report the fire to the appropriate authority.

For combating electrical fires, use a CO_2 (carbon dioxide) fire extinguisher and direct it toward the base of the flame. Carbon tetrachloride should never be used for fighting fires since it changes to phosgene (a deadly gas) upon contact with hot metal. Even in open air this gas creates a hazardous condition. The application of water to electrical fires is also dangerous; and foam type fire extinguishers should not be used since the foam is electrically conductive. In case of cable fires in which the inner layers of insulations, or insulation covered by armor, are burning, the only positive method of preventing the fire from running the length of the cable is to cut the cable and separate the two ends.

Precautions in Handling Cathode-Ray Tubes

The trend toward the use of large cathode-ray tubes has increased the dangers of implosions, or collapse of the glass tube, as a result of atmospheric pressure. The tubes are not dangerous if properly handled; but if they are struck, dropped, or handled carelessly in any way, they can very well become an instrument of severe injury or death.

The following precautions should be taken for the protection of personnel:

1. Wear goggles to protect the eyes from flying glass particles which result from implosion due to fracture of the envelope. The goggles should be of the type which provide side and front protection and which have clear lenses that can stand a rigid impact test.

2. Wear suitable gloves to protect the hands.

3. Be sure that no part of the body is directly exposed to possible glass splinters caused by implosion. Also remember that the coating on some tubes is poisonous if absorbed into the bloodstream.

4. Take care of the tube by not exposing it to possible damage. When a new tube is needed, remove it from the packing box with caution, taking care not to strike or scratch the envelope. Insert the tube into the equipment socket cautiously, using only moderate pressure. Do not jiggle the tube. Use these same precautions when removing the tube from the equipment.

When the tube must be set down, it is important that the face be placed on a clean, soft padding. Do not stand directly in front of the face, because accidental implosion may cause it to be propelled directly forward with a velocity sufficient to cause severe injury.

TREATMENT FOR ELECTRICAL SHOCK

The greatest hazard around electrical and electronic equipment is the danger of electrical shock. Some very important things to remember when treating a victim for electrical shock are as follows:

1. Deenergize the circuit or release the victim from contact. Use caution, or you too may become a victim.
2. Begin artificial respiration IMMEDIATELY but only if the victim is not breathing. (Use the mouth-to-mouth method if at all possible.)
3. Keep the victim quiet after normal breathing is resumed.
4. Keep the victim lying down, head slightly lower than the feet. Keep him warm, but do not overheat him.

For a more detailed coverage of first aid methods, study Standard First Aid Training Course, NAVPERS 10081 (Series).

CHAPTER 14

PUBLICATIONS, RECORDS, AND SECURITY MEASURES

The AC must remain abreast of the ever changing rules, regulations, and procedures applicable to the field of air traffic control; he should periodically review the appropriate ATC publications for changes which might affect the manner in which traffic is to be controlled and regulated.

The importance of being able to describe certain documents and their contents as they pertain to the control of air traffic cannot be overemphasized; the Air Controlman who knows where to locate a particular item of information is generally the more competent controller.

In addition, the Air Controlman must have a working knowledge of the maintenance of logs, records, reports, and forms used in this field.

It would be impractical to list and discuss all the publications, records, reports, logs, and forms that have a direct bearing on the Air Controlman in the course of this chapter. Therefore, only those most frequently used in the daily routine are discussed.

The Air Controlman, dependent upon his assignment, may come in contact with material of a classified nature; that is, material or information, the contents of which, if divulged to unauthorized personnel, could have an adverse effect upon the national security.

This chapter will include a section concerning measures necessary to protect the security of classified material; the purpose of the security program; the manner in which material is classified and transmitted and other security-oriented items associated with this vital area.

FAA PUBLICATIONS

The following FAA publications are discussed in this section: Airman's Information Manual, FAA Regulations, Location Identifiers Handbook, Contractions Handbook, Terminal Air Traffic Control Handbook, Enroute Air Traffic Control Handbook, Flight Services Handbook, Certification and Rating Handbook, Advisory Circulars and Special Military Operations.

AIRMAN'S INFORMATION MANUAL (AIM)

The Airman's Information Manual has been designed as a pilot's operational manual for use primarily within the conterminous United States.

All ACs should be familiar with this manual for ready reference when assisting pilots as it contains a wealth of data related to ATC functions.

Use of the AIM is part of the practical test for obtaining a Facility Rating in accordance with FAR Part 65. The manual is divided into four parts (issued separately), each of which is described in the following paragraphs.

Part 1, Basic Flight Manual and ATC Procedures

This part is issued quarterly (FEB, MAR, APR, NOV) and contains basic fundamentals which are required for flying in the U.S. National Airspace System; adverse factors affecting safety of flight; health and medical facts of interest to pilots; ATC information affecting rules, regulations and procedures; a glossary of aeronautical terms; Air Defense Identification Zones (ADIZs); designated mountainous areas; SCATANA; and emergency procedures.

Part 2, Airport Directory

This part is issued semiannually (MAR and SEP) and contains a directory of airports, seaplane bases, and heliports in the conterminous U.S., Puerto Rico, and the Virgin Islands which are available for transient civil use. It includes all of their facilities and services, except communications, in codified form. Those airports with communications are also listed in Part 3, which reflects their radio facilities. A list of new and permanently closed airports which updates this part is contained in Part 3.

Included also are listings of Flight Service Station (FSS) and National Weather Service (NWS) telephone numbers; U.S. entry and departure procedures, including airports of entry and landing rights airports.

Parts 3 and 3A, Operational Data and NOTAMs

Part 3 is issued every 56 days and contains a master index covering all parts of the Airman's Information Manual; an airport/facility directory containing a list of all major airports with control towers and/or instrument landing systems; a tabulation of air navaids and their assigned frequencies; preferred routes; standard instrument departures (SIDs); standard terminal arrival routes (STARs); substitute route structures; a sectional chart bulletin, which updates sectional charts cumulatively; special, general, and area notices; a tabulation of new and permanently closed airports, which updates Part 2; area navigation routes; and supplementary data to Part 4.

Part 3A is issued every 14 days and contains NOTAMs considered essential to the safety of flight as well as supplemental data to Part 3.

Part 4, Graphic Notices and Supplemental Data

Part 4 is issued quarterly (JAN, APR, JUL, OCT) and contains a list of abbreviations used in the AIM; parachute jump areas; VOR receiver check points; restrictions to enroute navaids; special notice-area graphics; Heavy Wagon and Olive Branch routes; terminal area graphics and other pertinent data not requiring frequent change.

FEDERAL AVIATION REGULATIONS (FARs)

The Federal Aviation Regulations and their amendments are issued by the FAA. These regulations are too numerous to be listed here; however, those parts which are more directly related to the AC's work were listed in chapter 3 of this manual.

LOCATION IDENTIFIERS HANDBOOK 7350.1 (SERIES)

A location identifier is a three-letter or other code suggesting, whenever practicable, the location name of the place it represents. Usually the first letter of the code is the initial letter of the location name. A code with the initial letter of the location name is not always assignable because of the large number of assigned codes. All three-letter identifiers assigned to Navy and Marine Corps air stations begin with the letter N.

This handbook incorporates all authorized three-letter location identifier assignments worldwide, the Canadian Government location identifier assignments, and special use assignments within the United States and areas under its jurisdiction.

CONTRACTIONS HANDBOOK 7340.1 (SERIES)

This handbook contains the approved word and phrase contractions used by personnel of FAA and other agencies that provide air traffic control, communications, weather, charting and associated services.

A contraction is a word or phrase represented in shortened form for the purpose of brevity. Contractions are developed by omitting letters, sounds, or syllables from words or phrases. They save space on telegraphic circuits, charts, reports, etc. Three-letter contractions that might conflict with location identifiers are always avoided.

The more common contractions used in telegraphic communications can be easily and quickly memorized. However, the entire list of contractions is so long that the manual must be referred to quite frequently.

TERMINAL AIR TRAFFIC CONTROL HANDBOOK 7110.8 (SERIES)

This handbook prescribes air traffic control procedures and phraseology for use by personnel providing terminal air traffic control services. It is one of the air traffic control manuals referred to in FAR Part 65. Controllers are required to be familiar with the provisions of this handbook which pertain to their operational responsibility and to exercise their best judgment if they encounter situations not covered by it.

Air Traffic Control Facilities Manual, OPNAV Instruction 3721.1 (Series) directs that the procedures contained in this handbook be used by U.S. Navy shore activities when performing air traffic control functions.

EN ROUTE AIR TRAFFIC CONTROL HANDBOOK 7110.9 (SERIES)

This handbook prescribes air traffic control procedures and phraseology for use by personnel providing en route air traffic control services.

Should your facility operate in an en route capacity, this manual should be referred to for procedures.

FLIGHT SERVICES HANDBOOK 7110.10 (SERIES)

This handbook consists of two parts. Part I, the basic part, prescribes procedures and phraseology for use by personnel providing flight assistance and communications services. Part II, the teletypewriter portion, includes services A and B teletypewriter operating procedures, pertinent International Teletypewriter Procedures, and the conterminous U.S. Service A Weather Schedules.

This handbook is primarily for Flight Service Specialists at FAA FSSs. However, certain portions contain information of use to the Navy AC that is not found in the Terminal Air Traffic Control Handbook. Of particular interest is Chapter 8, Flight Handling. This chapter describes the flight plan handling of military flight plans via FAA communications systems, and what action is taken when a flight is overdue or missing.

CERTIFICATION AND RATING HANDBOOK 7220.1 (SERIES)

This handbook governs the certification and rating of FAA Air Traffic Service Specialists and civil personnel engaged in air traffic control. It also governs those military and foreign national personnel who participate in the Air Traffic Service certification and rating program.

ADVISORY CIRCULAR

FAA issues advisory circulars to inform the aviation public in a systematic way of nonregulatory material previously issued in a wide variety of manuals, circular letters, aviation safety releases, etc. Advisory circulars are issued in a numbered-subject system, corresponding to the subject areas in the Federal Aviation Regulations.

An index of Advisory Circulars may be obtained by writing to: Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

NOTE: Advisory circulars are not applicable to naval air traffic control facilities unless such procedures are promulgated by naval directives.

SPECIAL MILITARY OPERATIONS HANDBOOK 7610.4 (SERIES)

This handbook specifies procedures for air defense activities in air traffic control service and other special military operations and services provided by air traffic control.

FEDERAL METEOROLOGICAL HANDBOOK #1 SURFACE OBSERVATIONS (FMH #1)

This handbook is promulgated within the Navy as NavAir 50-1D-1. It has been approved by appropriate personnel of the Departments of Commerce, Defense, and Transportation.

The handbook describes weather elements and how they are observed. The latter part of the handbook is devoted to types of observations, pilot's reports, and the determination, coding requirements, and dissemination of weather reports.

FLIGHT INFORMATION PUBLICATIONS

This program was designed using the concept that there are basically three separate phases of flight—flight planning, en route operations, and terminal operations. No one document contains all the information which may be required for a flight. FLIP Planning, planning charts, en route charts and supplements, instrument approach procedures and NOTAM files must be consulted prior to flight. In planning for international flights, reference must also be made to the Foreign Clearance Guide. This chapter contains a general outline and description of each publication included in the FLIP program.

FLIP PLANNING

FLIP Planning is presented in a completely new format. It is functionally arranged into two parts: General Planning (GP) and Area Planning (AP).

The General Planning Book contains general information on all FLIPs, explanations of The Divisions of The Airspace, Meterological Data, Time Signal Information, Terms and Abbreviations and Worldwide Conversion Tables. Much of the information which was duplicated in the previous Section IIs has been transferred to the General Planning Book. It also includes information on Flight Plans and Pilot Procedures that have common worldwide application plus information pertaining to ICAO Procedures.

The Area Planning Books contain planning and procedural data for specific geographical areas of the world. Essentially these books include those Theatre, Regional and National procedures which differ from the standard procedures adopted within ICAO. The previous Sections IIA and IIB have remained relatively unchanged except for titling. New features include:

1. The General Planning and Area Planning Books are now divided into chapters. Pages and major paragraphs are numbered accordingly to provide an easier reference when utilizing the Table of Contents.
2. Special Notices have been moved to the inside front cover of each publication.
3. Numerous items previously published in FLIP Planning have been deleted. This includes those items for which there is no longer an operational requirement, items which already appear in other FLIP Products, or material which is already published in a current service manual, directive, regulation or similar document. Many items were removed and will be placed in the applicable IFR Supplement because of the "in-flight" nature of the material.

A complete FLIP Planning for the entire area of coverage is comprised of sections as listed below. An area-of coverage chart will be on the back cover of all planning documents with the exception of AP/1B. Separate divider cards are provided for convenience in filing and in use of amendments.

General Planning

Published every 24 weeks, this section contains general information on all FLIPs, explanation of the Divisions Of Airspace, flight plans and codes, common worldwide pilot procedures, ICAO procedures, meteorological data, time signal information, terms and abbreviations and worldwide conversion tables.

Area Planning (AP/1, 2, and 3)

Published every 12 weeks, this section contains planning and procedures information for a specific geographic area.

Area Planning (AP/1A, 2A, and 3A)
(Special Use Airspace)

Contains a tabulation of all prohibited, restricted, danger, warning and alert areas, intensive student jet training areas, military training areas, and known parachute jumping areas. It is published on the following cycles:

Europe/Africa/ Middle East	Every 12 weeks
Scheduled PCNs	Every 4 and 8 weeks
North and South America Book	Every 16 weeks
Scheduled PCNs	Every 4, 8, and 12 weeks
Pacific/Australasia/ Antarctica Book	Every 16 weeks
Scheduled PCNs	Every 4, 8, and 12 weeks

Area Planning (AP/1B)
(Military Training Routes, United States)

Published every 12 weeks, it contains information relative to military training routes, including Olive Branch Routes, VFR Low Altitude High Speed Training Routes (LAHSTR) and refueling tracks and areas. Charts (6 charts on 3 sheets) containing graphic descriptions of the LAHSTR System throughout the United States are also included. This section is updated by PCNs every 4 and 8 weeks.

Planning Change Notice (PCN)

FLIP Planning is updated by PCNs or replacement pages. PCNs should be filed in front of the appropriate FLIP Planning after annotating the affected paragraph with a reference to the PCN, e.g., see PCN, dated 18 August 1975.

FLIP, PLANNING CHART—LOW ALTITUDE—U.S.

The IFR Wall Planning Chart consists of two sheets. It covers East and West U.S. and contains required information for preliminary flight planning.

There are also FLIP Planning Charts for both low and high altitude available for Europe and North Africa.

EN ROUTE AND TERMINAL PUBLICATIONS

FLIP en route and terminal publications are designed to provide airway structure, radio navigation, letdown, approach, and landing information for use during the in-flight phase of IFR operations. The FLIP En Route Supplement supports these publications with supplemental aerodrome, facility, communication, and procedural information. En route and terminal publications are available for all areas of the world, but only those applicable to the U.S. are discussed herein. ACs should refer to FLIP General Planning Section I, or the publications themselves, for more detailed information.

Standard Instrument Departures (SID)

SID charts are published either as individual charts or as a bound booklet containing departure air traffic control instructions in a pictorial form, for departure from an individual aerodrome.

FLIP En Route Low Altitude—U.S.

These charts portray the airway system and related data required for IFR operation at altitudes below 18,000 MSL. Twenty-six variable scale charts are printed on 13 sheets, L-1 through L-26, covering the entire U.S. An additional sheet, containing charts L-27 and L-28, which duplicate data shown on L-20, L-22, L-24, and L-25, is available for those who frequently plan flights north and south along the east coast within the area of coverage.

The effective date and the expiration date are shown on the cover of each item. Major changes to the airway structure and procedures are scheduled by the FAA to become effective on a specific date, once every 4 weeks. Charts are revised accordingly and show the date this information is effective. Charts, therefore, should not be used prior to the effective date. Other information, such as frequencies, hours of operation, etc., is not scheduled and changes occur daily. Action is taken to update this data during the revision cycle, but it has to be terminated 15 days before the projected effective date of the issue under revision to permit printing and timely distribution to users. NOTAMs must be consulted for the latest information on data changing after the cutoff date and during the life of the current charts.

FLIP En Route High Altitude—U.S.

These charts portray the jet route system and related data required for IFR operations at and above flight level 180. Four constant scale charts are printed on two sheets. These charts may be assembled to form a wall planning chart for high altitude.

FLIP En Route IFR Supplement—U.S.

This supplement is a bound booklet containing an alphabetical listing of all IFR aerodromes, integrated with an alphabetical listing of all navaids and ARTCC facilities. Also published are brief presentations of such items as ADIZ, direction finding, IFR emergency procedure, position reporting, two-way radio failure, and other information.

FLIP En Route VFR Supplement—U.S.

This supplement is a bound booklet containing an alphabetical listing of selected VFR aerodromes and cross-references to IFR aerodromes as published in the IFR supplement. Also included are city/aerodrome cross-reference listings, VFR special notices, and visual air/ground emergency procedures, and aerodrome sketches arranged in alphabetical order by aerodrome name. These sketches are designed as a visual aid to visual identification of aerodromes.

FLIP Terminal High Altitude—U.S.

These publications consist of four bound booklets, each covering a certain geographic area of the U.S.

They contain high-altitude instrument approach procedures combined with an aerodrome sketch with additional data as deemed necessary for an approach under IFR conditions.

Transitional information from the jet route structure to the terminal facility has been added to charts covering the U.S.

FLIP Terminal Low Altitude—U.S.

These publications consist of nine bound booklets, each covering a certain geographical area of the U.S.

They contain low-altitude instrument approach procedures combined with an aerodrome sketch with additional data as deemed necessary for an approach under IFR conditions.

Military Aviation Notice (MAN)

This publication is used to update the U.S. Low Altitude Terminal FLIP (9 volumes). It is published at the mid-point of the publication cycle for the Low Altitude Terminal FLIP (28 days).

The contents of MAN will include revised, added or deleted instrument approach procedures (IAPs). The effective date of this publication is indicated on the front cover.

Foreign Clearance Guide

The Foreign Clearance Guide is a group of bound booklets, including a general information section. The Foreign Clearance Guide is the official publication for disseminating USAF worldwide foreign clearance requirements and information on personnel travel; aircraft movement to, from, and between foreign areas; and transport of material aboard aircraft. It is also used by the Navy and Army. Revised area booklets and general information sections are issued on a semiannual and quarterly basis. The Foreign Clearance Guide Change Notices (FCCN) are issued monthly. These notices contain a cumulative listing of all permanent and temporary changes not yet incorporated in the booklets. A classified supplement is issued quarterly. Teletype Interim Changes Notices (ICN) are dispatched as required to selected addressees who require immediate notification of changes to the Guide.

DOD Catalog of Aeronautical Charts and Flight Information Publications

This catalog is a looseleaf publication, which provides a complete listing of DOD/USN/USAF aeronautical charts, flight information publications, and miscellaneous items available to DOD users. It includes indexes of available items, together with descriptive information for each item and requisitioning procedures. In this publication will be found added detail regarding publications produced by other agencies, and available for DOD usage (such as ICAO documents). A classified supplement is also available.

DOD Aeronautical Chart Updating Manual (CHUM)

This manual is published monthly to provide a cumulative listing of significant additions or corrections to be considered when using current editions of USAF/USN published aeronautical charts. It is used to update charts other than those contained in the FLIP series and contains notices of special interest to aeronautical chart users. It should be made available to flight crews during preflight planning.

DOD Aeronautical Chart Bulletin

This is also a monthly publication to inform activities of the availability of new aeronautical charts and publications, new additions of previously published charts, discontinued charts, and notices of special interest to requisitioners of aeronautical charts. The chart bulletin may be placed in front of the DOD Catalog of Aeronautical Charts and Flight Information Publications for ready reference during preflight planning.

New issues of the Bulletin do not make prior issues obsolete. The most recent six issues of the Bulletin become obsolete by each subsequent publication of the DOD Aeronautical Chart Bulletin Digest.

DOD Aeronautical Chart Bulletin Digest

This bulletin is published semiannually to provide activities with a listing of current editions of charts on issue. This information is provided so a check can be made of charts on hand to assure that editions carried are up-to-date.

NAVY PUBLICATIONS

AIR TRAFFIC CONTROL FACILITIES MANUAL, OPNAVINST 3721.1 (SERIES)

This manual encompasses the administrative and operational procedures applicable to the operation of naval ATC-facilities on a worldwide basis.

Included are procedures governing the operation of ATC facilities and airfields; control tower functions; information pertinent to approach control responsibilities; billet descriptions and operating positions for the various ATC branches associated with an air traffic control facility; and a listing of selected air traffic control instructions, both military and civil.

GENERAL FLIGHT AND OPERATING INSTRUCTIONS MANUAL, OPNAVINST 3710.7 (SERIES)

This manual prescribes general flight and operating instructions and procedures applicable to the operation of naval aircraft and related activities.

Chapters containing information relative to Flight Authorization, Planning, and Approval; Flight Rules; and Air Traffic Control are of direct interest to the AC 3 & 2.

ACs should familiarize themselves with the appropriate parts of this manual since it is applicable to the naval establishment and compliance with the procedures is mandatory.

NAVAL AIR TRAINING AND OPERATING PROCEDURES STANDARDIZATION (NATOPS) MANUAL CVA/CVS

This manual is published under the authority of CNO as part of the NATOPS program. Extensive coverage of CCA operating procedures and responsibilities is included.

NAVAL AIR TRAINING AND OPERATING PROCEDURES STANDARDIZATION (NATOPS) MANUAL LPH

Published under the authority of CNO, this manual standardizes the procedures for the control and handling of aircraft (helicopters) aboard Amphibious Assault Ships (LPHs).

Of primary interest to the AC is the coverage pertaining to the functions of the Air Operations Control Center/Helicopter Direction Center (AOCC/HDC).

AIR OPERATIONS MANUAL

OPNAV Instruction 3721.1 (Series) sets forth a basic outline for preparing standard Air Operations Manuals. These manuals are prepared locally under the supervision of the commanding officers of the air stations, and they must be signed by the commanding officers.

These manuals contain specific information and instructions for the control of aircraft and aircraft-handling equipment in use at the field, instructions relating to transient aircraft and personnel, and procedures for crash and rescue. The Operations Manual should be read and understood by all Air Controlmen soon after reporting to a new duty station so as to become familiar with types of local operations and facilities.

DIRECTIVES

Directives pertinent to policies, operating procedures, etc., are set forth in the form of instructions and notices by authorities in the chain of command. Each activity maintains a current file of those instructions and notices directly related to air traffic control. ACs should familiarize themselves with all such directives which in any way pertain to their rating.

MEMORANDUM FOR AVIATORS

This publication is published when necessary to disseminate urgent information or information of a temporary nature concerning dangers and aids to navigation.

TECHNICAL MANUALS

In all phases of work, the Air Controlman operates different types of electronic equipment designed for use in air traffic control. To efficiently and effectively use these different types of equipment, the Air Controlman must know where to find information describing proper equipment operating procedures. With such technical assistance and instruction from experienced personnel, the time required to become familiar with a particular piece of equipment may be shortened. Equipment familiarity is necessary to be a good controller since one must have confidence in his ability to operate and in the performance of the equipment.

There is a technical manual published for each electronic equipment system. This manual should be available in the local ground electronics shop. One chapter in each manual is devoted to operation. Such chapters contain information necessary for operating personnel to start, operate, and stop the equipment.

RECORDS AND REPORTS

While performing duties in the different fields of the rating, certain records, reports, operating logs, and equipment logs are maintained by the Air Controlman. With the exception of a few, there is no standard authorized format to be employed in the maintenance of these records. However, the general contents of many are the same. The reports, records, and logs discussed in this chapter are the ones that are maintained by control towers, operations offices, and radar facilities.

CONTROL TOWER LOG

This record or log is kept from watch to watch in all Navy control towers. It contains all of the pertinent data accumulated during each watch performed in the control tower. A partial listing of the data that is entered indicates status of equipment, check of communications, status of airport lighting facilities, runway or runways in use, and any other information deemed necessary by the control tower officer, chief, or section leader of the tower concerned. The items listed above are not standard throughout the Navy, but they serve to indicate certain items which should be contained in the control tower log.

At many facilities it is an accepted practice to make an entry in the tower log of the weather when the watch is changed and at anytime the field goes from VFR to IFR weather conditions or vice versa.

Additionally, many facilities log entries of emergencies and crashes in the tower log in red ink. All details of such incidents with the associated time of occurrence are included for later reference.

DAILY AND MONTHLY TRAFFIC TABULATION

To facilitate completion of certain reports required of the ATC Division, a daily and monthly tabulation of aircraft operations is necessary. One system commonly used is posting flight progress strips (described in chapter 5) on each operation. At midnight a traffic count is made from the strips, and subsequently a monthly count is made. These strips are kept for 3 months before they are destroyed. If any strip contains information on an aircraft involved in an accident or emergency, it is kept for a longer period of time.

This same basic procedure may also be employed by personnel assigned to the planning/approval branch and at the approach control position; however, different data is required in these areas.

In addition to the previously described data, radar facilities are required to maintain a record of all radar approaches conducted by both military and civil aircraft, under IFR and VFR conditions.

A compilation of all operations, is submitted semiannually to the Chief of Naval Operations with a copy sent to the Federal Aviation Administration.

This report is referred to as the Air Traffic Activity Report (OPNAV Form 3721/12). Instructions for completing this report are contained in the ATC Facilities Manual, OPNAV-INST 3721.1 (Series).

FLIGHT PLANNING/APPROVAL BRANCH LOGS AND RECORDS

The flight approval office is the central point for processing aircraft movement and related messages. This office must maintain various records, logs, and files connected with air operations. Examples of information on file include SCATANA action forms, Facility License for civilian concerns, VIP notification procedure, telephone numbers of other departments that furnish services required by transient aircrews, FLIPs, and FAA publications required in daily functions. Examples of records kept are flight plans (DD 175s) filed with flight clearance, flight progress strips, and teletype messages.

Duty Dispatcher's Log

The duty dispatcher's log is maintained at the flight approval desk from watch to watch. Personnel assuming the watch enter in the log their name, the date, and time the watch is being performed. Example of entries made in such a log are crash phone check, time checks, intercommunications checks, and any other data pertinent to operations that transpire during the watch.

PASS DOWN THE LINE (PDL)

This type of log may be maintained for the purpose of passing instructions from crew to crew and to ensure that night crews have access to information, etc. put out by the branch officer/supervisor. Also it may be used to relay local verbal standing or temporary orders issued by the division or operations officer. It is generally an informal type of log strictly for the purpose of getting the word to everyone.

FLIGHT DATA AND STATUS BOARDS

To reduce the constant answering in the flight approval office of questions from the general public, flight data and status boards are useful tools to the Air Controlman. The actual size, shape, and construction, as well as the manner in which the information is portrayed, undoubtedly may vary from station to station. However, the information normally displayed on the flight data board for inbound flights is as follows:

1. Bureau number.
2. Type of aircraft.
3. Point of departure.
4. ETA.
5. Pertinent remarks.

Status boards are usually of the type which shows the present status of the various navigational aids at the particular station. It is also possible that an additional status board may be maintained by the Air Controlman at stations assigned aircraft for search and rescue purposes. This type of status board normally contains information as to the flight status of the aircraft assigned and pertinent information concerning the crew.

Status boards may be maintained in a radar facility control room showing the area of responsibility and adjoining airspace, airways and jet routes, SIDs, fixes, handoff points, holding points and holding pattern airspace areas, and the published approaches available for reference at operating positions.

When assigned the duty of maintaining any status board, remember that the information is important and should be kept neat, accurate, and current at all times.

SECURITY

It has been said, "There is no such thing as peace. It is only the interim between wars." A study of history indicates that most wars are carefully planned long before the first shot is fired. During this so-called peaceful period, nations are engaged in the collection and evaluation of all forms of intelligence material from potential enemies.

In peacetime, people tend to relax; security is sometimes ignored. This tendency makes it easier for a potential enemy to gather information concerning our capabilities and intentions.

PURPOSE OF THE SECURITY PROGRAM

Basically, the purpose of the security program is to protect classified material from unauthorized disclosure.

It is the responsibility of every officer and man in the Navy to safeguard classified information. The AC must be especially vigilant since he frequently comes in contact with classified material.

SECURITY MANUAL

The Department of the Navy Security Manual for Classified Information, OPNAVINST 5510.1 (Series) is designed to furnish standards for handling classified matters. The manual itself does not guarantee security but makes security more readily attainable. Detailed instructions pertaining to the handling of classified matter can be found in this manual.

It must be remembered, however, that there is no adequate substitute for continuous day-to-day practice in the proper methods of handling classified material.

SECURITY PRINCIPLE

The Department of Defense employs a security formula which is simple in principle. It is based on the theory of circulation control—the control of the dissemination of classified information. Therefore, knowledge or possession of classified information is permitted only to those who actually require it in the performance of their duties, and then only after they have been granted the appropriate security clearances. This principle is generally referred to as a "need to know," and is a prime requisite for access to classified information.

Access to classified material is not automatically granted because a person has the proper clearances, holds a particular billet, or is sufficiently senior in authority, but only if the criteria of proper clearance and "need to know" are both met.

LIMITATIONS OF SECURITY

Security is a means—not an end. Rules which govern security of classified matter are much the same as gunnery safety rules. They do not guarantee protection, and they do not attempt to meet every situation.

Security regulations are not intended to restrict the initiative of mature individuals. With common sense and mature thinking, it is possible to obtain a satisfactory degree of security with a minimum of sacrifice in operating efficiency.

CLASSIFICATION CATEGORIES

Official information which requires protection in the interest of national defense is limited to one of three categories: Top Secret, Secret, or Confidential. No information may be withheld or classified, if otherwise releasable, simply because such information might reveal an error or inefficiency or might be embarrassing.

Top Secret

The use of the classification Top Secret is limited to defense information or material which requires the highest degree of protection. Top Secret is applied only to that information or material, the defense aspect of which is paramount and the unauthorized disclosure of which could result in EXCEPTIONALLY GRAVE DAMAGE to the Nation, such as the following:

1. Leading to a break in diplomatic relations, armed attack on the United States or its allies, or a war.
2. The compromise of military plans or scientific or technological developments vital to the national defense.

Secret

The use of the classification Secret is limited to defense information or material, the unauthorized disclosure of which could result in SERIOUS DAMAGE to the Nation, such as the following:

1. Jeopardizing the international relations of the United States.
2. Endangering the effectiveness of a program or policy vital to the national defense.
3. Compromising important military or defense plans, scientific or technological developments important to national defense.
4. Revealing important intelligence operations.

Confidential

Information or material classified Confidential is placed in the category whose unauthorized disclosure could be PREJUDICIAL to the defense interest of the Nation.

If it is desired to understand more thoroughly the various categories of classified matter, the Security Manual has a number of examples in each category. However, the most important thing to be learned at this time is that each category represents a degree of damage to the Nation that could be done by letting this material get into the hands of unauthorized persons. The category also determines how the material is handled and the measures used for its protection, as will be seen later in this chapter.

Special Categories

Theoretically, the three classifications discussed should safeguard any information desired. However, there are several other safeguards prescribed for use. These are not security classifications, as such, but indicate an increased degree of security to be applied when handling items thus marked.

Restricted Data

Restricted Data is assigned to documents or material concerning the design, manufacture, or utilization of atomic weapons; the production of special nuclear material; or the use of special nuclear material in the production of energy, unless such data or materials have been removed from this category by the Atomic Energy Commission.

For Official Use Only

"For Official Use Only" is assigned to official information which requires protection in accordance with statutory requirements or in the public interest, but which is not within the purview of the rules for safeguarding information in the interest of national defense. Its description, use, and limitations are set forth in the effective edition of SECNAVINST 5570.2 (Series).

Special Handling Required/Not Releasable To Foreign Nationals

The term "Not Releasable to Foreign Nationals" is assigned to classified documents to prevent inadvertent disclosure to foreign nationals. This term is often abbreviated within the Intelligence Community as NOFORN, and when assigned to classified documents it indicates: (1) that the documents are furnished for the exclusive use of the U.S. military representatives on international staffs or in similar circumstances; (2) to holders and other handling personnel that the documents involved have already been reviewed by the office of origin or other responsible authority, and that disclosure to foreign nationals is subject to special restrictions.

Another control marking used to help prevent inadvertent disclosure to foreign nationals is NO FOREIGN DISSEM. This control marking is used when it is determined by the originator of a classified intelligence document that the intelligence information contained therein must not be released for foreign nationals or foreign governments in any form.

Classified intelligence documents or non-intelligence documents, even though they bear no control markings, may not be released to foreign nationals or foreign governments without prior approval of the Chief of Naval Operations. Therefore, all classified documents, whether so marked or not, are NOFORN.

Special Access Programs

"Special Access Programs" are thos programs identified with specific projects or subjects requiring security protection or handling not guaranteed by the normal security classification and requiring that the program materials be handled and reviewed only by specially cleared or authorized personnel.

The administrative responsibility for any special access program rests with the command having the need for a special access program.

METHODS USED TO SUBVERT U.S. MILITARY PERSONNEL

The methods used by foreign intelligence agents to subvert U.S. Military personnel are many and varied. A few of the more common methods are mentioned in the following paragraphs to alert the AC to the possible dangers of entrapment.

In recent years foreign agents have shown considerable success in "hooking" Americans and their allies by a variety of methods. In many instances these entrapments have occurred because of the gullibility, carelessness, ignorance or recklessness of the personnel concerned. During recent years, it has become more and more common for U.S. Military personnel to visit foreign countries. This has come about either due to military commitments or simply because foreign travel during leave periods has become more popular. Also, more and more foreign visitors come to the United States. We must therefore expect that both at home and abroad there will be a continuing and perhaps increasing chance that apparently innocent contacts can become an inadvertent compromising situation where classified information is concerned.

Some examples of methods used to place unsuspecting individuals in compromising situations are: flattering him, praising his ideas; doing everything for him, so that after a while he comes to depend on the agent and his fellows for friendship and support; catching a person in an embarrassing situation or staging such a situation and then blackmailing him; bribing a man to do something that appears relatively innocuous, and then holding forth threats of exposure plus bigger bribes in order to get him to perform more serious acts; threatening a person with harm to himself or his relatives.

A classic instance of entrapment by foreign agents, which has been repeated many times, goes as follows: The individual has gotten drunk (or drugged) at a tavern or party, or is invited to a woman's (or man's) apartment. Then he is photographed and threatened with blackmail. Often the agent will not use the blackmail material right away, but wait years in the hope that the person will rise to a position of greater influence or of access to important information. Or, the agent will ask for just a small favor and pay money for it; this is done in order to have even stronger blackmail leverage against a person who might decide to face the consequences of his misbehavior—voluntary or forced.

In some instances foreign agents, or their police, have arrested people, accusing them of espionage, stealing, or immorality. The agents plant the evidence on the person and then claim that when he returns home—if ever—no one will believe he was innocent. Next, the agents arrange a deal whereby the person will be released if he will do something for them. This act can be quite innocent appearing, but later becomes a means of blackmail.

Service men should be alert to possible traps; they should avoid being alone in certain areas, especially overseas, and they should not ask for trouble by going into various locations—out of curiosity, bravado, or ignorance.

Communist and other foreign agents have proved that they are willing to "play dirty ball" and their methods have ranged from subtle, long term corruption, to quick, blatant blackmail methods. Air Controlmen who have access to classified matters and whose actions can be exploited for propaganda purposes are prime targets. Navy men must be alert, and careful in their conduct, and should report any unusual contacts or invitations to their superiors.

VIOLATIONS AND COMPROMISES

Any person having knowledge of the loss or possible compromise of classified matter must report the fact immediately to his commanding officer. The commanding officer then takes the proper action as outlined in detail in chapter 6 of the Security Manual.

Violations of regulations pertaining to the safeguarding of classified information, but not resulting in its loss, compromise, or disclosure, are acted upon by the commanding officer.

It must always be remembered that the officer is responsible for classified material in his care. Anyone who mishandles classified material is disciplined by his commanding officer or by a court-martial, depending on the circumstances.

PERSONAL CENSORSHIP

There is no way of estimating how many battles have been lost, how many ships were sunk, or how many lives were sacrificed because someone casually, or in a moment of boasting, unintentionally betrayed a vital military secret.

It is quite natural for a man to be proud of the work he is doing. He wants to share this pride with his friends and family. Enthusiasm toward one's work is clearly a desirable trait, but not when it results in discussing classified information.

To maintain security one should decline to discuss official matters by skillful maneuvering of the conversation or by outright refusal to talk shop.

CUSTODY

Safekeeping

The first obligation of any person working with classified material is to protect that material. Top Secret, Secret, or Confidential material may neither be removed from its designated working space without approval of competent authority nor left unguarded. It is kept locked in its proper accommodation, for a single glance at a classified intelligence plan might compromise the entire plan. Another danger is that a photograph might be taken in a split second with a concealed camera.

It has been stated that the Navy's security system operates on the principle of "need to know." It is essential, then, that combinations and keys to classified containers be known only to those who are actually using the material in their work. To ensure this, certain rules must be followed.

The combination or key to a security container should be changed at the time it is received, at the time of transfer of any person having knowledge of it, at anytime there is reason to believe it has been compromised, or in any case at least once every 12 months.

If a container in which classified material is stowed is found unlocked in the absence of assigned personnel, it should be reported immediately to the senior duty officer. The unlocked container must be guarded until the duty officer arrives at the scene. The duty officer then inspects the classified material involved, locks the container, and makes a security violation report to the commanding officer. Appropriate further action is taken by the commanding officer.

It should be noted that other government agencies, such as the Air Force, do not use the Numerical Evaluation System presented in chapter 6 of the Security Manual for determining custody allowances for classified material, and when assigned to joint commands it is advisable to determine the governing security regulations in effect there.

Accounting

Except for publications containing a distribution list by copy number, all copies of Top Secret Documents must be serially numbered at the time of origination in the following

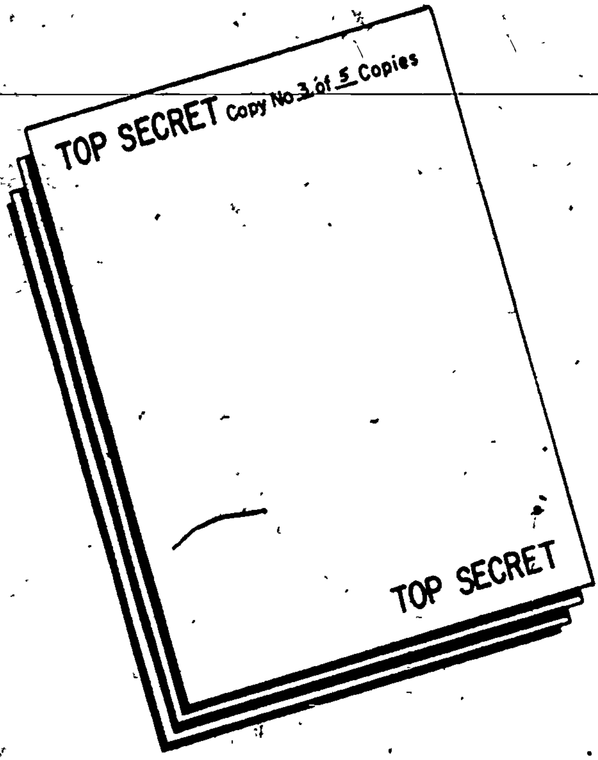

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Figure 14-1.—Numbering of classified copies.

manner: "Copy No._____of_____copies." (See fig. 14-1.)

A list of all persons having knowledge of a particular item of Top Secret information must be maintained and a continuous chain of receipts kept to ensure positive control. The control of Top Secret material is the duty of the Top Secret Control Officer.

Commanding officers establish administrative procedures for recording all Secret material originated and received, and maintain a receipting system for all Secret material distributed or routed to activities within their commands. As a general rule, Secret materials are also serially numbered.

Commanding officers also provide accountability for all Confidential materials originated or received by their commands.

CUSTODIAL PRECAUTIONS

Each individual in the Naval Establishment should take every precaution to prevent deliberate or casual access to classified information by unauthorized persons. Some of the precautions are discussed in this section.

When classified materials are removed from stowage for working purposes they should be kept face down or covered when not in use.

Visitors not authorized access to the particular classified information within a working space should be received in a specially designated visiting space.

Classified information should never be discussed over a telephone. Remember also that a telephone scrambler device does not ensure security.

If, for any reason, a room must be vacated during working hours, all classified material in the room must be locked in its proper stowage containers.

At the close of the working day a system of security checks should be carried out to ensure that the classified material is properly protected. All classified material must be properly stowed. All classified material which must be passed from watch to watch has to be properly accounted for. All burn bags should be burned or properly stowed. The contents of wastebaskets which contain classified material must be burned or stowed. All classified notes, rough drafts, and similar papers are placed in the burn bag during the day as a matter of routine.

Personnel concerned with locking combination locks or safes must remember to rotate the dial of all combination locks at least four turns in the same direction when securing them. In most locks, if the dials are given only a quick twist, it is generally possible to open the lock merely by turning the dial back in the opposite direction. Also, responsible personnel are assigned to check all drawers of safes and file cabinets to assure that they are held firmly in the locked position when secured.

In the event of a fire alarm or other emergency, classified material is stowed in the same manner as at the end of a working day. Each person who has classified material in his possesion at the time of a fire alarm or other emergency assures that the material is properly safeguarded.

Other examples of handling classified material during emergencies are discussed in the Security Manual.

DISPOSITION OF CLASSIFIED MATERIAL

When military personnel resign or are to be separated from the Navy or released from active duty, all classified material held by them is turned in to the source from which it was received, to their commanding officer, or to the nearest naval command, as appropriate, prior to the delivery of final orders or separation papers.

Personnel to be separated from the Navy or to be released to inactive duty submit to their commanding officer a signed statement to the effect that they have turned in all classified material. Also, they are instructed that they are not to reveal classified information, of which they might have knowledge, even after discharge.

TRANSMISSION OF CLASSIFIED MATERIAL

Any time material leaves the hands of an originator and is sent on its way to the addressees, it is TRANSMITTED. Whether it goes by courier, by radio, or by mail, if it is classified, it has to be safeguarded. The only possible way to obtain absolute transmission security is to refrain from communications over an extended period. Of course, this is impossible. Since the AC may be involved in the production of classified material, it follows that he will also be concerned with its transmittal. Therefore, it is necessary that he have a thorough understanding of the rules for transmitting classified material.

Method of Transmission

Top Secret material may be transmitted by direct personal contact of officials concerned, Armed Forces Courier Service, or electric means in encrypted form. Top Secret material must not be transmitted through the United States postal system or any foreign postal system.

Secret material may be transmitted in any of the means approved for transmittal of Top Secret material and by United States registered mail. Confidential material is handled in the same manner as Secret.

Preparation of Material For Transmission

Whenever classified material is transmitted by other than electrical means in encrypted form, it must be enclosed in two opaque sealed containers. As long as this requirement is observed, the material may be wrapped, boxed, or crated, or a combination thereof.

Classified written material must be folded or packed in such a manner that the text will not be in direct contact with the inner container. A receipt form must be attached to or enclosed in the inner container for all Top Secret and Secret material. Confidential material will require a receipt only if the originator deems it necessary.

The mailing of written materials of different classifications in a single package should be avoided whenever possible. When it is unavoidable to send material of more than one classification in a single package, the inner container must be marked with the highest classification of the contents.

The inner container must show the address, classification (including where appropriate the "Restricted Data" marking), and any applicable special instructions. It must be carefully sealed to minimize the possibility of access without leaving evidence of tampering.

The outer container must show the complete and correct address and the return address of the sender. This may be omitted for shipments in full truckload or carload lots.

The outer container must not bear a classification marking, a listing of the contents divulging classified information, or any other unusual data or marks which might invite special attention to the fact that the contents are classified.

DESTRUCTION OF CLASSIFIED MATERIAL

Classified material not required by a command must not be allowed to accumulate but must either be turned in to the appropriate office or be destroyed.

Top Secret, Secret, and Confidential material may be destroyed by burning, melting, chemical decomposition, pulping, pulverizing, or shredding, provided destruction of the classified material is complete and reconstruction is impossible.

CLASSIFIED MATERIAL DESTRUCTION RECORD
OPNAV FORM 5511-12 (Rev. 5-58)

CLASSIFICATION*
UNCLASSIFIED

TO: COMMANDER SIXTH FLEET

FROM (Name and address of activity)
USS INDEPENDENCE (CVA-62); c/o FPO, N.Y.,N.Y.

DATE OF REPORT
1 June 19__

The classified material described below has been destroyed in accordance with regulations established by the Department of The Navy Security Manual for Classified Information, OPNAV INSTRUCTION 5510.1 (effective edition).

The purpose of this form is to provide activities with a continuous record of destruction of classified material. Also copies may be utilized for reports to activities originating material, where such report is necessary.

DOCUMENT NO. AND DESCRIPTION OF MATERIAL DESTROYED	NO. OF COPIES	DATE OF DESTRUCTION
*(Classification of this form should be indicated above when title or other identification is classified.)		
CTF 60 OP ORDER 419, dated 17 August 1970, ltr ser 0017/62 Reg. No. 1143759, Secret Control No. 00387-62	2	1 June 19__
AND NO OTHERS		

OFFICER OR INDIVIDUAL AUTHORIZING DESTRUCTION	TYPED NAME	RANK, RATE, OR GRADE	FILE OR SERVICE NO.
John L. Martin (Signature)	JOHN L. MARTIN	LT	279-267101

WITNESSING OFFICIAL	WITNESSING OFFICIAL
Edward L. Jones (Signature) EDWARD L. JONES, LTJG,USNR	William C. Marrini (Signature) WILLIAM C. MARRINI, AC1, USN

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Figure 14-2.—Classified Material Destruction Record.

When appropriate, certificates of destruction are prepared and signed by the witnessing officials. (See fig. 14-2.)

Witnessing officials must observe the complete destruction of the classified material. The residue must be checked to determine if destruction is complete and reconstruction is impossible. Efforts must be made to ensure that portions of burning material are not carried away by wind or draft.

APPENDIX I

ATC DEFINITIONS AND ABBREVIATIONS

ACIC.—Aeronautical Charting and Information Center.

ADVISORY SERVICE.—Advice and information provided by a facility to assist pilots in the safe conduct of flight and aircraft movement.

AIM.—Airman's Information Manual.

AIRAD (Airmen Advisory).—A Notice to Airmen normally given only local dissemination, during preflight or inflight briefing, or otherwise during contact with pilots.

AIRCRAFT MOVEMENT INFORMATION SECTION (AMIS).—A service to provide aircraft identification for security purposes.

AIRCRAFT OPERATIONS.—Arrivals or departures of aircraft at airports.

AIR DEFENSE COMMAND (ADC).—A service providing for national defense.

AIR DEFENSE IDENTIFICATION ZONE (ADIZ).—Area within which the security control of air traffic is exercised.

AIR - GROUND COMMUNICATIONS.—Air-to-ground and ground-to-air communication; used in traffic control, search and rescue, inflight advisory service, emergency recall, security identification, and air safety advice.

AIRPORT SURFACE DETECTION EQUIPMENT (ASDE).—A short distance radar used for the control of aircraft and surface vehicles on an airport.

AIRPORT SURVEILLANCE RADAR (ASR).—A relatively short range radar used by control tower personnel for arrival and departure control within a 30-mile area.

AIRPORT TRAFFIC CONTROL SERVICE.—Air traffic control service provided by an airport traffic control tower for aircraft operating on the movement area and in the vicinity of an airport.

AIRPORT TRAFFIC CONTROL TOWER (TOWER).—A facility providing airport traffic control service.

AIR ROUTE TRAFFIC CONTROL CENTER (CENTER).—A facility established to provide traffic control service to instrument flight rules (IFR) flights operating within controlled airspace and principally during the en route phase of flights.

AIR TRAFFIC CONTROL FACILITY (FACILITY).—A facility providing air traffic control service.

AIR TRAFFIC CONTROL SPECIALIST) CONTROLLER).—A duly authorized person providing air traffic control service.

ALNOT.—Alert notice.

ALTIMETER.—An aneroid barometer graduated to show height instead of pressure.

ALTIMETER SETTING.—A barometric pressure in inches for setting a pressure scale type altimeter.

ALTIMETER SETTING INDICATOR.—A direct reading aneroid barometer graduated to show station pressure corrected to sea level.

AMOS.—Automatic Meteorological Observing System.

ANEROID BAROMETER.—An instrument for measuring atmospheric pressure.

APPROACH CONTROL FACILITY.—A facility providing approach control service.

APPROACH CONTROL SERVICE.—Air traffic control service, provided by a terminal area traffic control facility, for arriving and departing IFR aircraft and, on occasion, VFR aircraft.

APPROACH FIX.—The fix from or over which final approach (IFR) to an airport is executed.

APPROACH GATE.—That point on the final approach course which is 1 mile from the approach fix on the side away from the airport or 5 miles from the landing threshold, whichever is farther from the landing threshold.

APPROACH SEQUENCE.—The order in which aircraft are positioned while awaiting approach clearance or while on approach.

ARC.—The track over the ground of an aircraft flying at a constant distance from a navaid by reference to distance measuring equipment (DME).

AREA NAVIGATION.—A method of navigation that permits aircraft operations on any desired course within the coverage of station referenced navigation signals or within the limits of self-contained system capability.

AVIATION WEATHER OBSERVATION.—An evaluation made from the surface, according to set procedures, of those weather elements which are most important for aircraft operations.

AZ-EL.—A type of radarscope that provides azimuth, range and elevation data. This unit of radar is used by precision radar units.

AZIMUTH.—Angular position or bearing in a horizontal plane.

BASE LINE.—The line formed by the sweep on a cathode-ray tube. Commonly referred to as time base.

BASIC VFR.—Ceiling of 1,000 feet and visibility of 3 miles.

BEARING.—The direction of the line of sight, from the radar antenna to the target, measured in degrees.

BEARING CURSOR.—A mechanical bearing line for reading target and/or course. Also commonly known as navigation head.

BLIND ZONE.—The area within the coverage of the radar reception pattern where radar echoes cannot be received.

CALIBRATION MARKERS.—Indications on the screen of a radar indicator which divide the range scale into known intervals for range determination, or for checking against mechanical indicating dials, scales, or counters.

CANADIAN AIR DEFENSE IDENTIFICATION ZONE (CADIZ).—An ADIZ located in Canada.

CARDINAL ALTITUDES OR FLIGHT LEVELS.—Odd or even 1,000-foot altitudes or flight levels. Examples: 5,000, 6,000, 7,000, FL 250, FL 260, FL 270.

CENTER'S AREA.—The specified airspace within which an air route traffic control center provides air traffic control and advisory service.

CENTRAL ALTITUDE RESERVATION FACILITY (CARF).—A facility established to act as a clearing house for mission type flights.

CLEARANCE LIMIT.—The fix to which an aircraft is issued an air traffic clearance.

CHECK OBSERVATION.—An abbreviated surface aviation weather observation taken to determine if certain elements have changed by some specific value since the preceding aviation observation.

COMBINED STATION/TOWER (CS/T).—A facility resulting from the combining of a Flight Service Station and an Airport Traffic Control Tower, as is done for economy at relatively low activity airports.

COMMON SYSTEM.—Common civil/military system of air traffic control and navigation.

COMPASS LOCATOR.—An L/MF nondirectional radio beacon installed in the approach area, at or near the ILS outer marker and/or middle marker, to be used with an airborne direction finder in making an approach to landing.

CONTACT APPROACH.—An approach wherein an aircraft on an IFR flight plan, operating clear of clouds with at least 1 mile flight visibility and having received an air traffic control authorization, may deviate from the prescribed instrument approach procedure and proceed to the airport of destination by visual reference to the surface.

CONTROL SLASH.—That slash, of a beacon target consisting of more than one slash, which represents the actual position of the associated aircraft. The control slash is always the one closest to the interrogating radar beacon site.

CORNER REFLECTOR.—A metal device of triangular shape, used for the purpose of providing a strong radar echo from a known position on the ground.

ECHO.—The signal reflected by a target (fixed or moving) to a radar receiver. Also, the deflection or indication, on the screen of a cathode-ray tube, representing a target.

EDDY.—A local irregularity in a wind. All winds near the earth's surface contain eddies, which at any given place produce gusts or lulls. Air containing numerous eddies is said to be turbulent.

EN ROUTE AIR TRAFFIC CONTROL SERVICE.—Air traffic control service provided aircraft on an IFR flight plan, generally by centers, when these aircraft are operating between departure and destination terminal areas.

ESTABLISHED AIRWAYS/ROUTES.—Preplanned and/or published airways or routes not requiring "on-the-spot" computation by the controller to determine airspace to be protected. These include:

(1.) A designated airway, published in the FARs, plus any locally charted turning-radius airspace.

(2.) A designated route, published in the FARs, and its locally charted, associated, protected airspace, plus any turning-radius airspace.

(3.) A direct route, locally charted by a facility for sector use but not disseminated in the FARs, and its associated, protected airspace plus any turning-radius airspace.

ESTIMATED TIME OF ARRIVAL (ETA).—Estimated time of arrival over the point of first intended landing.

EXPECTED APPROACH CLEARANCE TIME (EAC).—The time at which it is expected that an arriving aircraft will be cleared to commence approach for a landing.

EXPECTED FURTHER CLEARANCE TIME (EFC).—The time at which it is expected that additional clearance will be issued to a flight.

FACILITY.—See air traffic control facility.

FINAL APPROACH-IFR.—The flightpath of an aircraft which is inbound to the airport on an approved final instrument approach course, beginning at the point of interception of that course and extending to the airport or the point where circling for landing or missed approach is executed.

FINAL APPROACH-VFR.—A flightpath of a landing aircraft in the direction of landing along the extended runway centerline from the base leg to the runway.

FIX.—A geographical position determined by visual reference to the surface, by reference to one or more radio navaids, by celestial plotting, or by another navigational device.

FLOW CONTROL.—Limitations applied to the flow of traffic to keep elements of the system, such as airports or airways, from becoming overloaded.

GAIN.—Control for increasing or decreasing the amplification of the radar data on the scope.

GENERAL AVIATION.—That segment of aviation operating for private purposes, either for individual pleasure or transportation of business personnel, crop dusting, etc.

GRASS.—A voltage fluctuation or electronic noise introduced into the receiver in such a manner that it appears on the scope. Sometimes referred to as snow. It gives the scope a speckled appearance so that weak signals might not be observed.

H FACILITY.—An L/MF nondirectional radio beacon primarily intended for use with airborne direction finders to give bearing information to the pilot.

HF COMMUNICATIONS.—Communications using high radiofrequencies (HF).

HH FACILITY.—A high-powered H facility, used primarily for transoceanic or other long distance flights.

HIGH RADIOFREQUENCY (HF).—3,000 to 30,000 kilohertz.

HOLDING.—A predetermined maneuver which keeps an aircraft within a specific airspace while awaiting further clearance.

HOLDING FIX.—A specified fix used as a reference point in establishing and maintaining the position of an aircraft while holding.

IDENT FEATURE.—The special feature in ATCRBS equipment and the I/P feature in certain SIF equipment used to distinguish one displayed select code from other codes.

IFR AIRCRAFT.—An aircraft conducting flight in accordance with Instrument Flight Rules.

INSTRUMENT APPROACHES.—Approaches to airports made by aircraft under instrument flight rules.

JET ADVISORY SERVICE.—The service provided certain civil aircraft while operating within radar and nonradar jet advisory areas. Within radar jet advisory areas, civil aircraft receiving this service are provided radar flight following, radar traffic information, and vectors around observed traffic. In nonradar jet advisory areas, civil aircraft receiving this service are afforded standard IFR separation from all other aircraft known to ATC to be operating within these areas.

LOCAL TRAFFIC.—Aircraft operating in the traffic pattern of the landing area concerned.

MARKER.—Electronic range or bearing indication on a radar indicator.

MICROSECOND.—One-millionth of a second. The unit of time commonly used in radar.

MILLIBAR.—A unit of pressure equal to a force of 1,000 dynes per square centimeter.

MINIMUM CROSSING ALTITUDE (MCA).—The lowest altitude at certain radio fixes at which an aircraft must cross when proceeding in the direction of a higher minimum en route IFR altitude.

MINIMUM EN ROUTE IFR ALTITUDE (MEA).—The altitude in effect between radio fixes which assures acceptable navigational signal coverage and meets obstruction clearance requirements between those fixes.

MINIMUM OBSTRUCTION CLEARANCE ALTITUDE (MOCA).—The specified altitude in effect between radio fixes on VOR airways, off-airway routes, or route segments which meets obstruction clearance requirements for the entire route segment and which assures acceptable navigational signal coverage only within 22 miles of a VOR.

MINIMUM RECEPTION ALTITUDE (MRA).—The lowest altitude required to receive adequate signals to determine specific VOR/VORTAC/TACAN fixes.

MODE.—The number or letter referring to the specific pulse spacing of the signals transmitted by an interrogator.

MOVEMENT AREA.—The part of an airport reserved for the taking off, landing, and taxiing of aircraft.

MSL.—Mean sea level.

NAVAID.—Navigational aid.

NOTAM.—A Notice to Airmen in message form requiring expeditious and wide dissemination by telecommunications.

NATIONAL SEARCH AND RESCUE PLAN.—An interagency agreement whose purpose is to provide for the effective utilization of all available facilities in all types of search and rescue missions.

OUTER FIX.—A fix in the destination terminal area, other than the approach fix, to which aircraft are normally cleared by an air route traffic control center or a terminal area traffic control facility, and from which aircraft are cleared to the approach fix or final approach course.

OUTER MARKER.—Radio beacon emitting a vertical fanshaped pattern; typical placement is 5 miles out from the approach end of the runway, along the localizer course.

PARALLAX.—The apparent displacement of a target due to the eye position of the observer. Occurs when a map overlay system is used.

PENETRATION.—That portion of a published high altitude instrument approach procedure which prescribes a descent path from the fix on which the procedure is based to a fix or altitude from which an approach to the airport is made.

PRECAUTIONARY APPROACH.—A procedure designed to afford a pilot experiencing flight difficulties a means of landing safely and expeditiously while providing a safe ejection altitude if he elects to discontinue the approach.

PRECIPITATION.—A collective name for deposits of atmospheric moisture in liquid and solid form, including rain, snow, hail, dew, hoar frost, etc.

PRECISION APPROACH.—An instrument approach conducted in accordance with directions issued by a controller referring to the surveillance radar display until the aircraft is turned onto final approach and, thereafter, to a precision approach radar display.

PRESENTATION.—The form which the radar echo signals are made to take on the cathode-ray tube screen, as determined by the nature of the sweep circuit utilized. Examples: AZ-EL or surveillance presentation.

PRIMARY RADAR.—See radar.

PULSE.—A momentary, sharp change in a current or voltage, followed almost immediately thereafter by a sharp return to normal.

PULSE LENGTH OR DURATION.—Elapsed time, from start to finish, of a single pulse. Radar uses one antenna for both transmitting and receiving. Transmissions must cease prior to the moment of reception. A system of pulsed energy makes the use of one antenna possible. The length of time the transmitter is ON during one cycle is determined by the pulse length.

PULSE REPETITION FREQUENCY (PRF).—After a pulse is fired, the transmit-receive switch shifts to receive. The transmitter remains off for a period greater than the time required for the pulse to return. This process is repeated continuously at a rate known as the pulse repetition frequency.

RADAR (RADIO DETECTION AND RANGING).—A device which, by measuring the time interval between transmission and reception of radio pulses and correlating the angular orientation of the radiated antenna beam or beams in azimuth and/or elevation, provides information on range, azimuth, and/or elevation of objects in the path of the transmitted pulses.

(1.) PRIMARY RADAR.—A radar system in which a minute portion of a radio pulse transmitted from a site is reflected off an object and then received back at that site.

(2.) RADAR BEACON (SECONDARY RADAR).—A radar system in which the object to be detected is fitted with cooperative equipment in the form of a radio receiver/transmitter (transponder). Radio pulses transmitted from the searching transmitter/receiver (interrogator) site are received in the cooperative equipment and used to trigger a distinctive transmission from the transponder. This latter transmission, rather than a reflected signal, is then received back at the transmitter/receiver site.

RADAR ADVISORY.—The term used to indicate that the provision of advice and information is based on radar observation. (See advisory service.)

RADAR CONTACT.—The term an air traffic controller uses to inform an aircraft that it is identified on the radar display, that radar service can be provided until radar identification is lost or radar service is terminated, and that when the aircraft is informed of "radar contact" it automatically discontinues reporting over compulsory reporting points.

RADAR FLIGHT FOLLOWING.—The radar tracking of identified aircraft targets and the observation of the progress of these flights sufficiently to retain identity.

RADAR HANDOFF.—That action whereby radar identification of, radio communication with and, unless otherwise specified, control responsibility for an aircraft is transferred from one controller to another without interruption of radar flight following.

RADAR IDENTIFICATION.—The process of ascertaining that a radar target is the radar return from a particular aircraft.

RADAR SERVICE.—A term which encompasses one or more of the following services based on the use of radar which can be provided by a controller to a radar-identified aircraft. These include:

1. Radar separation—radar spacing of aircraft in accordance with established minimums.
2. Radar navigational guidance—vectoring aircraft to provide course guidance.
3. Radar monitoring—the radar flight-following of an aircraft whose primary navigation is being performed by its pilots to observe and note deviations from its authorized flight path, airway, or route. This includes noting the aircraft's position relative to approach fixes.

RADAR SURVEILLANCE.—The radar observation of a given geographical area for the purpose of performing some radar function.

RADAR TRACKING.—The observation of the movement of specific radar targets.

RADIAL.—A magnetic bearing extending from a VOR/VORTAC/TACAN.

RANGE MARKS.—Electronic reference lines appearing on the scope to indicate distance from either touchdown or the antenna site.

RANGE SELECTOR.—On surveillance equipment the controller has a choice of ranges to be presented. Usually four or five different settings from 5 miles to over 30 miles.

RAPCON.—A radar approach control facility established by or in cooperation with the U.S. Air Force primarily to serve air traffic at an Air Force base.

RCC.—Search and rescue coordination center.

RCR.—Runway conditions reading.

RECEIVING CONTROLLER/FACILITY.—A controller/facility receiving control of an aircraft from another controller/facility.

RESOLUTION:

1. Range—The minimum range difference between two separate targets at the same bearing that will allow both to appear as distinct, separate echoes on the indicator.
2. Bearing—The minimum angular separation between two targets at the same range that will allow both to appear as distinct, separate echoes on the indicator.
3. Elevation—The minimum angular separation in a vertical plane between two targets at the same range and bearing that will allow both to appear as distinct, separate echoes on the indicator.

RIME.—A rough or feathery coating of ice.

RNAV.—Area navigation.

ROUTE.—A defined path, consisting of one or more courses, which an aircraft traverses in a horizontal plane over the surface of the earth.

RUNWAY END.—The end of that portion of a runway useable for landing or takeoff.

RUNWAY VISUAL RANGE (RVR).—The maximum distance in the direction of takeoff or landing at which the runway, or specified lights or markings delineating it, can be seen from a position above a specified point on its centerline, at a height corresponding to the average eye-level of pilots at touchdown.

SAR.—Search and rescue.

SCAN.—That area in space covered by the radar antenna pattern. It may be an area of 360° with varying ranges as on the airport surveillance radar, or a restricted area such as that of the precision radar.

SCATANA.—Security Control of Air Traffic and Air Navigation Aids.

SCOPE.—The face of the cathode-ray tube that is visible to the operator on which appears a display of a given area of coverage. It contains the visual display of the reception of the radar system and video mapping.

SCOPE ALIGNMENT.—A means of checking the accuracy of the radar data received and displayed. It also is the means of making minor corrections to the radar display or to attain proper and correct positioning of radar data.

SEARCH AND RESCUE FACILITY.—A facility responsible for maintaining and operating a search and rescue service for occupants of missing or downed aircraft.

SECONDARY RADAR.—(See radar.)

SELECT CODE.—That code displayed when the ground interrogator and the airborne transponder are operating on the same mode and code simultaneously.

SENSITIVITY TIME CONTROL (STC).—This is an automatic electronic aid that reduces the gain of targets close in and increases the gain of targets at distant ranges.

SEPARATION.—Spacing of aircraft to achieve their safe and orderly movement in flight and while landing and taking off.

SEPARATION MINIMUMS.—The minimum longitudinal, lateral, or vertical distances by which aircraft are spaced through the application of air traffic control procedures.

SFA.—Single frequency approach.

SID.—Standard instrument departure.

SIF.—Selective identification feature (of the basic Mark X radar beacon system).

SIGMET.—Significant Meteorological Information.

SINGLE-PILOTED AIRCRAFT.—An aircraft possessing one set of flight controls, tandem cockpits, or two sets of flight controls but operated by one pilot.

SLANT RANGE.—The straight line distance to the target. Radar range is determined by slant line range and not the normal geographic ranging.

SLASH.—A radar beacon reply displayed as an elongated target.

STRAIGHT-IN APPROACH-IFR.—An instrument approach wherein final approach is begun without first having executed procedure turn.

STRAIGHT-IN APPROACH-VFR.—Entry of the traffic pattern by interception of the extended runway centerline without executing any other portion of the traffic pattern.

SUNSET AND SUNRISE.—The mean solar times of sunset and sunrise as published in the Nautical Almanac, converted to local standard time for the locality concerned. Within Alaska, the end of evening civil twilight and the beginning of morning civil twilight, as defined for each locality.

SURVEILLANCE APPROACH.—An instrument approach conducted in accordance with directions issued by a controller referring to the surveillance radar display.

SWEEP.—A luminescent line formed by a stream of electrons on the face of the radar-scope.

TACAN-ONLY AIRCRAFT.—An aircraft possessing TACAN but no VOR navigational system capability.

TAKEOFF CLEARANCE.—Authorization by an airport traffic control tower for an aircraft to take off.

TAKEOFF THRESHOLD.—The beginning of that portion of a runway useable for takeoff.

TARGET.—The indication shown on a radar display resulting from a primary radar return or a radar beacon reply.

TELETYPEWRITER SYSTEM.—A system of circuits, either landline or radio, whereby messages are transmitted or received in typewritten form.

TERMINAL AREA FACILITY.—A facility (RAPCON, or tower) providing air traffic control service for arriving and departing IFR aircraft and, on occasion, tower en route control service.

TOWER EN ROUTE CONTROL SERVICE.—Departure, en route and arrival control service provided to IFR aircraft by one or more terminal area facilities.

TRACK.—The flightpath of an aircraft over the surface of the earth.

TRAFFIC INFORMATION—RADAR.—Information issued to alert an aircraft to any radar targets observed on the radar display which may be in such proximity to its position or intended route of flight as to warrant its attention.

TRAFFIC PATTERN.—The traffic flow that is prescribed for aircraft landing at, taxiing on, and taking off from an airport. The usual components of a traffic pattern are upwind leg, crosswind leg, downwind leg, base leg, and final approach.

TRANSFERRING CONTROLLER/FACILITY.—A controller/facility transferring control of an aircraft to another controller/facility.

TRANSMISSOMETER.—A direct reading instrument that indicates the visibility in the vicinity of a particular runway, usually the instrument runway.

TURBOPROP.—Turbine-engine-driven propeller.

TURBOJET EN ROUTE DESCENT.—A procedure for effecting the descent of military jet aircraft from an en route altitude to the final approach without execution of the maneuvers prescribed in a published high altitude instrument approach procedure. Its purpose is to expedite the movement of air traffic.

TURBULENCE.—Irregular motion of the atmosphere produced when air flows over a comparatively uneven surface, such as the surface of the earth, or when two currents of air flow past or over each other in different directions or at different speeds.

UHF COMMUNICATIONS.—Communications using ultrahigh radiofrequencies.

ULTRAHIGH RADIOFREQUENCY (UHF).—300 to 3,000 megahertz.

USERS.—The various groups of aviation that use the services of the nation's aviation facilities.

VECTOR.—A heading issued to an aircraft to provide navigational guidance by radar.

VFR AIRCRAFT.—An aircraft conducting flight in accordance with Visual Flight Rules.

VHF COMMUNICATIONS.—Communications using the very high radiofrequencies.

VIDEO MAPPING.—A method of reproducing a map of the area covered by the radar on the face of the cathode-ray tube or scope. It is electronically fed into the receiving system and displayed on the scope along with any target returns of the radar. The video mapper is synchronized with the antenna rotation so that the video map corresponds to the area covered by the antenna.

VISIBILITY.—The transparency and illumination of the atmosphere as affecting the distance at which objects can be seen.

VISUAL APPROACH.—An approach wherein an aircraft on an IFR flight plan, operating in VFR conditions under the control of a radar facility and having received an air traffic control authorization, may deviate from the prescribed instrument approach procedures and proceed to the airport of destination by visual reference to the surface.

WARNING AREA.—An airspace warning area is the same as a Restricted Area but is located outside the United States or its Territories and possessions.

WAY POINT.—A predetermined geographical position used for route definition and/or progress reporting purposes that is defined relative to a VORTAC station position.

Two subsequently related way points define a route segment.

WEATHER ADVISORY.—In aviation weather forecast practice, an expression of anticipated hazardous weather conditions as they affect the operation of air traffic and as prepared by the National Weather Service.

APPENDIX II

JOINT ELECTRONICS TYPE DESIGNATION SYSTEM

Set Indicator Letters					
1st letter (designed installation classes)	2d letter (type of equipment)	3d letter (purpose)	Model No.	Modification letter	Miscellaneous identification
Installation	Type of Equipment	Purpose			
A-Piloted aircraft.	A-Invisible light, heat radiation.	A-Auxiliary assemblies (not complete operating sets used with or part of two or more sets or sets series).	1	A	X-Changes in.
			2	B	Y-Voltage.
B-Underwater mobile, submarine.			3	C	Z-Phase or frequency.
	C-Carrier.	B-Bombing.			
C-Air transportable (inactivated, do not use).	D-Radiac.	C-Communications (receiving and transmitting).			T-Training.
D-Pilotless carrier.	E-Nupac.		4, etc.	D, etc.	(V)-Variable grouping.
F-Fixed ground,	F-Photographic.	D-Direction finder, reconnaissance, and/or surveillance.			
G-Ground, general ground use.	G-Telegraph or teletype.				
K-Amphibious.	I-Interphone and public address.	E-Ejection and/or release.			
		G-Fire control or searchlight directing.			
M-Ground, mobile.	J-Electromechanical or inertial wire covered.				
P-Portable.	K-Telemetering.	H-Recording and/or reproducing (graphic, meteorological and sound).			
S-Water surface.	L-Countermeasures.				

JOINT ELECTRONICS TYPE DESIGNATION SYSTEM-Continued

Set Indicator, Letters: 1st letter (designed installation classes)	2d letter (type of equipment)	3d letter (purpose)	Model No.	Modification letter	Miscellaneous identification
Installation	Type of Equipment	Purpose			
T-Ground, transportable.	M-Meteorological.	K-Computing.			
U-General utility.	N-Sound in air.				
V-Ground, vehicular.	P-Radar.				
W-Water surface and underwater combination.	Q-Sonar and underwater sound.	M-Maintenance and test assemblies (including tools).			
	R-Radio.				
	S-Special types, magnetic, etc., or combinations of types.	N-Navigational aids (including altimeters, beacons, compasses, racons, depth sounding, approach, and landing).			
	T-Telephone (wire).				
	V-Visual and visible light.				
	W-Armament (peculiar to armament, not otherwise covered).	Q-Special or combination of purposes.			
	X-Facsimile or television.	R-Receiving, passive detecting.			
	Y-Data processing.	S-Detecting and/or range and bearing, search.			
		T-Transmitting.			
		W-Automatic flight or remote control.			
		X-Identification and recognition.			

APPENDIX III

FAR, PART I, DEFINITIONS AND ABBREVIATIONS

General definitions

"Administrator" means the Administrator of the Federal Aviation Administration or any person to whom he has delegated his authority in the matter concerned.

"Air Carrier" means a person who undertakes directly by lease, or other arrangement, to engage in air transportation.

"Air commerce" means interstate, overseas, or foreign air commerce or the transportation of mail by aircraft, or any operation or navigation of aircraft within the limits of any Federal airway or any operation or navigation of aircraft which directly affects, or which may endanger safety in, interstate, overseas, or foreign air commerce.

"Aircraft" means a device that is used or intended to be used for flight in the air.

"Airplane" means an engine-driven fixed-wing aircraft heavier than air, that is supported in flight by the dynamic reaction of the air against its wings.

"Airport" means an area of land or water that is used or intended to be used for the landing and takeoff of aircraft, and includes its building and facilities, if any.

"Airport traffic area" means, unless otherwise specifically designated in Part 93, that airspace within a horizontal radius of 5 statute miles from the geographical center of any airport at which a control tower is operating, extending from the surface up to, but not including 3,000 feet above the surface.

"Airship" means an engine-driven lighter-than-air aircraft that can be steered.

"Air traffic" means aircraft operating in the air or on an airport surface, exclusive of loading ramps and parking areas.

"Air traffic clearance" means an authorization by air traffic control, for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled airspace.

"Air traffic control" means a service operated by appropriate authority to promote the safe, orderly, and expeditious flow of air traffic.

"Alternate airport" means an airport at which an aircraft may land if a landing at the intended airport becomes inadvisable.

"Approved," unless used with reference to another person, means approved by the Administrator.

"Armed Forces" means the Army, Navy, Air Force, Marine Corps, and Coast Guard, including their regular and reserve components and members serving without component status.

"Autorotation" means a rotorcraft flight condition in which the lifting rotor is driven entirely by action of the air when the rotorcraft is in motion.

"Balloon" means a lighter-than-air aircraft that is not engine driven.

"Calibrated airspeed" means indicated airspeed of an aircraft, corrected for position and instrument error. Calibrated airspeed is equal to true air speed in standard atmosphere at sea level.

"Ceiling" means the height above the earth's surface of the lowest layer of clouds or obscuring phenomena that is reported as "broken," "overcast," or "obscuration," and not classified as "thin" or "partial."

"Civil aircraft" means aircraft other than public aircraft.

"Controlled airspace" means airspace, designated as continental control area, control area, control zone, or transition area, within which some or all aircraft may be subject to air traffic control.

"Decision height" with respect to the operation of aircraft, means the height at which a decision must be made, during an ILS or PAR instrument approach, to either continue the approach or to execute a missed approach.

"Flight level" means a level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury. Each is stated in three digits that represent hundreds of feet. For example, flight level 250 represents a barometric altimeter indication of 25,000 feet; flight level 255, an indication of 25,500 feet.

"Flight plan" means specified information relating to the intended flight of an aircraft, that is filed orally or in writing with air traffic control.

"Flight visibility" means the average forward horizontal distance, from the cockpit of an aircraft in flight, at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.

"Foreign air carrier" means any person other than a citizen of the United States, who undertakes directly, by lease or other arrangement, to engage in air transportation.

"Glider" means a heavier-than-air aircraft, that is supported in flight by the dynamic reaction of the air against its lifting surfaces and whose free flight does not depend principally on an engine.

"Ground visibility" means prevailing horizontal visibility near the earth's surface as reported by the National Weather Service or an accredited observer.

"Helicopter" means a rotorcraft that, for its horizontal motion, depends principally on its engine-driven rotors.

"Heliport" means an area of land, water, or structure used or intended to be used for the landing or takeoff of helicopters.

"IFR conditions" means weather conditions below the minimum for flight under visual flight rules.

"IFR over-the-top," with respect to the operation of aircraft, means the operation of an aircraft over-the-top on an IFR flight plan when cleared by air traffic control to maintain "VFR conditions" or "VFR conditions on top."

"Indicated airspeed" means the speed of an aircraft as shown on its pitot static airspeed indicator calibrated to reflect standard atmosphere adiabatic compressible flow at sea level uncorrected for airspeed system errors.

"Kite" means a framework, covered with paper, cloth, metal, or other material, intended to be flown at the end of a rope or cable, and having as its only support the force of the wind moving past its surfaces.

"Large aircraft" means aircraft of more than 12,500 pounds, maximum certificated takeoff weight.

"Lighter-than-air aircraft" means aircraft that can rise and remain suspended by using contained gas weighing less than the air that is displaced by the gas.

"Mach number" means the ratio of true airspeed to the speed of sound.

"Medical certificate" means acceptable evidence of physical fitness on a form prescribed by the Administrator.

"Minimum descent altitude" means the lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure, where no electronic glide slope is provided.

"Navigable airspace" means airspace at and above the minimum flight altitudes prescribed by or under this chapter, including airspace needed for safe takeoff and landing.

"Night" means the time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time.

"Non-precision approach procedure" means a standard instrument approach procedure in which no electronic glide slope is provided.

"Operate," with respect to aircraft, means use, cause to use, or authorize to use aircraft for the purpose of air navigation, including the piloting of aircraft, with or without the right of legal control (as owner, lessee, etc.).

"Operational control," with respect to a flight, means the exercise of authority over initiating, conducting, or terminating a flight.

"Over-the-top" means above the layer of clouds or other obscuring phenomena forming the ceiling.

"Parachute" means a device used or intended to be used to retard the fall of a body or object through the air.

"Pilot in command" means the pilot responsible for the operation and safety of an aircraft during flight time.

"Positive control" means control of all air traffic, within designated airspace, by air traffic control.

"Precision approach procedure" means a standard instrument approach procedure in which an electronic glide slope is provided, as in ILS and PAR.

"Prohibited area" means designated airspace within which the flight of aircraft is prohibited.

"Rating" means a statement that, as part of a certificate, sets forth special conditions, privileges, or limitations.

NOTE: Applies to FAA certificates only. Not to be confused with Navy enlisted rating.

"Reporting point" means a geographical location in relation to which the position of an aircraft is reported.

"Restricted area" means airspace designated under Part 73 of this chapter within which the flight of aircraft, while not wholly prohibited, is subject to restriction.

"Rocket" means an aircraft propelled by ejected expanding gases generated in the engine from self-contained propellants and not dependent on the intake of outside substances. It includes any part which becomes separated during the operations.

"Rotorcraft" means a heavier-than-air aircraft that depends principally for its support in flight on the lift generated by one or more rotors.

"Route segment" means a part of a route. Each end of that part is identified by—

(1) a continental or insular geographical location; or

(2) a point at which a definite radio fix can be established.

"Small aircraft" means aircraft of 12,500 pounds or less, maximum certificated takeoff weight.

"Traffic pattern" means the traffic flow that is prescribed for aircraft landing at, taxiing on, or taking off from, an airport.

"True airspeed" means the airspeed of an aircraft relative to undisturbed air.

"United States," in a geographical sense, means (1) the States, the District of Columbia, Puerto Rico, and the possessions, including the territorial waters, and (2) the airspace of those areas.

"VFR over-the-top," with respect to the operation of aircraft, means the operation of an aircraft over-the-top under VFR when it is not being operated on an IFR flight plan.

Abbreviations and symbols

"ALS" means approach light system.
"ASR" means airport surveillance radar.
"ATC" means air traffic control.
"CAS" means calibrated airspeed.

"DH" means decision height.
"DME" means distance measuring equipment compatible with TACAN.

"FAA" means Federal Aviation Administration.
"FM" means fan marker.

"HIRL" means high-intensity runway lighting system.
"IAS" means indicated airspeed.
"ICAO" means International Civil Aviation Organization.
"IFR" means instrument flight rules.
"ILS" means instrument landing system.
"INT" means intersection.

"LMM" means compass locator at middle marker.
"LOM" means compass locator at outer marker.

"M" means Mach number.
"MAA" means maximum authorized IFR altitude.
"MALS" means medium intensity approach light system.
"MCA" means minimum crossing altitude.
"MDA" means minimum descent altitude.
"MEA" means minimum en route IFR altitude.
"MM" means ILS middle marker.
"MOCA" means minimum obstruction clearance altitude.
"MRA" means minimum reception altitude.
"MSL" means mean sea level.

"NDB(ADF)" means nondirectional beacon (automatic direction finding).
"NOPT" means no procedure turn required.

"PAR" means precision approach radar.
"RBN" means radio beacon.
"RCLM" means runway centerline marking.
"RCLS" means runway centerline light system.
"REIL" means runway end identification lights.

"RVR" means runway visual range as measured in the touchdown area.

"SALS" means short approach light system.

"TACAN" means ultrahigh frequency tactical air navigational aid.

"TAS" means true airspeed.

"TDZL" means touchdown zone lights.

"VFR" means visual flight rules.

"VHF" means very high frequency.

"VOR" means very high frequency omnirange station.

"VORTAC" means collocated VOR and TACAN.

APPENDIX IV

U. S. CUSTOMARY AND METRIC SYSTEM UNITS OF MEASUREMENTS

THESE PREFIXES MAY BE APPLIED TO ALL SI UNITS

Multiples and Submultiples	Prefixes	Symbols
$1\,000\,000\,000\,000 = 10^{12}$	tera (tĕr'ȧ)	T
$1\,000\,000\,000 = 10^{9}$	giga (jĭ'gȧ)	G
$1\,000\,000 = 10^{6}$	mega (mĕg'ȧ)	M*
$1\,000 = 10^{3}$	kilo (kĭl'ō)	k*
$100 = 10^{2}$	hecto (hĕk'tō)	h
$10 = 10$	deka (dĕk'ȧ)	da
$0.1 = 10^{-1}$	deci (dĕs'ĭ)	d
$0.01 = 10^{-2}$	centi (sĕn'tĭ)	c*
$0.001 = 10^{-3}$	milli (mĭl'ĭ)	m*
$0.000\,001 = 10^{-6}$	micro (mī'krō)	μ *
$0.000\,000\,001 = 10^{-9}$	nano (năn'ō)	n
$0.000\,000\,000\,001 = 10^{-12}$	pico (pē'kō)	p
$0.000\,000\,000\,000\,001 = 10^{-15}$	femto (fĕm'tō)	f
$0.000\,000\,000\,000\,000\,001 = 10^{-18}$	atto (ăt'tō)	a

*Most commonly used

COMMON EQUIVALENTS AND CONVERSIONS

Approximate Common Equivalents		Conversions Accurate to Parts Per Million	
1 inch	= 25 millimeters	inches x 25.4*	= millimeters
1 foot	= 0.3 meter	feet x 0.3048*	= meters
1 yard	= 0.9 meter	yards x 0.9144*	= meters
1 mile	= 1.6 kilometers	miles x 1.609 34	= kilometers
1 square inch	= 6.5 square centimeters	square inches x 6.4516*	= square centimeters
1 square foot	= 0.09 square meter	square feet x 0.092 903 0	= square meters
1 square yard	= 0.8 square meter	square yards x 0.836 127	= square meters
1 acre	= 0.4 hectare †	acres x 0.404 686	= hectares
1 cubic inch	= 16 cubic centimeters	cubic inches x 16.3871	= cubic centimeters
1 cubic foot	= 0.03 cubic meter	cubic feet x 0.028 316 8	= cubic meters
1 cubic yard	= 0.8 cubic meter	cubic yards x 0.764 555	= cubic meters
1 quart (lq.)	= 1 liter †	quarts (lq.) x 0.946 353	= liters
1 gallon	= 0.004 cubic meter	gallons x 0.003 785 41	= cubic meters
1 ounce (avdp)	= 28 grams	ounces (avdp) x 28.349 5	= grams
1 pound (avdp)	= 0.45 kilogram	pounds (avdp) x 0.453 592	= kilograms
1 horsepower	= 0.75 kilowatt	horsepower x 0.745 700	= kilowatts
1 millimeter	= 0.04 inch	millimeters x 0.039 370 1	= inches
1 meter	= 3.3 feet	meters x 3.280 84	= feet
1 meter	= 1.1 yards	meters x 1.093 61	= yards
1 kilometer	= 0.6 mile	kilometers x 0.621 371	= miles
1 square centimeter	= 0.16 square inch	square centimeters x 0.155 000	= square inches
1 square meter	= 11 square feet	square meters x 10.7639	= square feet
1 square meter	= 1.2 square yards	square meters x 1.195 99	= square yards
1 hectare †	= 2.5 acres	hectares x 2.471 05	= acres
1 cubic centimeter	= 0.06 cubic inch	cubic centimeters x 0.061 023 7	= cubic inches
1 cubic meter	= 35 cubic feet	cubic meters x 35.3147	= cubic feet
1 cubic meter	= 1.3 cubic yards	cubic meters x 1.307 95	= cubic yards
1 liter †	= 1 quart (lq.)	liters x 1.056 69	= quarts (lq.)
1 cubic meter	= 250 gallons	cubic meters x 264.172	= gallons
1 gram	= 0.035 ounces (avdp)	grams x 035 274 0	= ounces (avdp)
1 kilogram	= 2.2 pounds (avdp)	kilograms x 2.204 62	= pounds (avdp)
1 kilowatt	= 1.3 horsepower	kilowatts x 1.341 02	= horsepower

† common term not used in SI

*exact

INDEX

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QUALIFICATIONS FOR ADVANCEMENT

This appendix provides you with a list of the minimum qualifications for advancement to Air Controlman Third or Second Class. The official source of this list is the Manual of Qualifications for Advancement, NAVPERS 18068-C. The assignment numbers given opposite the qualifications refer to the assignments in the NRCC, Air Controlman 3 & 2, NAVEDTRA 10367-F. Each course assignment contains information related to a practical or knowledge factor, as shown.

AIR CONTROLMAN 3 & 2

Air Controlmen perform air traffic control duties in air control towers, radar air traffic control facilities, and air operations offices ashore and afloat; operate radiotelephones, light signals and systems, and direct aircraft under VFR and IFR conditions; operate surveillance radar, and identification equipment (IFF); operate ground- and carrier-controlled approach systems and air surveillance radar approach equipment; assist pilots in the preparation and processing of flight plans and clearances; and maintain current flight planning information and reference materials.

QUALIFICATIONS FOR ADVANCEMENT	Required for Advancement to AC	Covered in Assignments
A. SAFETY		
1.00 Practical Factors		
.01 Observe safety precautions in handling and operating electrical and electronic equipment	E-4	8, 13
B. CONTROL TOWER OPERATIONS		
1.00 Practical Factors		
.01 Determine frequencies and operate electronic equipment to communicate with aircraft	E-4	8, 10
.02 Control air traffic under VFR conditions	E-4	2, 9
.03 Issue instructions to aircraft on the ground relative to taxiing, parking, and related airport information	E-4	9, 10

QUALIFICATIONS FOR ADVANCEMENT

	Required for Advancement to AC	Covered in Assignments
B. CONTROL TOWER OPERATIONS - Continued		
1.00 Practical Factors		
.04 Issue oral instructions from the control tower to dispatch fire, crash, and rescue equipment for emergency landings, crashes, and accidents	E-4	10
.05 Operate interphone communications equipment	E-4	4, 8
.06 Copy instrument flight rules (IFR) clearances and relay to aircraft	E-4	4, 10
.07 Operate airport traffic control signal light gun	E-4	8
.08 Operate field and approach lighting systems and rotating beacons	E-4	9
2.00 Knowledge Factors		
.01 Types of information included in landing, taxi, and takeoff instructions	E-4	10
.02 Standard Navy airfield markings and lighting system	E-4	8, 9
.03 Procedures and phraseology used to communicate with aircraft from the control tower	E-4	6, 9, 10
.04 Standard visual signals used between aircraft and control towers	E-4	11
.05 SCATANA and ADIZ procedures pertaining to air traffic controllers	E-4	11
.06 Types, designations, and general flight characteristics of current U. S. military aircraft	E-4	1
.07 Characteristics and capabilities of control tower equipment	E-4	8
.08 Federal air regulations pertaining to air traffic control by naval control towers	E-4	1
.09 Procedures for control of aircraft which has experienced an emergency situation in flight	E-4	10
.10 Procedures for alerting search and rescue facilities	E-4	4
.11 Principles of and requirements for the security of communications	E-4	10

QUALIFICATIONS FOR ADVANCEMENT	Required for Advancement to AC	Covered in Assignments
C. RADAR AIR TRAFFIC CONTROL AND IFR PROCEDURES		
1.00 Practical Factors		
.41 Operate surveillance radar, IFF equipment, and remote radar indicators	E-5	12, 13
2.00 Knowledge Factors		
.01 Purpose and interrelationships of operator positions and equipment in air traffic control facilities	E-4	12, 13
.02 Description and use of electronic aids to air navigation	E-4	7
.07 Basic joint system and nomenclature used to identify air traffic control facilities	E-4	8
.08 General procedures of search and rescue operations	E-4	4
.09 Purpose of approach control facilities	E-4	11, 12
.40 IFR procedures for air traffic control	E-5	2, 11, 12
.41 Procedures for locating, identifying, and tracking aircraft by using radar, IFF, and related equipment	E-5	8, 12
.42 Effects of weather and topography on the operating capabilities of radar, IFF, and related equipment	E-5	13
.43 Characteristics, purposes, phraseology, and general operating procedures of landing approach systems, including Precision Approach Radar (PAR), Carrier Controlled Approach (CCA), Optical Landing Systems (OLS), Air Surveillance Radar (ASR), and Automatic Carrier Landing System (ACLS)	E-5	7, 12, 13
D. FLIGHT PLANNING AND FLIGHT ASSISTANCE SERVICE		
1.00 Practical Factors		
.01 Process flight plans	E-4	4
.02 Process incoming NOTAMS	E-4	4
.03 Prepare, assemble, and maintain flight packets and brief pilots on their contents	E-4	3
.04 Maintain flight data and status boards	E-4	4, 14

QUALIFICATIONS FOR ADVANCEMENT	Required for Advancement to AC	Covered in Assignments
D. FLIGHT PLANNING AND FLIGHT ASSISTANCE SERVICE - Continued		
1.00 Practical Factors		
.05 Draft air traffic control messages for teletype dissemination	E-4	4
.40 Maintain air traffic operations logs and records	E-5	4, 15
.42 Prepare NOTAMS for release	E-5	4
2.00 Knowledge Factors		
.01 General contents and use of the FLIP System	E-4	4, 14
.02 Symbols, courses, coordinates, distances, topography, and variations found in aeronautical charts	E-4	3
.03 Types and purposes of NOTAMS	E-4	4
.04 Air traffic clearance symbols and abbreviations	E-4	4
.05 Standard aeronautical charts and publications used in air navigation	E-4	3, 15
.07 Types and purposes of flight assistance services	E-4	4
.43 Procedures for the procurement of standard aeronautical charts and publications	E-5	3
E. WEATHER		
1.00 Practical Factors		
.01 Obtain altimeter settings and relay to aircraft	E-4	8
.02 Interpret hourly aviation weather reports and apply appropriate VFR weather minimums to air traffic control	E-4	6
2.00 Knowledge Factors		
.01 Types of weather changes which should be reported to local weather facilities	E-4	5
.02 Basic characteristics of weather elements and their significance to air traffic control	E-4	5, 6, 7
.40 Weather minimums applicable to IFR approaches and departures, and special VFR operations	E-5	2

QUALIFICATIONS FOR ADVANCEMENT	Required for Advancement to AC	Covered in Assignments
Z. ADMINISTRATION		
1.00 Practical Factors		
.40 Use DOD Catalog of Charts and Publications	E-5	3, 14
AA. SECURITY		
1.00 Practical Factors		
None.		
2.00 Knowledge Factors		
.39 General scope, policies, and procedures relative to the following classified information and material requirements:		
a. Access, reproduction, dissemination, accountability and control of classified material	E-4	15
b. Safekeeping and storage of classified material	E-4	15
c. Compromise of classified information and security violations	E-4	15
d. Personnel security investigations and clearances	E-4	15
e. Disposal and destruction of classified material	E-5	15
f. Methods of transmission or transportation of classified information and material	E-5	15
g. Command security program management	E-5	15

AIR CONTROLMAN 3 & 2

NAVEDTRA 10367-F

Prepared by the Naval Education and Training Program Development Center, Pensacola, Florida

Your NRCC contains a set of assignments and self-scoring answer sheets (packaged separately). The Rate Training Manual, Air Controlman 3 & 2, NAVEDTRA 10367-F, is your textbook for the NRCC. If an errata sheet comes with the NRCC, make all indicated changes or corrections. Do not change or correct the textbook or assignments in any other way.

COURSE OBJECTIVE

While completing this nonresident career course you will demonstrate your understanding of course materials by correctly answering items on the following: rating requirements and procedures for advancement within the AC rating; military aircraft designations and characteristics; Federal Air Regulations; basic air navigation; flight services; meteorological elements affecting aviation; aviation weather reports and advisories; aids to air navigation; control tower equipment; airport traffic control and airfield equipment; air traffic control communications; IFR/SVFR control procedures; radar and allied equipment and control procedures; publications, records, and security measures.

HOW TO COMPLETE THIS COURSE SUCCESSFULLY

Study the textbook pages given at the beginning of each assignment before trying to answer the items. Pay attention to tables and illustrations as they contain a lot of information. Making your own drawings can help you understand the subject matter. Also, read the learning objectives that precede the sets of items. The learning objectives and items are based on the subject matter or study material in the textbook. The objectives tell you what you should be able to do by studying assigned textual material and answering the items.

At this point you should be ready to answer the items in the assignment. Read each item carefully. Select the BEST ANSWER for each item, consulting your textbook when necessary. Be sure to select the BEST ANSWER from the subject matter in the textbook. You may discuss difficult points in the course with others. However, the answer you select must be your own. Use only the self-scoring answer sheet designated for your assignment. Follow the scoring directions given on the answer sheet itself and elsewhere in this course.

Your NRCC will be administered by your command or, in the case of small commands, by the Naval Education and Training Program Development Center. No matter who administers your course you can complete it successfully by earning grades that average 3.2 or higher. If you are on active duty, the average of your grades in all assignments must be at least 3.2. If you are NOT on active duty, the average of your grades in all assignments of each creditable unit must be at least 3.2. The unit breakdown of the course, if any, is shown later under Naval Reserve Retirement Credit.

WHEN YOUR COURSE IS ADMINISTERED BY LOCAL COMMAND

As soon as you have finished an assignment, submit the completed self-scoring answer sheet to the officer designated to administer it. He will check the accuracy of your score and discuss with you the items that you do not understand. You may wish to record your score on the assignment itself since the self-scoring answer sheet is not returned.

If you are completing this NRCC to become eligible to take the fleetwide advancement examination, follow a schedule that will enable you to complete all assignments in time. Your schedule should call for the completion of at least one assignment per month.

Although you complete the course successfully, the Naval Education and Training Program Development Center will not issue you a letter of satisfactory completion. Your command will make a note in your service record, giving you credit for your work.

WHEN YOUR COURSE IS ADMINISTERED BY THE NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER

After finishing an assignment, go to the next. Retain each completed self-scoring answer sheet until you finish all the assignments in a unit (or in the course if it is not divided into units). Using the envelopes provided, mail your satisfactory completion to certify successful completion of the course (or a creditable unit of the course). To receive a course-completion letter follow the directions given on the course-completion form in the back of this NRCC.

You may keep the textbook and assignments for this course. Return them only in the event you disenroll from the course or otherwise fail to complete the course. Directions for returning the textbook and assignments are given on the book-return form in the back of this NRCC.

PREPARING FOR YOUR ADVANCEMENT EXAMINATION

Your examination for advancement is based on the Manual of Qualifications for Advancement (NAVPERS 18068). The sources of questions in this examination are given in the Bibliography for Advancement Study (NAVEDTRA 10052). Since your NRCC and textbook are among the sources listed in this bibliography, be sure to study both in preparing to take your advancement examination. The qualifications for your rating may have changed since your course and textbook were printed, so refer to the latest editions of NAVPERS 18068 and NAVEDTRA 10052.

NAVAL RESERVE RETIREMENT CREDIT

This course is evaluated at 29 Naval Reserve retirement points. These points are creditable to personnel eligible to receive them under current directives governing retirement of Naval Reserve personnel. Points will be credited in units as follows:

Unit 1: 12 points upon satisfactory completion of assignments 1 through 6.
Unit 2: 12 points upon satisfactory completion of assignments 7 through 12.
Unit 3: 5 points upon satisfactory completion of assignments 13 through 15.

Naval Reserve retirement credit will not be given for this course if the student has previously received credit for any AC 3 & 2 ECC, ECC/FITS, or NRCC.

Naval nonresident career courses may include a variety of items -- multiple-choice, true-false, matching, etc. The items are not grouped by type; regardless of type, they are presented in the same general sequence as the textbook material upon which they are based. This presentation is designed to preserve continuity of thought, permitting step-by-step development of ideas. Some courses use many types of items, others only a few. The student can readily identify the type of each item (and the action required of him) through inspection of the samples given below.

MULTIPLE-CHOICE ITEMS

Each item contains several alternatives, one of which provides the best answer to the item. Select the best alternative and erase the appropriate box on the answer sheet.

SAMPLE

s-1. The first person to be appointed Secretary of Defense under the National Security Act of 1947 was
1. George Marshall
2. James Forrestal
3. Chester Nimitz
4. William Halsey

The erasure of a correct answer is indicated in this way on the answer sheet:

	1 T	2 F	3	4	
s-1		C			

TRUE-FALSE ITEMS

Determine if the statement is true or false. If any part of the statement is false the statement is to be considered false. Erase the appropriate box on the answer sheet as indicated below.

SAMPLE

s-2. Any naval officer is authorized to correspond officially with a bureau of the Navy Department without his commanding officer's endorsement.

The erasure of a correct answer is also indicated in this way on the answer sheet:

	1 T	2 F	3	4	
s-2		CC			

MATCHING ITEMS

Each set of items consists of two columns, each listing words, phrases or sentences. The task is to select the item in column B which is the best match for the item in column A that is being considered. Specific instructions are given with each set of items. Select the numbers identifying the answers and erase the appropriate boxes on the answer sheet.

SAMPLE

In items s-3 through s-6, match the name of the shipboard officer in column A by selecting from column B the name of the department in which the officer functions.

A. Officers	B. Departments
s-3. Damage Control Assistant	1. Operations Department
s-4. CIC Officer	2. Engineering Department
s-5. Assistant for Disbursing	3. Supply Department
s-6. Communications Officer	

The erasure of a correct answer is indicated in this way on the answer sheet:

	1 T	2 F	3	4	
s-3		C			
s-4	C				
s-5			C		
s-6	C				

How To Score Your Immediate Knowledge of Results (IKOR) Answer Sheets

	1 T	2 F	3	4	
1		C	6		1
2	C	9		9	2
3			C		
4	CC	12			1

Total the number of incorrect erasures (those that show page numbers) for each item and place in the blank space at the end of each item.

Sample only

Number of boxes erased incorrectly	0-2	3-7	8-
Your score	4.0	3.9	3.8

Now TOTAL the column(s) of incorrect erasures and find your score in the Table at the bottom of EACH answer sheet.

NOTICE: If, on erasing, a page number appears, review text (starting on that page) and erase again until "C", "CC", or "CCC" appears. For courses administered by the Center, the maximum number of points (or incorrect erasures) will be deducted from each item which does NOT have a "C", "CC", or "CCC" uncovered (i.e., 3 pts. for four choice items, 2 pts. for three choice items, and 1 pt. for T/F items).

While working on a course a student may refer freely to open-book texts and references. He may seek advice and instruction from others on problems arising in the course, but the solutions submitted must be the result of the student's own work and decisions. The student is prohibited from referring to or copying the solutions of others, or giving completed solutions to anyone else taking the same course. Noncompliance can result in suspension from the course by the administering activity and disciplinary action by the Chief of Naval Personnel.

Assignment 1

Air Controlman Rating and Military Aircraft Designation and Characteristics

Text: Pages 1 - 19

Learning Objective: Recognize the AC rating as a general rating, the duties performed by the AC3 and AC2, the medical standards necessary to be an AC, and the advancement opportunities available.

1-1. A general rating is one which reflects qualifications in
1. civilian skills identified with a peacetime Navy
2. civilian skills identified with a wartime Navy
3. broad occupational fields of related duties and functions
4. subdivisions or specialties within broad occupational fields

1-2. The rating structure for enlisted personnel in the AC rating provides for
1. one general rating and two service ratings
2. two service ratings only
3. two general ratings and one service rating
4. a general rating only

1-3. AC3s and AC2s may be assigned the responsibility for performance of which of the following functions?
1. Maintaining current flight planning information
2. Directing aircraft in all kinds of weather
3. Assisting pilots in preparing and processing flight plans and clearances
4. All of the above

1-4. As you advance, your success is judged increasingly in terms of the
1. amount of work you do
2. amount of efficient work your men do
3. number of different billets you fill
4. neatness and orderliness of the work areas for which you are responsible

1-5. To be considered for the Air Controlman rating, an applicant must pass a medical examination as prescribed by FAR, Part 67.

1-6. Air Controlmen are required to possess a Third Class medical certificate.

1-7. In addition to receiving an increased amount of pay, what are the personal benefits realized from advancement?
1. A feeling of accomplishment
2. Increased challenge and interesting job assignments
3. Increased respect from superiors and subordinates
4. All of the above

1-8. The AC3's or AC2's worth to the Navy is judged in part on the basis of the qualities of leadership he displays.

● Refer to figure 1-1 in your textbook in answering items 1-9 and 1-10.

1-9. At what rate level does the AC have his first opportunity to apply for advancement to Warrant Officer?

1. E-6
2. E-7
3. E-8
4. E-9

1-10. At what step in your path of advancement will you have your first opportunity to apply for advancement to Limited Duty Officer?
1. E-6
2. E-7
3. E-8
4. E-9

1-11. Applicants eligible for Warrant Officer or Limited Duty Officer are selected according to scores obtained on an Officer Battery Exam.

Learning Objective: Recognize the requirements necessary for advancement, how appropriate training material can be found for applicable rate levels, and how Personnel Qualification Standards (PQS) apply to you.

1-12. Refer to figure 1-2 in your textbook. A Navy-wide examination for advancement to petty officer is first administered to personnel in what pay grade?
1. E-2
2. E-3
3. E-4
4. E-6

1-13. After an AC striker has met all the requirements for advancement to AC3, he is automatically advanced to this rate level.

1-14. The publication which delineates the minimum requirements for advancement is the
1. Naval Aeronautic Publications Index, NAVAIR 00-500
2. Bibliography for Advancement Study, NAVEDTRA 10052 (Series)
3. Manual of Qualifications for Advancement, NAVPERS 18068 (Series)
4. List of Rate Training Manuals and Correspondence Courses, NAVEDTRA 10061 (Series)

1-15. Practical factors are things you must be able to DO in order to perform the duties of your rate.

1-16. Before being advanced to AC2 and AC3, you may be required to demonstrate your proficiency at performing skills established for the AC3 level.

1-17. The Bureau of Naval Personnel keeps the Manual of Qualifications for Advancement, NAVPERS 18068 (Series), current through the issuance of
1. study materials
2. changes
3. bibliographies
4. new manuals

1-18. Before referring to the Manual of Qualifications for Advancement you should make sure that you have the latest revision and that all pertinent changes have been incorporated.

1-19. Which of the following statements about the PQS presently being developed is INCORRECT?
1. They will provide guidelines on specific equipment and systems for ACs preparing for advancement
2. They will require ACs to attend special on-the-job training programs for advancement
3. They will provide analyses of specific duties, assignments, and responsibilities for specific ratings
4. They will provide advancement and qualification standards based on the "Quals" Manual

In items 1-20 through 1-23, select from column B the PQS subdivision which provides each category of information listed in column A.

	A. Information	B. Subdivisions
1-20.	Operational and maintenance procedural questions	1. 100 Series
		2. 200 Series
1-21.	Qualification cards to record individual satisfactory progress of assigned duties	3. 300 Series
		4. 400 Series
1-22.	The prerequisite background theory required for the study of specific equipment	
1-23.	A breakdown of equipment into sections for functional study	

1-24. When an AC is transferred to another activity, how may he answer the PQS questions of the required evaluator in order to requalify?
1. By giving the supervisor oral answers to his questions only
2. By submitting written answers to the supervisor's questions only
3. By performing skills on applicable equipment only
4. By oral or written answers to the supervisor's questions

1-25. The Record of Practical Factors, NAVEDTRA 1414/1 (AC), provides a history of an AC's
1. general performance on the job
2. demonstration of skills required for advancement
3. grades of examinations required for advancement
4. military qualifications relative to other men in his rating

1-26. What action should you take if you are transferred to another duty station before qualifying in all practical factors?
1. Make sure your NAVEDTRA 1414/1 (AC) is removed from your service record
2. Make sure your service record contains your NAVEDTRA 1414/1 (AC) before being transferred
3. Requalify in all practical factors
4. Make sure the remaining practical factors are recorded on a new NAVEDTRA 1414/1 (AC) as they are completed

1-27. In qualifying for advancement, demonstration of your ability to perform practical requirements has the same relationship to practical factors as demonstration of your professional knowledge has to
1. written examinations
2. performance tests
3. Navy training manuals
4. correspondence courses

1-28. Before being eligible to take the Navy-wide advancement examination for a rate, the AC must complete those Rate Training Manuals marked with an asterisk (*) in which publication?
1. Bibiography for Advancement Study, NAVEDTRA 10052 (Series)
2. Record of Practical Factors, NAVEDTRA 1414/1 (AC)
3. List of Rate Training Manuals and Correspondence Courses, NAVEDTRA 10061 (Series)
4. Manual of Qualifications for Advancement, NAVPERS 18068 (Series)

1-29. The general qualifications common to all rates which all enlisted personnel are expected to satisfactorily complete for advancement to all rate levels are
1. knowledge factors
2. practical factors
3. military requirements
4. professional qualifications

Learning Objective: Recognize the different types of Rate Training Manuals, how they are identified, recommended study habits to complete the nonresident career course, and sources where training material may be procured.

1-30. What kind of manual is Air Controlman 3 & 2, NAVEDTRA 10367-F?
1. Basic
2. Rating
3. General
4. Subject matter

1-31. The word "basic" as used in Rate Training Manual titles has which meaning relative to the material in the manual?
1. It is common to several Navy ratings
2. It should be studied by all Navy personnel
3. It is simple and fundamental enough to be understood by beginners
4. It is basic or fundamental to the rating from which the manual's title is derived

1-32. Your textbook, Air Controlman 3 & 2, NAVEDTRA 10367-F, is a revision of the original Rate Training Manual.

1-33. It is recommended that in studying a Rate Training Manual for advancement you should begin by
1. reading the introductions, headings, and subheadings of each chapter
2. outlining the entire manual
3. preparing a list of questions to be answered as study progresses
4. familiarizing yourself with the entire manual

1-34. The reason why suggestions 4 and 7 are included in the list of study suggestions given in your textbook is that in following them, you
1. write an outline of the manual which will be a valuable reference for future study
2. are able to peg each subject to an individual qualification as given in the "Quals" Manual
3. are able to separate the military qualifications from the professional qualifications in the textbook
4. familiarize yourself with the aims and contents of the manual and relate the subject areas to your past experiences, thereby creating an excellent learning situation

1-35. A good method for determining what you have learned from studying a chapter in a training manual is to write the main ideas in your own words.

1-36. How can you be sure that you are getting the latest professional information needed for advancement?
1. By screening available films and utilizing those applicable to your rating
2. By utilizing only the latest revision of publications that are periodically revised
3. By ensuring that all official changes have been inserted in the pertinent publications requiring change insertion
4. All of the above

Learning Objective: Identify military aircraft designations.

In answering items 1-37 through 1-43, refer to tables 2-1 and 2-2 in your textbook, as applicable.

1-37. Aircraft procured in limited quantities to develop the potentialities of the design are given which status prefix letter?
1. Z
2. Y
3. N
4. J

1-38. Aircraft in the research stage of development are given what basic or modified mission symbol?
1. J
2. N
3. X
4. Z

1-39. All but which of the following are modified mission symbols for military aircraft?
1. H
2. R
3. P
4. W

1-40. The letter E in an aircraft designation indicates that the modified mission of the aircraft could be which of the following?
1. Attack
2. Observation
3. Antisubmarine
4. Airborne early warning

1-41. Aircraft designed for in-flight refueling of other aircraft are identified by which modified mission symbol?
1. R
2. K
3. B
4. A

1-42. Cargo/transport aircraft have a modified mission symbol of
1. A
2. C
3. P
4. T

1-43. Which of the following designates an aircraft used for training pilots?
1. DT-28B
2. T-39D
3. UH-43C
4. YEA-3A

In items 1-44 through 1-47, refer to the military aircraft designation RA-5C. Select from column B the meaning of each symbol listed in column A.

	A. Symbols	B. Meaning
1-44.	R	1. Basic and/or modified mission symbol
1-45.	A	2. Series symbol
1-46.	5	3. Modified mission symbol
1-47.	C	4. Design number

1-48. Which symbol in the military aircraft designation YSH-34J indicates the type of aircraft?
1. H
2. J
3. S
4. Y

1-49. What does the aircraft designation YLB-8B indicate?
1. An experimental fighter modified with special electronic equipment in its first series of basic design
2. A prototype, cold-weather bomber in its first series change of the basic design
3. An experimental reconnaissance fighter in its first series of the basic design
4. A permanently grounded attack fighter used for instructional purposes in its eighth series of basic design

Learning Objective: Recognize pilot and control tower operator responsibilities and aircraft performance and maneuverability characteristics.

1-50. Even though the control tower operator issues a clearance permitting a pilot to make a landing, the pilot is NOT relieved of the responsibility for handling his aircraft cautiously.

1-51. What is the reason for jet aircraft being equipped with drogue chutes and afterburners?
1. To allow them to utilize shorter runways
2. To allow them to take off and land crosswind
3. To allow them to take off and land with the wind
4. Each of the above

1-52. Relative to aircraft performance, it is true that the higher field elevation (altitude), the
1. lower the rate of climb will be and the longer the takeoff distance required
2. lower the rate of climb will be and the shorter the takeoff distance required
3. higher the rate of climb will be and the longer the takeoff distance required
4. higher the rate of climb will be and the shorter the takeoff distance required

1-53. In addition to the information given in the preceding item, another aircraft performance characteristic is that as the density of the air increases, the lift
1. decreases
2. increases
3. remains the same
4. decreases momentarily and then increases

1-54. ACs are vitally concerned with the wake turbulence created by both jet and reciprocating-engine aircraft because such turbulence can remain in the approach and landing area for several minutes and endanger other aircraft landing or taking off.

1-55. The air turbulence created by a jet engine will decrease if the afterburner is utilized.

1-56. During ground operations, more turbulence is created by a jet aircraft when it is moving than if it is holding.

1-57. An AC who has received a request for landing instructions must consider aircraft performance as related to which of the following?
1. The aircraft landing speed and the approach pattern
2. The runway length and the barometric pressure
3. The position of all other aircraft under his cognizance
4. All of the above

Learning Objective: Recognize aircraft operational characteristics.

1-58. The configuration of the A-4's landing gear presents a problem of stability when the aircraft lands or takes off under crosswind conditions.

In items 1-59 through 1-61, select from column B the type of aircraft most closely identified by each statement in column A.

A. Statements	B. Aircraft
1-59. A two-engine jet aircraft capable of taking off in about 5,000 feet and landing in about 3,000 feet	1. P-3 2. C-130 3. F-4
1-60. A four-engine turboprop aircraft with a climb rate of 1,500 fpm, a cruise speed of 350 kt, and a capability of operating on two engines for about 17 hours	4. F-8
1-61. A four-engine turboprop aircraft capable of taking off in about 3,500 feet and landing in about 2,200 feet.	

1-62. Which of the newer types of aircraft requires such little takeoff and landing areas that it can operate from unprepared fields?
1. AV-8A Harrier
2. F-14 Tomcat
3. OV-10 Bronco
4. S-3A Viking

Learning Objective: Indicate the meanings of terms and abbreviations contained in the Federal Aviation Regulations (FAR, Part 1). (Appendix III)

1-63. Any contrivance used or intended for flight in the air is known as an
1. airplane
2. aircraft
3. airship
4. airfoil

1-64. The objective of an air traffic clearance is to prevent
1. known aircraft from colliding
2. unknown aircraft from colliding
3. a known and an unknown aircraft from colliding
4. unnecessary flights from being scheduled

In items 1-65 through 1-67, select from column B the term associated with each FAR definition listed in column A.

	A. Definitions	B. Terms
1-65.	An altitude of constant atmospheric pressure related to 29.92 in. mercury	1. Air Traffic
1-66.	Aircraft operating in the air or on the airport surfaces, excluding loading ramps and parking areas	2. Flight level
1-67.	Weather conditions below the acceptable minimums for flight under visual flight rules	3. IFR conditions
		4. Indicated air-speed

1-68. Puerto Rico and the airspace over it are included when geographical reference is made to the
1. islands of the Atlantic near the United States
2. United States
3. Carribean area
4. North American continent

In items 1-69 through 1-71, select from column B the definition of each FAR term in column A.

	A. Terms	B. Definitions
1-69.	Controlled airspace	1. The exercise of authority over initiating, conducting, or terminating a flight
1-70.	Operational control	2. Designated airspace within which the flight of aircraft, while not wholly prohibited, is subject to restriction
1-71.	Positive control	3. The control of all air traffic within designated airspace by air traffic control
		4. Airspace designated as such within which some or all traffic may be subject to air traffic control

In items 1-72 through 1-74, select from column B the meaning of each abbreviation listed in column A.

	A. Abbreviations	B. Meanings
1-72.	TACAN	1. The maximum IFR altitude authorized for aircraft flying under instrument flight rules
1-73.	VOR	2. A tactical air navigational aid operating on ultra-high frequency
1-74.	MAA	3. An automatic direction finding beacon
		4. An omnirange station operating on very high frequency

Assignment 2

Federal Air Regulations

Text: Pages 20 - 45

Learning Objective: Recognize those portions of FAR 65 applicable to the issuance of air traffic control tower certificates or facility ratings and the application of those regulations governing the exercise of privileges of the basic certification or facility rating.

● In items 2-1 through 2-3, assume that you were issued an air traffic control operator certificate under FAR 65 on 19 Jan 1975.

2-1. If this certificate were revoked 6 June 1975 and the order of revocation made NO provision otherwise, when could you apply for another certificate of the same kind?
1. 6 Sep 1975
2. 1 Jan 1976
3. 19 Jan 1976
4. 6 Jun 1976

2-2. This certificate was issued for what length of time?
1. 1 year
2. 6 months
3. 90 days
4. Until surrendered, suspended, or revoked

2-3. If this certificate were destroyed, you would apply in writing to the FAA Airman Certification Branch, Federal Aviation Administration for a new one and may carry a telegram from the FAA confirming issuance of your certificate as a certificate pending receipt of a duplicate.

2-4. Which of the following statements indicates that an applicant who failed to make a passing grade on the written test for a control tower operator certificate is ready for re-examination?
1. He applies for retesting in 15 days
2. He receives 5 hours of instruction from a certificated and appropriately rated ground instructor in each subject failed
3. He receives 10 hours of instruction in all subject areas of the test
4. He presents a statement within 30 days that he has studied each subject he failed on the test

2-5. What OPNAV Instruction promulgates the applicability of Federal Air Regulations, Part 65, to Navy ACs?
1. 3722.2 (Series)
2. 3271.1 (Series)
3. 3721.1 (Series)
4. 3723.2 (Series)

2-6. In addition to being mentally and physically fit for an air traffic control tower operator certificate, the applicant must also qualify in which of the following respects?
1. Be able to read, write, and understand the English language, and to speak it clearly and distinctly
2. Be of good moral character
3. Be at least 18 years old
4. All of the above

2-7. Familiarity with which of the following is essential to qualify as a control tower operator?
1. Airman's Information Manual
2. Notices to Airmen
3. Flight Information Publication System
4. Both 1 and 2 above

2-8. What is the minimum amount of time that a control tower operator must satisfactorily serve before being eligible to apply for a facility rating?
1. 6 months
2. 2 months
3. 12 months
4. 4 months

2-9. A controller possessing a facility rating for a particular control tower is authorized to issue clearances for IFR flights without prior coordination with the appropriate Air Route Traffic Control Center.

2-10. Under normal conditions, a certified air traffic control tower operator must be relieved of all duties after remaining on duty a maximum of how many consecutive hours?
1. 7 hr
2. 8 hr
3. 10 hr
4. 24 hr

2-11. A person holding a control tower operator certificate or medical certificate, or both, shall present it (them) for inspection upon request by whom?
1. An authorized representative of the National Transportation Safety Board
2. Any federal, state, or local law enforcement officer
3. The Administrator of the National Transportation Safety Board
4. Any of the above

2-12. The holder of an air traffic control tower operator certificate may NOT perform any duties under his certificate if he has served only 3 of the preceding 6 months as an operator at the airport to which his facility rating applies.

Learning Objective: Recognize the extent of controlled airspace and identify the types and limits of such airspace and associate restrictions pertinent thereto.

2-13. Federal airways are normally how wide?
1. 8 nautical miles
2. 8 statute miles
3. 4 nautical miles
4. 4 statute miles

2-14. In relation to Federal airways, what is significant about the airspace above Hawaii?
1. This area has the lowest upper limit in the Federal airway system
2. The airways over this area begin at 1,200 feet and extend to 18,000 feet
3. There is an airway upper limit in this area, but it is revised and altered semiannually
4. There is no upper limit to the airways above this area

2-15. A control area may include all but which of the following?
1. A Federal airway
2. A control area extension
3. The continental control area
4. An additional control area

2-16. Terminal control areas are designated as such commensurate with the
1. ratio of takeoffs to landings
2. volume of traffic and number of passengers carried
3. number and experience of control tower personnel
4. RADAR available

2-17. Which of the following is a description of the area defined in FAR 71.13?
1. An area of controlled airspace upward from 1,200 feet wherein instrument landing procedures are uncontrolled
2. An area at the intersection of more than two airways of less than standard size
3. An area designated a transition area in conjunction with an airway, or segment of an airway, beginning at 1,200 feet above the surface of the earth
4. Any area where airways come together upward from 1,200 feet

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Learning Objective: Recognize the types of and restrictions to special use airspace in order to provide assistance to pilots utilizing or requiring transition through these areas.

In items 2-18 through 2-20, select from column B the area of special use airspace that is most closely related to each statement in column A.

	A. Statements	B. Special Use Areas
2-18.	Flights are not restricted in this area, but pilots are advised to avoid it during periods of special use	1. Restricted
		2. Prohibited
		3. Alert
2-19.	Flights are not restricted in this area, but pilots should be informed that a high volume of pilot training or unusual type of aerial activity is taking place in it	4. Warning
2-20.	Pilots are not allowed to fly into this area except by special permission	

2-21. The using agency of a Restricted area shall accomplish all but which of the following?
1. Schedule activities within the area
2. Authorize flight through or within the area
3. Contain activities within the area
4. Provide positive control within the area

Learning Objective: Recognize jet routes and advisory areas as a portion of the National Airspace System.

2-22. Between what altitudes are jet routes established?
1. 3,000 feet AGL to 14,499 feet
2. 14,500 feet to 17,999 feet
3. FL 180 to FL 450
4. FL 460 to FL 600

2-23. Each jet route consists of a direct course for navigating aircraft.

2-24. Jet advisory areas consist of airspace as designated, within the continental control area.

For items 2-25 through 2-28, select from column B the response associated with column A.

A. Advisory area	B. Response
2-25. Enroute radar jet advisory	1. Does not include airspace within positive control areas
2-26. Terminal radar jet advisory	2. Includes jet routes from FL 270 through FL 310 inclusive
2-27. Nonradar jet advisory	3. Includes the area within 14 miles either side of the VOR/VORTAC radials
2-28. Jet advisory areas	4. Includes the area within 14 miles either side of the jet route

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Learning Objective: Recognize regulations governing the operation of aircraft as prescribed by FAR, Part 91.

2-29. During transoceanic flight, a Pan American jet aircraft is subject to the specific rules of
1. Annex 2 to the convention on International Civil Aviation
2. the company or agency responsible for the flight
3. the country in which the aircraft is to land
4. FAR 2

2-30. Before beginning an IFR flight, the pilot in command must determine the fuel requirements for the flight. In addition, what other information must he be familiar with?
1. Alternatives available if the flight cannot be completed
2. Any known traffic delays of which he has been advised by ATC
3. Weather reports and forecasts
4. All of the above

2-31. Relative to formation flying, which of the following is expressly forbidden by Federal Aviation Regulations?
1. An Air Force B-52 conducting air-to-air refueling operations with a KC-135
2. A flight of Navy A-4s
3. Two American Airlines DC-9s carrying paying passengers
4. Six T-28s of the Naval Air Training Command under instruction

2-32. Which type of aircraft has right-of-way priority over all the other types listed?
1. Glider
2. Airship
3. Helicopter
4. Any of the above that is in distress

2-33. If an aircraft on a heading of 045 degrees and a glider on a heading of 220 degrees meet one another at the same altitude, what action should be taken?
1. The aircraft should give way
2. Both must give way to the right
3. Both must give way to the left
4. The glider must descend to pass well clear

2-34. In which of the following situations does the first named aircraft have the right-of-way over the second?
1. An A-7 overtaking an A-4E
2. An F-8C approaching an A-6 head-on
3. An F-8C converging with another F-8C on its right
4. A P-3B being overtaken by an A-4E

2-35. A jet aircraft may be flown at a speed of more than 200 kt in an airport traffic area provided
1. approval is obtained from the nearest flight service station
2. the aircraft does not exceed an altitude greater than 3,000 ft
3. the duration of the excess-speed flight will not exceed 5 min
4. the operational limits of the aircraft are such that it cannot be safely flown at a slower speed

2-36. According to Federal Aviation Regulations, which of the following is the minimum level above which acrobatic flight in an aircraft is permitted?
1. 500 feet MSL
2. 500 feet above the surface of the earth
3. 1,500 feet MSL
4. 1,500 feet above the surface of the earth

2-37. Aircraft position lights are specified as essential and must be lighted under which of the following conditions?
1. On all IFR flights
2. Between sunrise and sunset
3. Between sunset and sunrise
4. All of the above

2-38. A pilot may change his flight plan from IFR to VFR provided
1. an amended clearance is not required
2. his aircraft is outside positive controlled airspace and the weather permits VFR operations
3. his aircraft is in VFR weather conditions regardless of the type of airspace he is within
4. the change will take place definitely outside of the controlled airspace

2-39. In an emergency situation in which an aircraft cruising at 6,000 feet receives priority over other aircraft from ATC to make an emergency descent, to whom and under what conditions must the pilot submit a written report?
1. To the FAA Regional Office concerned within 24 hours
2. To the FAA Regional Office concerned, if requested, within 24 hours
3. To the chief of that ATC facility, if requested, within 48 hours
4. To the chief of that ATC facility within 48 hours

2-40. An aircraft approaching a congested area must pass a 500-foot television tower that is 1,000 feet to the right of the flight path. What is the minimum altitude that the pilot must maintain over the town?
1. 1,000 ft
2. 1,500 ft
3. 2,000 ft
4. 2,500 ft

2-41. The minimum safe altitude over other than congested areas is
1. 500 feet above the surface
2. 600 feet above the surface
3. 800 feet above mean sea level
4. 1,000 feet above mean sea level

2-42. Which of the following types of aircraft is generally exempted from the minimum safe altitude restrictions in the Federal Aviation Regulations?
1. Glider
2. Helicopter
3. Jet engine aircraft
4. Reciprocating engine aircraft

2-43. What is the lowest usable flight level in an area of operation where the current reported altimeter setting is 28.65?
1. 185
2. 190
3. 195
4. 200

2-44. If an airport has NO obstructions in its airport traffic area, what is the minimum altitude AGL that should be maintained by a jet aircraft?
1. 1,000 ft
2. 1,500 ft
3. 2,000 ft
4. 2,500 ft

2-45. The final authority for use of a runway for takeoff including an assigned preferential runway where the safe operation of an aircraft is concerned rests with the
1. chief airport traffic controller
2. air traffic controller with a facility rating
3. pilot of the aircraft concerned
4. operations officer

2-46. If a pilot has requested taxiing instructions for takeoff and the tower has issued a clearance to "taxi to" the runway for his takeoff, which of the following statements indicates the correct compliance with taxi procedures according to FAR 91.87?
1. The pilot taxies across intersecting runways and onto his assigned runway and immediately commences his takeoff
2. The pilot taxies across intersecting runways and turns onto his assigned runway and halts for further instructions from the tower
3. The pilot taxies across intersecting runways and stops at the entrance to his assigned runway for further instructions from the tower
4. The pilot halts at each intersecting runway as he taxies to this assigned runway, requesting further tower clearances at each halt

2-47. If a fixed wing aircraft is to operate within a Group I terminal control area, it must be equipped with all but which one of the following?
1. An operable two-way radio capable of using the appropriate frequencies for that control area
2. An operable radar beacon transponder having at least a Mode A/3 64-code capability
3. VOR or TACAN receiver
4. An operable doppler system

2-48. In order for a helicopter to operate in a Group I terminal area, it must have an operable VOR or TACAN receiver.

2-49. In the event of a disaster, who has the responsibility to impose temporary flight restrictions in order to provide a safe environment for relief aircraft?
1. Flight service station
2. FAA Administrator
3. Airport manager
4. Tower chief

2-50. No person may operate an aircraft in the vicinity of the President contrary to the restrictions established by the
1. White House
2. Secret Service
3. FAA Administrator
4. President

2-51. Refer to table 3-1 in your textbook. For VFR flight outside of controlled airspace above 1,200 feet, the minimum horizontal distance from clouds is
1. 100 ft
2. 500 ft
3. 1,000 ft
4. 2,000 ft

2-52. When flight visibility is less than 1 mile, an aircraft may be operated if
1. the pilot has cancelled his IFR clearance and is proceeding VFR
2. it is in a control area and the pilot has a clearance from the tower
3. it is over a sparsely populated area and all minimums of safe altitude rules are observed
4. it is a helicopter operating outside of controlled airspace at or below 1,200 feet above the surface at a reduced speed

2-53. No aircraft, other than helicopters, may be operated in VFR flight under any circumstances when the visibility is less than how many statute miles?
1. One mile
2. Two miles
3. Three miles
4. Four miles

2-54. The pilot of a C-118 is planning a VFR flight below 18,000 feet from NAS Alameda to NAS North Island. The navigator has computed a magnetic heading of 160 degrees for the flight. At which of the altitudes listed below could the flight be made?
1. 14,500 ft
2. 15,500 ft
3. 16,000 ft
4. 17,000 ft

2-55. The pilot of an A-4 plans to fly VFR above 18,000 feet on a magnetic heading of 255 degrees between Chicago and Denver. The flight could be made by flying at a flight level of
1. 195
2. 215
3. 225
4. 235

2-56. If a pilot is scheduled to fly his aircraft in controlled airspace under IFR conditions, he must file an IFR flight plan and receive the proper clearance from air traffic control.

2-57. If the RVR minimum for an instrument approach procedure is 5,000 feet, but the RVR for the runway of intended landing is NOT reported, the pilot may land his aircraft if the visibility is
1. 1/2 statute mile
2. 7/8 nautical mile
3. 1 statute mile
4. 1 1/4 nautical miles

2-58. Which of the following statements about cruising altitudes in controlled airspace under IFR conditions is correct?
1. They are determined by the course being flown and the true airspeed filed
2. They are assigned by air traffic control
3. They are assigned as either even or odd as predetermined and specified by the Administrator and published in flight information publications
4. They are requested from, and assigned by, Flight Service for all aircraft as specified in En Route Air Traffic Control Handbook 7110.9

2-59. An aircraft on an IFR flight plan operating in VFR weather conditions experiences radio failure and the pilot is NOT able to maintain two-way radio communications. What should he do?
1. Proceed under VFR and land as soon as practicable
2. Maintain his last assigned altitude and proceed to his alternate airport
3. Fly in close proximity to the nearest control tower en route, show a landing light, and wait for further clearance via blinker and/or flag hoist
4. Maintain his last assigned cruising altitude, reverse his course, and return to the last navaid checked en route, starting immediate descent upon reaching the range

2-60. Which of the following items must be included in all reports to ATC containing information applicable to situations described under FAR, Part 91.129?
1. Name of the operator sending the message
2. Aircraft's identification
3. Altitude and heading of the aircraft from which the message is relayed
4. Pilot's identification

Learning Objective: Recognize the terms used in IFR altitudes (FAR, Part 95), and describe the rules governing aircraft operation in a defense area (FAR, Part 99).

In items 2-61 through 2-63, select the correct response from column B as applicable to the terms listed in column A.

A. Terms		B. Response
2-61.	MAA	1. Assures navigational signal reception and obstruction clearance between fixes
2-62.	MEA	2. The lowest altitude at which an intersection can be determined
2-63.	MRA	3. Navigational signals are assured only within 25 miles of the VOR station concerned
		4. Adequate reception of navigational aid signals is assured

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2-64. The minimum obstruction clearance altitude (MOCA) assures obstruction clearance between specified fixes, but adequate reception of navigational signals is assured only within
1. 15 miles of the TACAN station concerned
2. 25 miles of the VOR station concerned
3. 50 miles of the TACAN station concerned
4. 75 miles of the VOR station concerned

2-65. Which of the following flights conducted within an Air Defense Identification Zone (ADIZ) is exempted from normal FAR requirements for ADIZ flights?
1. Two F-8s crossing through the ADIZ at its lowest boundary under VFR flight
2. An unscheduled air carrier carrying cargo to a military installation within the ADIZ
3. An A-4 from a base within the ADIZ on an approved test hop to remain within 10 nautical miles of the base
4. A scheduled foreign airliner

2-66. If an aircraft is scheduled for a flight in the Alaskan Coastal ADIZ, what type of flight plan must the pilot file prior to the flight?

1. An IFR only
2. A DVFR only
3. A DVFR or IFR
4. Both a DVFR and an IFR

2-67. If an aircraft will penetrate the domestic ADIZ on a flight from Mexico to Texas in an area where NO appropriate reporting points are available and the pilot has computed an estimated penetration time of 1805, he must report this estimated time to an appropriate aeronautical facility by at least

1. 1720
2. 1735
3. 1750
4. 1800

Assignment 3

Basic Air Navigation

Text: Pages 47 - 68

Learning Objective: Recognize the basic fundamentals and terminology of air navigation, the problems encountered, and how to arrive at their solutions.

3-1. The AC should be familiar with the fundamentals of air navigation in order to assist pilots in planning and completing flights.

3-2. What is the function of air navigation?
1. To measure the distance of an intended flight and to estimate the time needed to make it
2. To locate positions along an intended flight and at its termination
3. To determine the direction necessary to accomplish an intended flight
4. All of the above

In items 3-3 through 3-6, select from column B the definition of each navigational term listed in column A.

A. Terms	B. Definitions
3-3. Position	1. The spatial separation between two points
3-4. Direction	2. Some place that can be identified
3-5. Distance	3. The position of one point in space relative to another without reference to distance between them
3-6. Time	4. An elapsed interval

3-7. What is the primary instrument used in air navigation?
1. A globe of the earth
2. A chart of the earth's surface
3. A set of dividers
4. A navigational plotter

3-8. Even though the greatest diameter of the earth is 26 miles longer than the polar axis, this difference constitutes such a small percentage that it is NOT taken into account for navigational purposes.

3-9. A position on the earth's surface in relation to a city is useful in identifying an aircraft's position while crossing the Atlantic Ocean.

3-10. In aerial navigation, position is expressed in terms of coordinates which are intersections of imaginary lines on the surface of the earth.

Refer to figure 4-1 in your textbook in answering items 3-11 and 3-12.

3-11. Which of the following statements about a great circle on the earth's surface is INCORRECT?
1. It always passes through both poles
2. It divides the earth into equal halves
3. Its plane passes through the earth's center
4. It may be drawn through any point on the earth's surface

3-12. Which of the following statements describes a characteristic of a small circle on the earth's surface?
1. The plane of the small circle passes through the center of the earth
2. The plane of the small circle is parallel to the plane of the Equator
3. The circumference of the small circle is less than the circumference of the Equator
4. The diameter of the small circle is at least as great as the radius of the earth

3-13. Which of the following statements about the Equator is correct?
1. Its plane divides the earth into the Northern and Southern Hemispheres
2. Every point on it is 90° from both North and South Poles
3. Its plane is perpendicular to the earth's axis
4. Each of the above

3-14. A small circle whose plane is parallel to the plane of the Equator is called a
1. parallel of latitude
2. degree of latitude
3. meridian of longitude
4. degree of longitude

3-15. Parallels are imaginary lines that run east and west to measure distance north and south from the Equator.

3-16. The origin for the measurement of longitude on the Earth's surface is the
1. Equator
2. 45th parallel
3. Greenwich meridian
4. Earth's axis

3-17. What imaginary line is directly opposite the Greenwich meridian?
1. Equator
2. 180° meridian
3. Prime meridian
4. Great circle

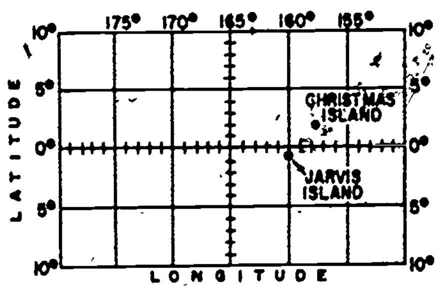


Figure 3A.--Portion of a chart

Refer to figure 3A in answering items 3-18 through 3-20.

3-18 Christmas Island is located at approximately
1. 2°00'N 157°30'E
2. 2°00'N 157°30'W
3. 2°00'S 157°30'E
4. 2°00'S 157°30'W

3-19. The difference of latitude (DL) between Jarvis Island and Christmas Island is about
1. 1°00'
2. 1°30'
3. 2°00'
4. 3°00'

3-20. The difference of longitude (DLo) between Jarvis Island and Christmas Island is
1. 2°30'
2. 3°00'
3. 3°30'
4. 4°00'

3-21. When expressing direction from one point to another on the earth's surface, what is used as the reference point?
1. Greenwich meridian
2. Equator
3. South pole
4. North pole

3-22. An aircraft on a heading of 045° is flying in which direction?
1. East
2. West
3. Northeast
4. Southwest

3-23. The magnetic meridians are lines of force which run between the north and south magnetic poles, as in any magnet, and which affect all magnetic materials.

3-24. The angle between magnetic north and true north is called
1. variation
2. deviation
3. heading
4. course

3-25. Magnetic disturbances within an aircraft cause
1. incorrect indicated airspeeds
2. deviation in the magnetic compass
3. variation in the magnetic compass
4. misalignment of the lubber's line

3-26. Swinging the compass is a phrase used to describe the process whereby the deviation in a particular compass is determined by comparing it with known magnetic headings.

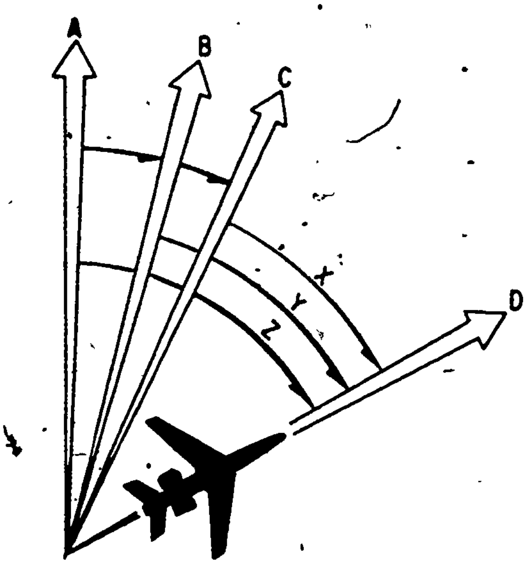


Figure 3B.--North designations in relation to an aircraft in flight.

- Refer to figure 3B in answering items 3-27 and 3-28.

3-27. If the arrow C represents compass north and the deviation and variation are both zero, which arrow represents the direction of true north?
1. A
2. B
3. C
4. D

3-28. If arrow A represents true north, angle X is 35°, angle Y is 40°, and angle Z is 50°, the total variation and deviation is how many degrees?
1. 15°
2. 35°
3. 40°
4. 50°

- Refer to figure 4-11 in your textbook in answering items 3-29 and 3-30.

3-29. If an aircraft's true heading is to be 045° when the variation and deviation are 10° east and 3° east respectively, what compass heading must be flown?
1. 032°
2. 035°
3. 038°
4. 042°

3-30. An aircraft's compass reads 060° in an area where the variation is 10° east. If the deviation of the compass is 2° west at a reading of 060°, what is the true heading of the aircraft?
1. 048°
2. 052°
3. 068°
4. 072°

3-31. The distance represented by one nautical mile is equivalent to which of the following values?
1. 2,000 yards for a short distance
2. One minute of latitude
3. 1,852 meters
4. All of the above

3-32. Inasmuch as navigators use nautical miles as the measurement of distance, they use knots as the measurement of speed.

3-33. Five hours after noon is expressed in nautical time as
1. 05:00 p.m.
2. 0500
3. 05:00 a.m.
4. 1700

3-34. When time is determined for other locations on the earth's surface, Greenwich Mean Time (GMT) is used as the standard reference.

3-35. How long does it take the sun to pass through 17° of longitude?
1. 1 hr
2. 52 min
3. 68 min
4. 26 hr

3-36. Greenwich time can also be referred to as
1. zero time
2. Zulu time
3. eastern standard time
4. central standard time

- Refer to figure 4-13 in your textbook in answering items 3-37 through 3-41.

3-37. If your watch is set on eastern standard time, how can you obtain GMT?
1. Add 4 hr
2. Add 5 hr
3. Subtract 4 hr
4. Subtract 5 hr

3-38. To change your watch to local time from GMT upon arrival at an island located at 157°50'W, you should
1. add 10 hr
2. add 11 hr
3. subtract 10 hr
4. subtract 11 hr

3-39. If you are in Tokyo, Japan where the longitude is 139°45'E and your watch reads 1020 GMT, what is the local Tokyo time?
1. 0020
2. 0120
3. 1920
4. 2020

3-40. When the local time in Bombay (zone -5) is 0700 4 July, what is the local time in Guatemala City (zone +6)?
1. 0800 5 July
2. 1200 4 July
3. 2000 3 July
4. 2000 4 July

3-41. When the local time in Wellington, New Zealand, is 1300M 20 March, what is the local time in Honolulu (zone +11)?
1. 1200X 19 March
2. 1400X 19 March
3. 1200X 20 March
4. 1400X 20 March

3-42. Naval time signals are sent as continuous wave (CW) signals every hour during the period from
1. 00 to 05 minutes after the hour
2. 15 to 30 minutes after the hour
3. 25 to 30 minutes before the hour
4. 05 to 00 minutes before the hour

Learning Objective: Employ the fundamentals of navigational plotting to the extent that you are able to determine a position on the earth's surface.

3-43. An accurate position can be determined if an aircraft's path crosses two intersecting lines of position simultaneously.

3-44. If a pilot sees a small lake lying directly off his right wingtip and notes that his true heading (TH) is 045°, what is the true bearing (TB) of the lake?
1. 045°
2. 135°
3. 225°
4. 315°

3-45. True north is used as the reference direction when measuring which of the following?
1. MC and TH
2. MC and TAS
3. TAS and TB
4. TB and TH

3-46. The pilot of an A-6 at an altitude of 10,000 feet on a TH of 270° sights an enemy fighter bearing 220° true. What is the relative bearing (RB) from the bomber to the fighter?
1. 050°
2. 130°
3. 230°
4. 310°

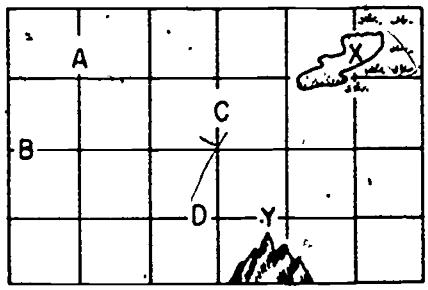


Figure 3C.--Portion of a chart showing landmarks.

Refer to figure 3C in answering items 3-47 and 3-48.

3-47. If the true heading of an aircraft is 045°, the relative bearing to the center of lake (X) is 045°, and the relative bearing to the peak of mountain (Y) is 085°, the aircraft is located at position
1. A
2. B
3. C
4. D

3-48. If the true heading of an aircraft is 045°, the relative bearing to the center of lake (X) is 035°, and the relative bearing to the peak of mountain (Y) is 105°, the aircraft is located at position
1. A
2. B
3. C
4. D

3-49. A pilot flying cross-country notes a railroad bridge on his chart at a TB of 050° from his 0900 way point. His TH is 320°, and the way point is directly on the course. His predicted TR has been maintained throughout his flight, and his ETAs at way points have been to the minute. If he continues to make his predicted TR and GS, he will see the bridge at 0900 on a RB of about
1. 010°
2. 090°
3. 190°
4. 270°

3-50. What can a pilot use to determine a fix?
1. TACAN only
2. LORAN only
3. RADAR only
4. All of the above

Learning Objective: Recognize information shown on aeronautical charts and chart source, correction, and procurement.

3-51. Which type of surface is considered to be undevelopable for chart purposes?
1. Cone
2. Cylinder
3. Plane
4. Sphere

In items 3-52 through 3-54, select from column B the desirable chart feature described by each statement in column A.

A. Statements	B. Features
3-52. The parallels and meridians intersect at right angles	1. Correct shape representation
3-53. The distance of every place from every other place bears a constant ratio to true distance on the earth	2. Constant and correct scale
3-54. The chart is conformal, and the scale is constant and correct in all directions	3. Coordinates easy to locate
	4. Conformality

3-55. A line which makes the same oblique angle with all meridians is called a
1. track line
2. rhumb line
3. loxodromic curve
4. great circle course line

3-56. Which of the following is the definition of an aeronautical chart?
1. A map used by oceanographers only at sea
2. A pictorial representation of the earth and its culture
3. A blank piece of paper upon which grid lines have been superimposed
4. A blank piece of paper upon which a map showing the entire surface of the earth is superimposed

Items 3-57 through 3-59 refer to figure 4-16 in your textbook.

3-57. Which chart projection has a straight rhumb line?
1. Mercator
2. Lambert Conformal
3. Polar Stereographic
4. Transverse Mercator

3-58. Which chart projection shows the least distortion of shapes and areas?
1. Mercator
2. Lambert Conformal
3. Polar Stereographic
4. Transverse Mercator

3-59. Which chart projection can be produced graphically?
1. Mercator
2. Lambert Conformal
3. Polar Stereographic
4. Transverse Mercator

3-60. Which of the following areas is likely to be represented by the smallest scale chart?
1. California
2. NAS, Alameda
3. The United States
4. The west coast of the United States

In items 3-61 through 3-63, select from column B the definition of each aeronautical chart term listed in column A.

A. Terms	B. Definitions
3-61. Graticule	1. All features portrayed except those on the aeronautical or grid overprint
3-62. Relief	2. A line connecting all points of a given elevation above sea level
3-63. Contour	3. Physical features related to relative differences in land surface elevation
	4. Lines of latitude and longitude

3-64. What technique of chart-making provides for large white open water areas and accentuates small bodies of water and small islands?
1. Water tint
2. Water vignette
3. Land tint
4. Relief

3-65. Density of culture portrayed on a chart is related to which of the following features?
1. Geographic area covered
2. Chart use
3. Chart scale
4. All of the above

3-66. Flight safety dictates that up-to-date and correct Aeronautical Charts and Flight Information Publications be available to pilots in Flight Planning.

3-67. The DOD Catalog of Aeronautical Charts and Flight Information Publications is kept current by new or replacement pages reflecting changes or additions that are published every
1. month
2. year
3. 3 months
4. 6 months

3-68. Major corrections and supplements to the aeronautical information shown on charts are published in
1. Notices to Airmen (NOTAMs)
2. DOD Aeronautical Chart Updating Manuals (CHUMs)
3. VFR Supplements
4. Flight Planning Documents

Learning Objective: Recognize the use and contents of flight packets.

3-69. The purpose of a flight packet is to provide the pilot with
1. a flight lunch
2. tools necessary to complete the flight
3. a filled-in flight plan
4. a filled-in weather brief sheet

3-70. All but which of the following factors will cause the contents of flight packets for station aircraft to vary?
1. The mission of the flight
2. The type of aircraft utilized
3. The number of aircraft utilized
4. The geographical location of the station

3-71. Aircraft squadrons VC 21 and VA 1, having 12 and 15 aircraft respectively, are based at a naval air station which has 5 station aircraft. How many flight packets must be maintained in the NAS Flight Planning/Approval Branch?
1. 33
2. 15
3. 12
4. 5

3-72. Flight packet checklists are used as
1. selection lists of items deemed necessary for the flight only
2. custody receipts for valuable materials that belong to the government only
3. safeguards to prevent omission of items that may be essential to the flight only
4. a checklist to serve all these requirements

Assignment 4

Flight Services

Text: Pages 69 - 91

Learning Objective: Recognize pilot responsibility, and assistance the AC provides to the pilot in planning a flight.

4-1. Records indicate that ACs assigned to the planning phase of aircraft clearances can help avert accidents and incidents involving aircraft by critically inspecting all flight plans and taking proper action when incompletenesses or discrepancies are detected.

4-2. A pilot planning a flight is NOT required to
1. familiarize himself with available weather reports and forecasts
2. determine fuel requirements
3. determine available alternatives and known traffic delays
4. submit his flight plan to an ARTCC facility

4-3. Although the primary responsibility for preflight planning rests with the pilot in command, this responsibility is shared by the
1. flight line crew
2. officer in charge
3. Air Controlmen
4. duty forecaster

4-4. The DD 175 Military Flight Plan must be used for all flights within the North American (NAM) Region which includes
1. the continent of North America
2. the Continental United States only
3. the 50 states and Canada to the North Pole
4. Canada to the North Pole and Continental United States

4-5. Pilots are responsible for reviewing and being familiar with weather conditions for the area in which their flight is contemplated.

4-6. After a pilot receives a weather briefing for a flight under instrument flight conditions, the DD Form 175-1 must be completed by the
1. pilot only
2. weather service forecaster only
3. either the pilot or forecaster
4. operations duty officer only

4-7. Relative to the information the pilot receives on the DD Form 175-1, the AC should assist him to ensure that the
1. weather briefing is filed
2. weather briefing is still valid at takeoff
3. weather information is accurate
4. operations duty officer sees the weather information report

4-8. If the daily flight schedule is used for clearing an aircraft for a local flight, the completed flight schedule must be retained in the base operations files for
1. 7 days
2. 30 days
3. 60 days
4. 90 days

4-9. Copies of the flight plan and weather forms for a completed flight must be kept on file for 3 months at the point of
1. departure only
2. landing only
3. departure and point of landing
4. departure or point of landing, but not both

Learning Objective: Recognize pilot limitations of flights involving en route stops and ship/shore operations, the functions of flight service stations, and means and techniques of relaying flight data.

4-10. A single DD Form 175 may be utilized for a flight which involves en route stops within the United States if a different pilot in command is used for each leg of the flight.

4-11. ACs are normally concerned with aircraft weight and balance on stopover flights.

4-12. What should be done relative to the flight plan of a VFR flight departing a carrier if communications between the ship and the shore activity specified in the flight plan as the destination airport can NOT be established?
1. The departure controller should cause the flight plan to be sent via regular naval communications
2. The pilot should file his flight plan by radio with the nearest shore activity as soon as possible after takeoff
3. The pilot should land at the nearest shore activity and file the flight plan to destination
4. The departure controllers should notify the pilot of the aircraft en route as soon as the flight plan is acknowledged by an alternate airport

4-13. The functions of the Flight Service Stations (FSS) include which of the following?
1. Accepting and closing flight plans and disseminating notices to airmen (NOTAMs)
2. Assisting lost VFR aircraft and assisting in the search for missing VFR aircraft
3. Maintaining en route communications with VFR aircraft and operating the national teletypewriter systems
4. All of the above

4-14. Communications dealing with flight plans and related messages concerning the movement of aircraft from a naval air station to an aircraft carrier are transmitted via
1. telephone
2. local interphone
3. Area B network
4. Navy communications

4-15. When an AC transmits a message on an interphone communications system, he should NOT
1. use the phonetic alphabet to spell peculiar words
2. speak into the handset in a moderate tone
3. pronounce all words clearly
4. speak faster than the receiving operator can accurately copy

4-16. Which of the following messages has the lowest priority in interphone communications?
1. A flight plan
2. A departure report
3. An ATC instruction or clearance
4. A movement message on a VFR aircraft

4-17. Which circuit is used to relay communications concerning IFR aircraft movement and control messages from one ARTCC to another?
1. Area B
2. Center B
3. Service F
4. Military B

Learning Objective: Identify data to be posted on flight progress strips and abbreviations, contractions, and symbols used for posting the data.

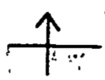
4-18. Current data on air traffic and clearances required for air traffic control and air traffic service are posted on
1. flight plans
2. DD Forms 175
3. flight progress strips
4. daily flight schedules

4-19. Flight data can be recorded on flight progress strips in plain language, the abbreviations or contractions contained in FAA Handbook 7340.1 (Series), or the control information symbols contained in FAA Handbook 7110.8 (Series).

In items 4-20 through 4-22, select from column B the branch, mission, or meaning designated by each prefix or suffix listed in column A and used in box 1 or box 3 of flight progress strips.

	A. Prefixes/ Suffixes	B. Branches/Meanings/ Missions
4-20.	VV	1. U.S. Navy
4-21.	M	2. DME, and transponder with no code capability
4-22.	/L	3. Military Airlift Command
		4. TACAN only, and transponder with no-code capability

Refer to figure 5-6 in your textbook. Select from column B the meaning of each control information symbol listed in column A and used in various boxes of both departure and arrival flight progress strips.

	A. Symbols	B. Meanings
4-23.		1. Cruise
		2. Takeoff
4-24.	>	3. At or above
		4. Before
4-25.	→	

4-26. What abbreviation is used on flight progress strips to indicate that an aircraft is cleared for landing and takeoff through an intermediate point?
1. D
2. H
3. T
4. Z

In items 4-27 through 4-29, select from column B the abbreviation that may be used on flight progress strips by approach control or control tower operators to convey each meaning listed in column A.

	A. Meanings	B. Abbreviations
4-27.	Report crossing	1. CA
4-28.	VFR conditions on top	2. RX
4-29.	Straight-in approach	3. OTP
		4. SI

Learning Objective: Recognize means and procedures for transmitting information pertaining to both VFR and IFR flights.

4-30. When flight service receives the required information for a VFR flight, the information is then transmitted to the aircraft's destination by
1. Area B teletype
2. Center B teletype
3. flight service interphone
4. Service F interphone

4-31. Upon receipt of a flight movement message, base operations is required to forward this information to flight service within how many minutes?
1. 5 min
2. 10 min
3. 20 min
4. 30 min

4-32. If the destination FSS fails to acknowledge a flight notification message from the departure FSS relative to a flight whose ETE is 2-1/2 hours after takeoff, when must the departure FSS use a regular telephone to assure delivery of the message to the destination FSS?
1. 30 minutes after departure
2. 1 hour after departure
3. 1 hour before the ETA
4. Any time before the ETA

4-33. When a flight departs after the first of three scheduled intermediate stops en route to its destination airport, the FSS serving that stop will transmit
1. the departure time to the next intermediate stopover point
2. the departure time to the remaining stopover points
3. an ETA for the next intermediate stopover point
4. an ETA for the remaining stopover points

4-34. An aircraft arrives at your station prior to your receiving a flight notification message. Who must his arrival be reported to?
1. The departure FSS tie-in
2. The destination FSS tie-in
3. The departure airport
4. All of the above

4-35. Which of the following items is NOT recorded on a DD 175 but is required when an IFR flight plan message is transmitted on a Military B teletype circuit?
1. The true airspeed
2. The aircraft identification
3. The departure point
4. The letters FP

4-36. Information relative to an IFR flight such as departure, progress, and arrival reports must be relayed to the appropriate ATC facility on a/an
1. Area B circuit
2. Center B circuit
3. Military B circuit
4. Service F circuit

4-37. If a pilot files a flight plan which includes a change from VFR to IFR en route to his destination, the proposed IFT flight plan message is relayed to the ARTCC in whose area the flight changes from VFR to IFR.

4-38. Notifying the pilot that GCA is inoperative could properly be the subject of a flight advisory to an inbound aircraft.

4-39. A flight advisory to an aircraft describing adverse weather conditions existing at a destination naval air station would be originated by the
1. destination operations
2. FSS nearest the station
3. ARTCC nearest the station
4. destination FSS tie-in station

4-40. Generally, all foreign military and overseas flights are required to clear through specified military bases.

Learning Objective: Identify conditions that require search and rescue (SAR) operations, functions of various agencies involved in these operations, and procedures followed in effecting search and rescue for both IFR and VFR flights.

4-41. Coordination of SAR operations in the conterminous United States is a responsibility of the
1. U. S. Air Force
2. Federal Aviation Agency
3. Joint Chiefs of Staff
4. International Civil Aviation Organization

4-42. Overall coordination of the SAR efforts of the various groups working together to find a missing aircraft in a particular area is the responsibility of the
1. ATCC
2. FSS
3. RCC
4. ARTCC

4-43. If a jet aircraft flying VFR fails to arrive at the ETA received from the last intermediate stop tie-in station, what period of time will elapse before an attempt is made by the destination tie-in station to locate the aircraft?
1. 15 min.
2. 30 min.
3. 45 min.
4. 60 min.

4-44. Under SAR procedures for overdue VFR aircraft, the FAA functions primarily to
1. participate directly as a searching activity along with the Armed Services
2. act as a communications link in SAR operations
3. perform rescue operations
4. act as SAR liaison

4-45. In the event that a jet aircraft for which a flight plan has been filed is overdue, an information request (INREQ) is initiated by the
1. departure base 1 hour after ETA
2. destination base 1 hour after ETA
3. departure base 30 minutes after ETA
4. destination base 30 minutes after ETA

4-46. An alert notice (ALNOT) can expand the search area for a missing aircraft to allow a communications search over a wider area than an INREQ.

4-47. Assume that an ALNOT was sent on a VFR flight that could NOT be located and the RCC suspended its search. What procedure should then be followed?
1. The originating station should advise RCC of the circumstances
2. The departure station should cancel the ALNOT
3. The originating station should send an ALNOT cancellation to all stations that received the ALNOT
4. The departure station should send an ALNOT cancellation to all stations that received the ALNOT

4-48. The station originating search and rescue of an overdue aircraft must, upon request, furnish the RCC with the positions and routes of all aircraft known to be along or near the route of the missing aircraft so that these aircraft can be used to assist in the search.

4-49. Which of the following statements best explains the absence of a standard SAR procedure in hazardous areas?
1. Remote areas do not have individual procedures
2. Specialized SAR units are always on the alert
3. Limited areas reduce the scope of SAR efforts
4. A variety of possible situations exists

4-50. The SAR procedure for an overdue IFR flight is initiated by the
1. FAS
2. FSS
3. RCC
4. ARTCC

4-51. What is the responsibility of the ARTCC which makes the determination that an IFR flight is overdue?
1. To alert the appropriate RCC
2. To transmit an ALNOT to all ARTCCs along the route of flight from the last reported position to the destination
3. To transmit an ALNOT on all Area B circuits 50 nautical miles on both sides of the route from the last reported position to the destination
4. All of the above

4-52. Responsibility for further search for an overdue IFR flight is transferred to RCC 30 minutes after
1. ETA at the destination
2. radio contact was lost
3. estimated fuel exhaustion
4. issuing the ALNOT

Learning Objective: Recognize individual and activity responsibilities for originating and executing procedures under the notices to airmen (NOTAM) system, the meanings and format of a NOTAM accountability number, services provided by the parts of the NOTAM summary, and frequency of NOTAM display board posting.

4-53. In regards to NOTAM procedures, you as an AC would NOT be concerned with
1. preparing NOTAMs for dissemination
2. receiving NOTAMs for posting
3. posting NOTAMs to the NOTAM board
4. preparing civil NOTAMs for dissemination

4-54. The USAF/USN NOTAM system is centrally coordinated and operated by the USAF Central NOTAM Facility (CNF) to provide both USAF and USN air activities with current NOTAMs.

4-55. NAS Memphis GCA will be out of service for 72 hours. What is the maximum number of hours prior to the outage that a NOTAM may be disseminated?
1. 24 hr
2. 36 hr
3. 48 hr
4. 72 hr

4-56. Which of the following is NOT a responsibility of originators of NOTAMs?
1. Notifying the commanding officer immediately of navaid malfunctions
2. Preparing NOTAMs for transmission on a specific circuit
3. Using the same accountability number for revision or cancellation of NOTAMs
4. Ensuring all stations receive the NOTAM

4-57. Local aerodrome items, such as taxiing conditions, are considered non-NOTAM information.

4-58. The first part of a NOTAM accountability number enables CNF to determine if it has received all NOTAMs from a given base, and the second part enables each base to determine if it has received all retransmitted NOTAMs.

4-59. The last three digits of the NOTAM accountability number are assigned by the
1. originator of the NOTAM
2. CNF
3. Air Force Communications Service
4. communications agency that transmits the message

4-60. Amplifying information included in the remarks section of a NOTAM, such as the time frame for the outage, makes this NOTAM a
1. new NOTAM
2. self-cancelling NOTAM
3. NOTAM time presentation
4. revised NOTAM

4-61. All dates and times expressed in NOTAMs are Greenwich Mean Time.

4-62. Which type(s) of NOTAM will utilize an accountability number that has previously been used to identify another type of NOTAM?
1. New only
2. Revised only
3. Cancellation only
4. Revised and Cancellation

4-63. The CONUS CNF will transmit a summary of active NOTAMs for its area of operation every
1. 6 hr
2. 12 hr
3. 18 hr
4. 24 hr

4-64. A NOTAM display board must be maintained in accordance with which OPNAVINST (Series)?
1. 3722.16
2. 3721.1
3. 3715.7
4. 3710.7

Assignment 5

Meteorological Elements Affecting Aviation

Text: Pages 93 - 122

Learning Objective: Identify standard sea level pressure and associated atmospheric terms, their characteristics, and effects.

5-1. Which of the following figures was adopted by the International Committee of Air Navigation as the standard sea level pressure for calibrating instruments that measure atmospheric pressure?
1. 14.70 pounds per square inch
2. 59.00 pounds per square inch
3. 29.92 inches of mercury
4. 1013.2 millibars

5-2. The layer of the atmosphere in which most of our weather occurs is the
1. exosphere
2. ionosphere
3. troposphere
4. stratosphere

5-3. Although the troposphere always has its highest vertical extent at the Equator, it is highest at any given point on the earth during the
1. spring
2. summer
3. fall
4. winter

5-4. A high-pressure area is a region in which the atmospheric pressure is
1. constantly changing
2. greater than that of neighboring regions
3. greater than 1013.2 mb at sea level
4. constantly changing, but usually greater than that of adjacent areas

5-5. When the atmospheric pressure at sea level is 30 inches of mercury, the pressure at 8,000 feet is approximately
1. 20 in.
2. 22 in.
3. 24 in.
4. 26 in.

5-6. If a pilot does NOT reset his altimeter setting after takeoff from an airport located in a high-pressure area and flies into a low-pressure area, how will the altimeter read?
1. High and the aircraft will be lower than indicated
2. High and the aircraft will be higher than indicated
3. Low and the aircraft will be lower than indicated
4. Low and the aircraft will be higher than indicated

5-7. What is a cyclone?
1. A high-pressure area with winds that circulate in a clockwise direction in the Northern Hemisphere
2. A low-pressure area with winds that circulate in a clockwise direction in the Northern Hemisphere
3. A high-pressure area with winds that circulate in a counterclockwise direction in the Northern Hemisphere
4. A low-pressure area with winds that circulate in a counterclockwise direction in the Northern Hemisphere

5-8. Which of the following factors are associated with high-pressure systems to make flying conditions more favorable than in low-pressure systems?
1. Less clouds and better daytime visibility
2. Less concentrated turbulent areas
3. Light or calm winds
4. All of the above

5-9. Which of the following statements about a hurricane is INCORRECT?
1. The wind changes direction after passage of the eye
2. A dead calm may exist in its center
3. It is accompanied by anticyclonic winds as high as 175 knots
4. It is accompanied by much rain and thunderstorm activity

5-10. A tornado differs from a hurricane in that a tornado has
1. more violent winds and a much smaller diameter
2. more violent winds and a much larger diameter
3. less violent winds and a much smaller diameter
4. less violent winds and a much larger diameter

5-11. The various types of air masses are determined by the measurement of their
1. temperature and pressure
2. humidity and temperature
3. wind velocity and pressure
4. humidity and wind velocity

5-12. What has the greatest influence upon the characteristics of an air mass?
1. The amount of humidity it contains
2. The length of time it travels
3. The path over which it travels
4. The source region

5-13. Which of the following is NOT a requirement for an area to be characterized as a good source region?
1. High pressure
2. Low pressure
3. A uniform surface
4. Uniform temperatures

5-14. Which of the following indicates maritime air of polar origin passing over a surface warmer than the air?
1. mPw
2. mPk
3. mPA
4. MPE

Learning Objective: Recognize the major cloud genera, characteristics, and levels at which they occur.

In items 5-15 through 5-17, select from column B the class of clouds associated with each cloud level listed in column A.

	A. Cloud Levels	B. Classes
5-15.	High	1. Altocumulus
5-16.	Middle	2. Cirrocumulus
5-17.	Low	3. Cumulus
		4. Stratocumulus

5-18. The lower level of which cloud type is found at heights of 16,500 feet above the ground?
1. Stratus
2. Altostratus
3. Cirrostratus
4. Cumulonimbus

5-19. Which cloud type has its lower level close to the surface of the earth?
1. Cirrus
2. Altocumulus
3. Stratocumulus
4. Cirrocumulus

5-20. Clouds of which type generally trouble pilots the least?
1. Cirrus
2. Nimbostratus
3. Stratus
4. Cumulus

5-21. What kinds of clouds may give the first signs of approaching bad weather?
1. Cirrus
2. Stratus
3. Cumulus
4. Cirrocumulus

5-22. What type of cloud is associated with the term "mackerel sky"?
1. Cirrostratus
2. Cumulonimbus
3. Stratocumulus
4. Cirrocumulus

5-23. What cloud genera abbreviation is associated with clouds that appear similar to a herd of sheep in the sky?
1. Ac
2. Ci
3. Cc
4. Sc

5-24. Clouds of which type appear as thick gray or blue-gray smooth overcast?
1. Altostratus
2. Altocumulus
3. Cirrocumulus
4. Cumulonimbus

5-25. Which type of cloud is always accompanied by precipitation?
1. Altocumulus
2. Cirrostratus
3. Stratocumulus
4. Nimbostratus

5-26. What type of cloud yields precipitation only in the form of drizzle?
1. Stratocumulus
2. Altostratus
3. Stratus
4. Nimbostratus

5-27. Which cloud belongs to a group of clouds with pronounced vertical development?
1. Altostratus
2. Cirrostratus
3. Stratocumulus
4. Cumulonimbus

5-28. A flat or anvil top is characteristic of which clouds?
1. Stratus
2. Cumulus
3. Cumulonimbus
4. Stratocumulus

Learning Objective: Identify types, effects, designations, and characteristics of fronts.

5-29. What is a front?
1. A boundary separating two different air masses
2. The face of an approaching cold air mass
3. The face of an approaching warm air mass
4. Either 2 or 3 above

5-30. What occurs when a region that is occupied by warm air is invaded by a cold air mass?
1. The cold air is forced upward
2. The cold air mixes with the warm air
3. The cold air pushes the warm air upward
4. The cold air is driven back by the warm air

5-31. All but which of the following weather characteristics are associated with the passage of a cold front?
1. Decreasing pressure
2. Decreasing humidity
3. Decreasing temperature
4. Shifting of wind direction

5-32. Cumulonimbus and nimbostratus clouds located at and immediately to the rear of a surface front characterize a
1. stationary cold front
2. warm front that is moving slowly
3. cold front that is moving slowly
4. cold front that is moving rapidly

5-33. Squall lines are associated with which type of front?
1. A warm front
2. An occluded front
3. A fast-moving cold front
4. A slow-moving cold front

5-34. A cold front is indicated on a colored weather map by a
1. red line with triangles
2. blue line
3. red line with half circles
4. blue line with triangles

5-35. What type of cloud formation usually appears first when a warm front is approaching?
1. Cirrus
2. Stratus
3. Cirrostratus
4. Nimbostratus

5-36. An occlusion occurs as a result of a
1. warm front overtaking a cold front
2. cold front overtaking a warm front
3. cold front meeting a stationary front
4. warm front meeting a stationary front

5-37. Which type of front usually causes the greatest extended period of poor flying weather?
1. Warm
2. Cold
3. Occluded
4. Stationary

Learning Objective: Recognize the characteristics and effects of water vapor in the air and the meaning of terms pertaining to saturated air.

5-38. Water in the air occurs in which form(s)?
1. Gas
2. Solid
3. Liquid
4. All of the above

5-39. Most of the weather that interferes with the operation of aircraft is directly associated with
1. pressure
2. wind velocity
3. temperature
4. some form of water

5-40. What is the maximum amount of water vapor (by volume) that can be held by air?
1. 5 percent
2. 2 percent
3. 3 percent
4. 4 percent

5-41. What determines the quantity of water vapor which can be contained in a saturated volume of the atmosphere?
1. The pressure
2. The temperature
3. The amount of air
4. All of the above

5-42. Relative humidity is defined as the
1. mass of water vapor present per unit volume of space
2. ratio of the mass of water vapor to the mass of dry air
3. ratio of the density of water vapor in the air to the density of the air
4. ratio of water vapor in the air to that required for saturation at a given temperature

5-43. The temperature to which air under constant pressure with a constant water vapor content must be cooled in order to become saturated is called the
1. relative humidity
2. dewpoint
3. fog point
4. humidity point

Learning Objective: Identify features of fog as they pertain to its composition and formation.

5-44. A cloud on the earth's surface is called fog. Which of the following statements most accurately describes this phenomenon?
1. Fog is composed of visible large water droplets
2. Fog is composed of minute, suspended, visible water droplets or ice particles
3. Fog is composed of visible water droplets and is of uniform density
4. Fog is composed of visible water droplets or ice particles that fall earthward

5-45. The basis for the prediction of fog is provided by the differential between the
1. relative humidity and absolute humidity
2. temperature and absolute humidity
3. dewpoint and relative humidity
4. dewpoint and temperature

5-46. All but which of the following changes increase the likelihood of fog formation?
1. The moisture content of the air decreases, and the temperature increases
2. The temperature decreases, and the moisture content of the air increases
3. The temperature remains constant, and the moisture content of the air increases
4. The moisture content of the air remains constant, and the temperature decreases

In answering items 5-47 through 5-53, assume that the atmospheric conditions are conducive to the formation of fog.

5-47. Which combination of meterological conditions is most likely to produce a deep and dense fog?
1. A brisk wind in dust-free air
2. A light wind with dust-laden air
3. Calm air laden with dust particles
4. Calm air relatively free of dust particles

5-48. If there is sufficient humidity, which condition is most favorable for the formation of radiation fog?
1. A clear sky in daytime
2. A clear sky at night
3. An overcast sky at night
4. An overcast sky in daytime

5-49. What kind of fog is formed when a warm, moist air mass passes over a cooler surface?
1. Steam
2. Upslope
3. Advection
4. Radiation

5-50. Advection fog is generally considered the most dangerous because of its greater
1. density
2. variability
3. degree of condensation
4. area coverage

5-51. What processes are taking place when an upslope fog is forming?
1. Air is rising, expanding, and cooling
2. Air is rising, contracting, and cooling
3. Air is descending, expanding, and cooling
4. Air is descending and being warmed by contraction

5-52. When does steam fog occur?
1. When evaporation from warm water saturates cold air passing over it
2. When air rising up a gradual land rise expands and cools
3. When air is carried over a colder surface
4. When a land surface on clear nights cools by giving off heat

5-53. Warm front fog forms as a result of
1. warm waters offshore coming in contact with an adjacent cold land area
2. rain falling from warm air into cold air
3. precipitation within a warm front
4. the up and down movement of warm air along a cold front

Learning Objective: Identify types, causes, and results of airframe icing formed during flight.

5-54. What icing conditions are NOT normally encountered in flight?
1. Rime ice, clear ice, and frost
2. Rime ice and carburetor ice
3. Frost and slush
4. Clear ice and glaze ice

5-55. What type of icing results when a film of liquid water freezes on an airframe?
1. Hoarfrost
2. Frost
3. Rime ice
4. Clear ice

5-56. Which of the following statements best describes the formation of rime ice?
1. The formation of rime ice requires a sudden drop in temperature to freeze supercooled droplets of water which have partially frozen after they have contacted an airframe
2. The partial melting and refreezing of clear ice on an airframe causes the spongy mass that forms rime ice
3. Rime ice is formed when supercooled droplets of water strike an airframe and freeze separately
4. Rime ice forms when the surface of an airframe has been subjected to some form of precipitation and a sudden drop in temperature causes the precipitation to freeze into a solid sheet of ice

5-57. Which type of airframe icing will be caused by a high performance aircraft flying rapidly from a region whose temperature is well below freezing to a another region where the temperature is considerably higher and the air is very moist?
1. Frost
2. Rime ice
3. Clear ice
4. Glaze ice

Learning Objective: Recognize conditions and terms associated with wind.

5-58. In dealing with the horizontal components of wind, reference is made to its direction and speed; but in dealing with its vertical components, reference is made to all but which of the following?
1. Updrafts
2. Downdrafts
3. Turbulence
4. Speed

5-59. Windflow is the direct result of variations in pressure which result from variations in temperature caused by global circulation of the air which maintains the earth's heat balance.

5-60. Direction of the horizontal component of the wind is determined by the direction in which it is blowing.

5-61. Windspeed is usually measured and expressed in terms of
1. miles per hour
2. knots
3. feet per second
4. meters per second

Learning Objective: Identify types, characteristics, causes, relationships to weather, and effects of photometeors, electrometeors, lithometeors, and hydrometeors.

5-62. Photometeors are caused when the light of the sun or moon is
1. reflected only
2. refracted only
3. diffracted only
4. reflected, refracted, or diffracted

5-63. Which of the following statements about the photometeors referred to in the preceding item would be correct?
1. They are the direct cause of adverse weather
2. They are active elements in weather development
3. They indirectly indicate what kind of weather to expect
4. All of the above

In items 5-64 through 5-66, select from column B the photometeor caused by each condition listed in column A.

	A. Conditions	B. Photometeors
5-64.	The diffraction of light by water droplets	1. Rainbow
		2. Fogbow
5-65.	The diffraction, refraction, and reflection of light within raindrops	3. Corona
		4. Halo
5-66.	The refraction of light as it passes through ice crystals	

5-67. The occurrence of a corona is associated with which types of clouds?
1. Cirriform or middle clouds
2. Cumulus or middle clouds
3. Cumulus or stratus clouds
4. Cirriform or stratus clouds

In items 5-68 through 5-70, select from column B the definition of each type of lightning indicated in column A.

	A. Types	B. Definitions
5-68.	CG	1. Lightning which occurs within a thunder cloud
5-69.	CC	2. Lightning which passes from one cloud to another
5-70.	CA	3. Lightning which passes between a cloud and the ground
		4. Lightning which passes from a cloud to the air but does not strike the ground

5-71. Of the following areas on the earth's surface, where is an Aurora most likely to occur?
1. Equator
2. North pole
3. North magnetic pole
4. North temperate zone

5-72. Which of the following is classified as a lithometeor?
1. Fog
2. Haze
3. Snow
4. Rain

5-73. Which lithometeor causes the sun to appear red at sunrise and sunset?
1. Haze
2. Dust
3. Sand
4. Smoke

5-74. Which hydrometeor is NOT a form of precipitation?
1. Dew
2. Snow
3. Hail
4. Drizzle

5-75. Precipitation is classified according to all but which one of the following?
1. Form
2. Size
3. Rate of fall
4. Horizontal movement

Assignment 6

Meteorological Elements Affecting Aviation

Text: Pages 123 - 139

Learning Objective: Identify types, characteristics, causes, relationships to weather, and effects of photometeors, lithometeors, and hydrometeors.

In items 6-1 through 6-3, select from column B the form of precipitation that possesses each characteristic listed in column A.

A. Characteristics	B. Precipitation Forms
6-1. It consists of white or translucent crystals	1. Rain
	2. Snow
6-2. It consists of white opaque round kernels 0.08 to 0.2 inch in diameter	3. Drizzle
	4. Snow pellets
6-3. It consists of small uniformly dispersed droplets that appear to float on air currents	

6-4. Which of the following forms of solid precipitation take(s) the form of minute, branched, starlike snowflakes?
1. Snow grains
2. Sleet
3. Hail
4. Snow pellets

6-5. What type of frozen precipitation is associated with thunderstorm activity?
1. Snow
2. Hail
3. Sleet
4. Snow grains

Learning Objective: Recognize how thunderstorms are formed, and describe their structures and other characteristics.

6-6. The atmospheric ~~conditions~~ necessary for the formation of a thunderstorm include a combination of conditionally
1. stable air of relatively low humidity and some type of lifting action
2. stable air of relatively high humidity and some type of subsiding action
3. unstable air of relatively low humidity and some type of subsiding action
4. unstable air of relatively high humidity and some type of lifting action

6-7. What must happen to air before it becomes unstable?
1. It must descend to a point where the air around it is warmer
2. It must descend to a point where the air around it is colder
3. It must be lifted to a point where it is warmer than the surrounding air
4. It must be lifted to a point where it is colder than the surrounding air

6-8. The three distinct stages of a thunderstorm in the order of its life cycle are
1. anvil, mature, and convective
2. convective, anvil, and mature
3. cumulus, mature, and dissipating
4. mature, dissipating, and cumulus

6-9. At what stage in the life cycle of a thunderstorm do surface rains begin to fall?
1. Anvil
2. Mature
3. Cumulus
4. Convective

6-10. The downdrafts of a thunderstorm cycle are initiated by the
1. frictional drag of rainfall
2. evaporative cooling of the air
3. adiabatic cooling of the air
4. warming of the upper air by condensation

6-11. In which stages of a thunderstorm are downdrafts significant?
1. Anvil, dissipating, and cumulus
2. Cumulus and dissipating
3. Cumulus and mature
4. Mature and anvil

6-12. The external visual appearance of a thunderstorm is NO indication of the presence and/or severity of hail and turbulence within the storm.

6-13. What causes the strong surface winds associated with a thunderstorm?
1. Vertical spreading of the updraft currents approaching the cloud's base
2. Vertical spreading of the horizontal currents as the cloud approaches
3. Horizontal spreading of the updraft currents at the cloud's base
4. Horizontal spreading of downdraft currents approaching the earth's surface

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Learning Objective: Identify activities which provide weather service to pilots, their functions, and the methods used in making various types of weather observations.

6-14. The National Weather Service meets its responsibilities for providing weather support to civil aviation in areas where there are no Weather Service offices. This is accomplished through the cooperation of which agency(ies)?
1. The FAA
2. Other governmental agencies
3. Private individuals and organizations
4. All of the above

6-15. Which of the following agencies is the main distributor of weather information to aviation interests?
1. FAA
2. NMC
3. NWS
4. WSO

6-16. Which of the following statements relative to the functions of the National Meteorological Center (NMC) is NOT correct?
1. It collects weather reports from all over the Northern Hemisphere
2. It provides analyses and forecasts up to 30 days in the future to other weather facilities
3. It permits other facilities to interpret its products without duplication
4. It assigns meteorologists to the Armed Forces weather offices

6-17. The issuance of weather forecasts for air route traffic control areas is a responsibility of the
1. WSO
2. WSFO
3. NMC
4. AMOS

6-18. A distinctive duty of a weatherman assigned to a WSO is to brief pilots relative to weather conditions.

6-19. What special processing center issues warnings concerning severe thunderstorms, tornadoes, surface hail, surface wind gusts of more than 50 knots, and other associated severe weather activities?
1. The National Weather Satellite Center
2. The High Altitude Forecast Center
3. The National Hurricane Center
4. The National Severe Storm Forecast Center

6-20. All efforts concerning tropical storms or typhoons for the area near the Hawaiian Islands are controlled by the
1. joint action of the National Weather Service and military weather services
2. National Hurricane Center
3. Weather Service office in San Francisco
4. NSSFC

In items 6-21 through 6-23, select from column B the specific type of weather observation in which each method of collecting weather information listed in column A is used.

	A. Methods	B. Types
6-21.	A ballon equipped with radio gear is sent aloft, and data is transmitted back to a ground station	1. AMOS
6-22.	A balloon is sent aloft and is visually tracked from a ground station	2. PIREP
6-23.	A pilot reports actual weather conditions encountered while in the air	3. RAWINSONDE
		4. PIBAL

6-24. Photographs of cloud patterns over large areas of the earth are obtained by orbiting satellites and are used in making weather predictions. These satellites generally orbit at an altitude above
1. 100 mi
2. 200 mi
3. 300 mi
4. 400 mi

Learning Objective: Identify transmission circuits and networks utilized for transmitting specific types of weather data.

In items 6-25 through 6-27, select from column B the teletype circuit used for the dissemination of each type of weather data listed in column A.

	A. Types of Weather Data	B. Circuits
6-25.	Domestic synoptic weather information	1. A
6-26.	NOTAMs	2. C
6-27.	International weather information	3. O
		4. COMET

6-28. Which abbreviation represents the U. S. Air Force network system used to collect and distribute military observations and pilot reports to military users?
1. PIREP
2. COMET
3. CONUS
4. NOTAM

6-29. Weather observations from ships at sea and other U. S. Navy weather facilities are collected by the Fleet Weather Centrals. These centrals utilize which of the following communications systems to transmit their reports?
1. The FAA weather circuits
2. The Air Force network system (COMET)
3. The U. S. Naval Communications System
4. All of the above

6-30. Analyses and forecasts are distributed in graphic form over facsimile networks operated by the
1. Navy only
2. Air Force only
3. National Weather Service only
4. Navy, Air Force, and the National Weather Service

Learning Objective: Recognize types, uses, format, coding, and contents of the hourly aviation weather report.

6-31. In order to describe as much weather information in as little space as possible, weather service personnel transmit it to air traffic control personnel in the form of numerals, symbols, and contractions.

6-32. In which of the classes of reports is the type specifically designated?
1. Local (L)
2. Record (R)
3. Special (S)
4. Record Special (RS)

6-33. In which of the four classifications of observations are sea level pressure, temperature, and dewpoint omitted?
1. L
2. R
3. RS
4. S

6-34. A station must make what type of observation if the sky condition shows clouds below 1,000 feet but there were NO clouds previously reported below this level?
1. L
2. R
3. RS
4. S

6-35. Which of the following weather changes calls for a special observation?
1. Rainfall starts
2. Ceiling lowers from 7,000 to 5,000 feet
3. Visibility increases from 1/2 to 3 miles
4. Wind velocity increases from 15 to 17 knots

6-36. What kind of observation is made if hail begins at a reporting station at 1700?
1. R
2. S
3. L
4. RS

6-37. What kind of observation is made if an aircraft mishap occurs near an airport?
1. R
2. S
3. L
4. RS

6-38. Refer to figure 7-1 and table 7-1 in your textbook. What is the lowest cloud height indicated on this report?
1. 1,320 ft
2. 1,100 ft
3. 2,500 ft
4. 4,000 ft

In items 6-39 through 6-41, refer to figure 7-2 of your textbook. Select from column B the sky cover symbol used to designate each cloud cover condition listed in column A.

	A. Cloud Cover Conditions	B. Symbols	
6-39.	Surface layer obscuration	1.	⦷
6-40.	Broken layer aloft	2.	⊕
6-41.	Overcast layer aloft	3.	X
		4.	⦶

6-42. Ceiling is defined as the height assigned to the sky coverages classified in all but which of the following symbols?
1. -X
2. ⦷
3. ⊕
4. X

6-43. Refer to table 7-2 in your textbook. What is the meaning of the letter preceding the height of the ceiling layer of sky cover indicated in figure 7-1 of your textbook?
1. Aircraft
2. Measured
3. Indefinite
4. Rawinsonde balloon or radar

6-44. Certified tower personnel shall report prevailing visibility when the prevailing visibility at the usual point of observation is less than 4 miles.

6-45. When visibility is measured in statute miles, how is it reported?
1. The nearest 5 miles beyond 15 miles
2. The nearest whole mile up to 15 miles
3. The exact mile and fraction thereof up to 3 miles
4. Any of the above, whichever is applicable

6-46. The prevailing visibility entered on the reports during nonuniform weather conditions reflects the greatest visibility attained or surpassed throughout at least
1. 1/4 of the horizon circle
2. 1/2 of the horizon circle
3. 3/4 of the horizon circle
4. any part of the horizon circle

6-47. Select the grouping below which accurately combines the weather elements and their reporting symbols.
1. Drizzle - A; hail - H; freezing drizzle - ZA
2. Drizzle - D; hail - A; freezing drizzle - ZD
3. Drizzle - L; hail - A; freezing drizzle - ZL
4. Drizzle - L; hail - E; freezing drizzle - ZL

6-48. If light rain showers and moderate snow showers are intermingled, this condition will be reported by teletype as
1. RW-SW
2. R+S(W)
3. RW+SW
4. SW RW-

6-49. What symbols are used to indicate the presence of light snow and moderate freezing rain?
1. S-ZR
2. ZRS-
3. S-ZR
4. ZR+S-

6-50. Which of the following groups of obstruction to vision symbols indicates the weather reporting symbols for identifying smoke, haze, and blowing spray, respectively?
1. K, H, and BY
2. GF, BY, and KH
3. S, H, and BS
4. SM, HZ, and BS

6-51. What hydrometeor or lithometeor is the obstruction to vision indicated in figure 7-1 of your textbook?
1. Fog and blowing sand
2. Dust
3. Blowing spray
4. Smoke and fog

In items 6-52 through 6-55, select from column B the encoded report figure which is an example of each type of weather information listed in column A.

	A. Types of Weather Information	B. Encoded Report Figures
6-52.	Barometric pressure	1. 82/60
6-53.	Temperature and dewpoint	2. 894 (prefix 9)
		3. 992
6-54.	Wind direction and speed	4. 2815
6-55.	Altimeter setting	

6-56. The runway visibility value (RVV) will be included in Navy reports when the visibility along the appropriate runway is less than the maximum of
1. one mile
2. two miles
3. three miles
4. four miles

6-57. The abbreviation RVRNO in a report means that the runway visual range is
1. zero
2. variable
3. not available
4. obscured by rain

6-58. The symbols in the coded PIREPS section of figure 7-1 of your textbook mean that the
1. base of the reported overcast is 270 feet
2. top of the reported overcast is 270 feet
3. top of the reported overcast is 2,700 feet
4. base of the reported overcast is 2,700 feet

Items 6-59 and 6-60 refer to the following Atlanta hourly aviation weather report:

NCQ-XM5⊘8⊕1 3/4F/894/72/63/3605/985/F3

6-59. The encoded ceiling is
1. 800 feet overcast
2. partially obscured
3. zero, zero
4. 500 feet broken

6-60. Wind direction and speed indicated on the report are
1. 098 degrees at 5 knots
2. 103 degrees at 63 knots
3. 180 degrees at 36 knots
4. 360 degrees at 5 knots

6-61. The fog conditions at the beginning and end of the NAS Patuxent (NHK) report shown in your textbook are respectively
1. 5 and variable
2. none and broken
3. fog exists and covers 4/10 of the sky
4. 2 and 4

Learning Objective: Recognize the procedures for recording and transmitting PIREPs to pilots and the weather service.

Items 6-62 through 6-66 refer to the following PIREPs:

DCA UA 20 S DCA 2120 DISCHARGE 50 P2
ATA UA 10 NE TYS 0530 EXTRM TURBC 60 C54
MSN UA 20 SE MSN 1815 WND 240 72 KTS 85 P3
MKC UA 10 S MKC 0635 CAT 100 A4

6-62. Turbulence was experienced by one of the pilots flying at an altitude of
1. 1,000 ft
2. 2,000 ft
3. 6,000 ft
4. 8,500 ft

6-63. Clear air turbulence (CAT) experienced at an altitude of 10,000 feet was reported to which weather station?
1. DCA
2. MKC
3. MSN
4. ATA

6-64. The highest wind speed reported by any of the pilots was
1. 50 kt
2. 60 kt
3. 72 kt
4. 100 kt

6-65. One pilot reported that an electrical discharge was experienced at what time?

1. 0535
2. 0635
3. 2120
4. 2129

6-66. The location of clear air turbulence (CAT) reported by one pilot was

1. 20 S DCA
2. 10 S MKC
3. 20 SE MSN
4. 10 NE TYS

Learning Objective: Recognize the types of weather advisories, data transmitted, and symbols used.

6-67. Although SIGMETs are prepared by WSFO offices for their respective districts and contain significant weather information affecting flight safety of transport and other aircraft, a SIGMET will NOT be issued for which of the following weather developments?

1. Severe icing
2. Squall lines
3. Winds of 40 knots or more at 2,000 feet and below
4. Large area dust storms that lower visibility to less than 2 miles

6-68. The pilot of a single-engine aircraft who plans to fly through a mountain pass should be advised of potentially hazardous weather conditions for the specific area by means of a/an

1. WH
2. WW
3. SIGMET
4. AIRMET

In items 6-69 through 6-71 select from column B the form in which each type of weather advisory listed in column A is transmitted.

	A. Types of Weather Advisories	B. Forms
		1. WW
6-69.	An NWS advisory concerning the location of the storm center, anticipated movement, intensity, and area expected to be affected by a hurricane	2. SEVERE WEATHER OUTLOOK NARRATIVE
6-70.	A severe weather forecast issued by NSSFC	3. SIGMET or AIRMET
6-71.	An NSSFC report of present surface and upper air criteria conducive to generating severe local storms	4. WH

Assignment 7

Aviation Weather Reports and Advisories

Text: Pages 140 - 160

Learning Objective: Identify information transmitted and phraseology used in making voice communications.

In items 7-1 through 7-3, select from column B the phraseology used in a radio transmission to a pilot that corresponds with each symbol of height and character of sky coverage listed in column A.

	A. Symbols	B. Phraseology
7-1.	M	1. OVERCAST
7-2.	⊕	2. INDEFINITE CEILING
7-3.	-X	3. MEASURED CEILING
		4. SKY PARTIALLY OBSCURED

7-4. Whether prevailing visibility is reported in statute miles or in nautical miles depends on whether the reporting activity is a ship or shore station.

7-5. Which of the following is omitted from a weather broadcast unless it is specifically requested?
1. Obstructions to vision
2. NOTAMs included in the weather report
3. Runway visual range
4. Sea-level pressure

7-6. How must you report current wind direction and speed coded 3241?
1. WIND FROM THREE TWO ZERO AT FOUR ONE
2. WIND DIRECTION THREE TWO SPEED FOUR ONE
3. WIND THREE TWO ZERO DEGREES AT FOUR ONE
4. WIND THREE TWENTY DEGREES AT FORTY ONE KNOTS

7-7. If the altimeter setting is encoded 983, you must report it as
1. SETTING TWO NINE EIGHT THREE
2. SETTING TWO NINER EIGHTY THREE
3. ALTIMETER THREE NINE EIGHT THREE
4. ALTIMETER TWO NINER EIGHT THREE

7-8. Assume that you receive the following encoded remarks in a weather report: SNOINCR4. How should this be transmitted to a pilot by voice communication?
1. SNOW INCREASED DURING PAST FOUR HOURS ONE INCH
2. SNOW INCREASED FOUR INCHES DURING PAST HOUR
3. SNOW INCREASED DURING PAST HOUR FOUR MILES VISIBILITY
4. SNOW INCREASED DURING PAST FOUR HOURS ONE MILE VISIBILITY

Learning Objective: Recognize subdivisions of matter and some of their characteristics.

7-9. Which of the following represents components of a particle of matter in descending order of size?
1. Electrons → protons → atom
2. Neutrons → molecule → electrons
3. Molecule → atom → subatomic particles (protons, neutrons, and electrons)
4. Atom → molecule → subatomic particles (electrons and protons)

7-10. Protons and electrons are subjected to gravitational forces which attract and electrical forces which may either attract or repel.

7-11. Which atomic component has a negative (-) charge?
1. Proton
2. Electron
3. Neutron
4. Nucleus

7-12. Which atomic components attract one another?
1. Electrons and protons
2. Electrons and neutrons
3. Protons and neutrons
4. Protons and nucleus

7-13. Which of the following types of force is directly dependent upon the relative motion of the charged particles of an atom?
1. Magnetic
2. Electrical
3. Gravitational
4. Each of the above

7-14. Electrically charged particles in motion are responsible for the existence of magnetic forces.

7-15. Refer to figure 8-1 in your textbook. When switch S is closed, current will flow until the
1. negative charges move through the capacitor to the positive side
2. conducting path becomes saturated with electrons
3. charges on the plates are equalized
4. charges on the plates are unequalized

7-16. What determines the strength of the magnetic field when the current carrying wire is formed into a coil and the current remains steady?
1. The amount of voltage
2. The resistance of the inductor
3. The direction of the current flow in the inductor
4. The magnitude of the inductance

7-17. An oscillating circuit depends upon which of the following components for providing a source of alternating electric and magnetic fields in a radio?
1. Capacitor only
2. Inductor only
3. Capacitor and inductor
4. Inductor and resistor

7-18. When the time required for a field to expand and collapse exceeds one-half cycle, what happens to the portion of energy that is detached?
1. It travels at approximately the speed of light and is dissipated into space with no useful application
2. It becomes electromagnetic radiation and may be used to link a radio transmitter and receiver
3. It slows to the speed of light and produces stronger inductance in the oscillator circuit of the transmitter
4. It is recycled into a capacitor to sustain oscillation in the transmitter

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Learning Objective: Identify basic radio principles and terms.

7-19. Refer to figure 8-3 in your textbook. A cycle may be defined as
1. the distance between corresponding points on consecutive waves
2. the distance from peak to peak on a wave
3. the distance from crest to trough on a wave
4. the distance between two consecutive wavelengths

7-20. Which electromagnetic wave is composed of a continuous series of similar waves of like characteristics?
1. MCW
2. Continuous
3. Broken carrier
4. Both 1 and 2 above

7-21. When modulated carrier wave radio transmissions are being used to convey a voice message, the unit in the system which reproduces the original message is the radio receiver.

7-22. Which type of modulation usually results in the radio receiver's output being nearly free of static?
1. Phase
2. Pulse
3. Amplitude
4. Frequency

7-23. What type of modulation is being used when the beginning of each cycle is displaced from a reference origin?
1. Amplitude
2. Frequency
3. Phase
4. Pulse

7-24. Single sideband transmission is most desirable when you need NOT be concerned with economy in the use of power needed to transmit.

7-25. A conductor used for radiating electromagnetic energy into space or for collecting it from space is called a/an
1. magnet
2. conductor
3. antenna
4. capacitor

7-26. The property of interchangeability of the same antenna for transmitting and receiving operations is known as antenna reciprocity.

7-27. A radio receiver is a device which selects a single frequency of electromagnetic radiation from an antenna and demodulates the signal to produce audible or usable frequencies.

Learning Objective: Identify uses, characteristics, operational procedures, and capabilities of omnidirectional range systems.

7-28. A VHF/UHF omnidirectional range produces directional guidance for aircraft in all directions from the facility.

7-29. An aircraft is on which radial when flying inbound on a magnetic heading of 180° to an omnidirectional facility?
1. 090°
2. 180°
3. 270°
4. 360°

7-30. The comparison between the change in the azimuth of the variable phase to that of the reference phase is the basic principle of the omnidirectional facility.

7-31. The omnirange transmission consists of one reference signal and a rotating signal that are out of phase on all points of the compass EXCEPT
1. 045°, 135°, 225°, and 315°
2. 000°, 090°, and 270°
3. 000° and 180°
4. magnetic north

7-32. The omnireceiver in the aircraft is capable of indicating when the aircraft has reached a preset course and is flying to the station on this course.

7-33. An advantage of distance measuring equipment (DME) is that both bearing and distance are provided from a selected navaid facility.

7-34. An airborne DME unit indicates the distance from an aircraft to the ground unit by measuring the interval of time required for a pair of pulses to travel from the
1. interrogator to the transponder
2. transponder to the interrogator
3. interrogator to the transponder and back to the interrogator
4. transponder to the interrogator and back to the transponder

7-35. Which of the following statements concerning DME is correct?
1. It measures horizontal surface distance from an airborne aircraft to the DME station
2. No navigational error is introduced in aircraft flying at high altitudes
3. It operates in the UHF band
4. Each of the above

7-36. What does the VOR/DME facility provide?
1. Bearing only from the facility
2. Bearing and elevation from the facility
3. Elevation only from the facility
4. Distance and direction from the facility

7-37. The omnirange systems are usually reliable regardless of atmospheric conditions because they
1. have LVOR "gap fillers"
2. operate in the VHF/UHF range
3. are not limited to four courses
4. operate at much higher power than other radio aids

7-38. Refer to table 8-2 in your textbook. A TACAN facility classified as a "T" facility may be approved for use at which altitudes?
1. From 18,000 ft to FL 450
2. Above FL 450
3. From 14,500 ft to 17,999 ft
4. 12,000 ft and below

7-39. The interval between transmissions of a 3-letter Morse code identifier by a TACAN facility is
1. 10.5 sec
2. 15.5 sec
3. 25.5 sec
4. 37.5 sec

7-40. FAA provides radials at certified airborne checkpoints in the airport vicinity to ensure that the accuracy of VOR receivers in the aircraft is within a tolerance of plus or minus 6 degrees for IFR flights.

7-41. What checkpoint on the airport is used by a pilot to check his VOR/TACAN prior to flight?
1. Any position on the taxiway
2. Any position on the runway
3. A position on the taxiway indicated by a 20-foot circle
4. Both 1 and 2 above

7-42. A ground TACAN facility is capable of simultaneously providing
1. bearing and distance information to an unlimited number of aircraft
2. distance information to an unlimited number of aircraft and bearing information to as many as 120 aircraft
3. bearing information to an unlimited number of aircraft and distance information to as many as 126 aircraft
4. bearing information to an unlimited number of aircraft when within range and distance information to as many as 120 aircraft

7-43. In order for two pilots to utilize air-to-air ranging, they must agree to use two TACAN channels that are separated by
1. 25 MHz
2. 50 MHz
3. 63 MHz
4. 75 MHz

7-44. An aircraft must be equipped with which of the following instruments to utilize TACAN fully?
1. Radio magnetic indicator and range indicator
2. Ambiguity indicator and range indicator
3. Course indicator, ambiguity indicator, and radio magnetic indicator (RMI)
4. Range indicator, course indicator, and radio magnetic indicator (RMI)

7-45. Refer to figure 8-11 in your textbook. Assume that the course indicator reads FROM instead of TO and flight conditions have NOT changed. What bearing will the number 2 needle on the RMI indicate?
1. 060°
2. 150°
3. 240°
4. 330°

7-46. Refer to figures 8-11 and 8-12 in your textbook. What indication is given by the course indicator used with TACAN equipment when a pilot is flying on the selected course toward an omnirange station?
1. The OFF flag appears
2. A small panel light is illuminated
3. The word FROM appears in a small window
4. The indicator bar centers

7-47. When an aircraft passes through a large cone of ambiguity located directly over a TACAN station, which of the following will be indicated on the aircraft's instrument panel?
1. The radio compass indicator will rotate aimlessly and stabilize at 180° from the bearing approaching the station
2. The range indicator will indicate distance above the station
3. The vertical bar on the course indicator will fluctuate from side to side momentarily, and the TO-FROM indicator will indicate FROM
4. All of the above

7-48. An ATC clearance is issued to a pilot requiring him to fly an ARC of a TACAN facility. From which instrument should he select a magnetic heading so as to maintain the ARC?
1. Range indicator
2. RMI
3. Course indicator
4. TO-FROM indicator

Learning Objective: Recognize the uses and operating characteristics of radio beacons as used by pilots for navigational and positioning purposes.

7-49. Which of the following statements concerning low-frequency, nondirectional beacons is INCORRECT?
1. They may have an associated voice feature
2. They transmit a continuous 3-letter identification
3. They produce practically static- and disturbance-free signals
4. They normally operate in the 200- to 400-kHz band

7-50. A radio beacon used with the instrument landing system (ILS) markers is referred to as a/an
1. nondirectional radio beacon
2. automatic direction finder
3. marker beacon
4. compass locator

7-51. Refer to table 8-3 in your textbook. Which of the following identifies a nondirectional beacon that has the highest power output but does NOT make voice transmissions?
1. HH
2. HH W
3. H W
4. MH

In items 7-52 and 7-53 assume that a[illegible] is on a magnetic heading of 360° and the radio compass needle points to 240°.

7-52. Where is the automatic direction finding (ADF) station in relation to the aircraft?
1. Behind and to the left
2. Behind and to the right
3. Ahead and to the left
4. Ahead and to the right

7-53. Which of the following turns represents the smallest course alteration (degrees of heading change) so the aircraft will home on the ADF station?
1. Counterclockwise 120°
2. Clockwise 180°
3. Either clockwise or counterclockwise 180°
4. Clockwise 240°

7-54. FM fanmarkers are located at definite points along an airway to provide aircraft with positive position identification.

7-55. What is the proper classification for a marker beacon physically located outside controlled airspace that consists of a 100-watt fanmarker and a nondirectional radio beacon of less than 50 watts that has NO voice facilities available?
1. FMW
2. FMHW
3. FMMHW
4. FMNDBW

Learning Objective: Recognize the capabilities, limitations, and operation of the Instrument Landing System (ILS).

7-56. The ILS utilizes radio beams and marker beacons to provide pilots with which of the following items of information?
1. Guidance
2. Range
3. Visual
4. All the above

7-57. An aircraft is on an ILS approach 18 nautical miles from the runway. What is the minimum altitude for receiving the oncourse signal from the localizer?
1. 1,000 ft
2. 3,000 ft
3. 4,000 ft
4. 4,500 ft

7-58. The frequency selector in an ILS system automatically switches the glidepath receiver to the appropriate frequency when the pilot selects which of the following?
1. The proper guidepath frequency
2. The proper fanmarker frequency
3. The proper localizer frequency
4. Either 1 or 2 above

7-59. The middle marker of an ILS course is indicated on the ILS marker receiver in the aircraft by the
1. white light flashing dots and dashes
2. amber light flashing dots
3. purple light flashing dots
4. amber light flashing dots and dashes

7-60. Which of the following statements concerning compass locators is INCORRECT?
1. They have a power output of less than 25 watts
2. They have a range of at least 15 miles
3. They are located on the airport
4. They operate between 200 and 415 kHz

Learning Objective: Identify the scope of the Joint Electronics Type Designation System (JETDS) and the meanings of specific equipment designations.

7-61. The JETDS applies to which of the following models of electronic systems, groups, components, and subassemblies for use by the Military?
1. Developmental
2. Preproduction
3. Production
4. All of the above

• Refer to appendix II in answering items 7-62 through 7-64.

In items 7-62 through 7-64, select from column B the meaning of each of the 3 letters of the designation ARC-38 as listed in column A.

	A. Letters	B. Meanings
7-62.	A	1. Purpose
7-63.	R	2. Modification
7-64.	C	3. Installation
		4. Type of Equipment

7-65. What is the proper designation of electronic equipment that can be used for more than one purpose, can be used for both transmission and reception of voice communications, and is installed on a vehicle whose only purpose is to transport it?
1. AN/MRH-38
2. AN/MRQ-38
3. AN/MRT-38
4. AN/VRQ-38

7-66. What is the meaning of the last 3 letters of the designation AN/FSA-17?
1. Photographic passive receiving auxiliary assembly
2. Fixed detecting airborne assembly
3. Fixed special auxiliary assembly
4. Fixed surface heat assembly

Assignment 8

Control Tower Equipment

Text: Pages 160 - 191

Learning Objective: Recognize construction features, operating characteristics and procedures, and advantages/disadvantages of various radio communications consoles.

8-1. Inasmuch as a single-piloted IFR aircraft should be provided with a single frequency approach, it may be necessary for the control tower, the radar facility, and approach control to operate on the same frequency during the approach of such an aircraft.

Items 8-2 through 8-7 refer to the AN/FSA-17 communications console.

8-2. This system provides as many as 20 transmit/receive channels, 10 of which may be used for voice communications and 10 for interphone.

8-3. If you want to transmit while monitoring a frequency, you should place the pertinent radiophone switch in its full-up position.

8-4. Relative to the control switch position on the FSA-17 receiver, under what circumstances will the receiver's amber indicator light glow when a signal is received?
1. Provided the control switch is in the MONITOR position
2. Provided the control switch is in the TRANSMIT position
3. Provided the control switch is in the RECEIVE position
4. Irrespective of the position of the control switch

8-5. If a radio call is received on the frequency controlled by radiophone switch No. 17, a green light above this switch will glow if the switch is in its middle or full-up position.

8-6. What is the color of the indicator light that is located above each interphone switch and which glows when the position is called by another operator?
1. Red
2. Blue
3. Green
4. Yellow

8-7. A signal received by any one of the 20 receivers is automatically and simultaneously fed to the overhead speakers and headsets.

8-8. Although similar in design and method of operation to the AN/FSA-17, the AN/FSA-52 communications console is superior in that it provides for
1. more frequencies only
2. greater intercommunications only
3. additional operating positions only
4. more frequencies, greater intercommunications, and additional operating positions

8-9. The only undesirable feature of the AN/FSA-58 communications console is the absence of a backup power supply in the event of primary power failure.

8-10. Utilizing the AN/FSA-58 communications console, a controller's position normally consists of how many modules?
1. One
2. Two
3. Three
4. Four

8-11. Relative to an operator depressing the XMTR SEL button on the AN/FSA-58 radiophone module, which of the following statements is correct?
1. The green light at the controller's position will glow a steady bright
2. The white light at the supervisor's console will flash
3. The red light at the controller's position will glow at half brilliance
4. The yellow light at the supervisor's console will flash

8-12. An indication that a controller has selected the TELCO position on the AN/FSA-58 communications jackbox is the glowing of the
1. flashing red light on the module
2. flashing green light on the jackbox
3. steady white light on the module
4. steady green light on the jackbox

Learning Objective: Identify a microphone and the technique of using one.

8-13. A microphone is a device used to convert sound energy into electrical energy.

8-14. How should a hand-held microphone be held?
1. Within one-half inch of the lips
2. With the lips just touching it
3. With the lips firmly against it
4. Within six inches of the lips

8-15. Which of the following is NOT considered proper microphone technique?
1. Speak clearly and distinctly
2. Avoid extremes of voice pitch
3. Shield your microphone from outside noises
4. More than one microphone used at one time

8-16. The manner in which the message is delivered determines the effectiveness of the transmitted signal.

Learning Objective: Indicate uses and operating principles of the RD-217/UNH Voice Recorder-Reproducer and the storage, filing, splicing, and demagnetizing procedures of the tape used on it.

8-17. Recordings made of communications between air traffic control facilities and aircraft are used for which of the following purposes?
1. Circuit discipline
2. Aircraft accident analysis
3. Voice training of air traffic control personnel
4. All of the above

8-18. The maximum number of minutes of recording possible with this recorder-reproducer without tape change is
1. 1,425 min
2. 1,440 min
3. 1,455 min
4. 1,420 min plus a 15-minute overtime allowance

8-19. Spare tapes should be stored in a room in which the temperature and relative humidity do NOT exceed
1. 60° F and 60 percent
2. 60° F and 75 percent
3. 75° F and 75 percent
4. 75° F and 60 percent

8-20. Recorded reels of tape must be kept on file for at least 10 days before they are erased.

8-21. When two pieces of recorder tape are joined with splicing tape, the piece of splicing tape should be stretched a distance of one-half its original length and then applied.

8-22. What is the correct sequence of steps to follow when you demagnetize a tape with the demagnetizer?
1. Turn the power switch on until the neon light becomes bright, place the reel on rollers and rotate, and release the power switch
2. Place the reel on rollers, turn the power switch on until the neon light becomes bright, remove the reel, and release the power switch
3. Turn the power switch on until the neon light becomes bright, place the reel on rollers and rotate, remove the reel, and release the power switch
4. Place the reel on rollers and rotate, turn the power switch on until the neon light becomes bright, remove the reel, and release the power switch

8-23. The maximum length of time that a roll of tape should remain in the demagnetizer after the neon light becomes illuminated is
1. 10 sec
2. 15 sec
3. 10 min
4. 15 min

8-24. It is important that both the RD-217/UNH recorder and the demagnetizer be properly grounded when they are being operated.

Learning Objective: Recognize construction features and operating characteristics of the RD-379(V)/UNH Recorder-Reproducer and the RP-214(V)/UN Reproducer.

8-25. The RD-379(V)/UNH is a solid state recording system.

8-26. How many identical tape transport assemblies does the RD-379(V)/UNH contain?
1. One
2. Two
3. Three
4. Four

8-27. One of the most desirable features that this recorder possesses is the ability to simultaneously record how many channels?
1. 3 channels
2. 5 channels
3. 10 channels
4. 12 channels

8-28. It is normal practice to record time on one channel. This recorded time signal is displayed in what order?
1. Seconds-days-hours-minutes
2. Days-hours-minutes-seconds
3. Hours-minutes-seconds-days
4. Seconds-minutes-hours-days

8-29. The RP-214(V)/UN is capable of reproducing how many channels?
1. One channel only
2. Two channels simultaneously
3. Three channels simultaneously
4. Four channels simultaneously

8-30. What is the minimum fast-forward and rewind speed of the RP-214(V)/UN?
1. 100 ips
2. 125 ips
3. 150 ips
4. 170 ips

Learning Objective: Recognize operating principles and procedures, uses, and tolerances applicable to the wind indicator and altimeter setting indicator.

8-31. Which of the following statements is applicable to a wind velocity indicator installed in an NAS control tower?
1. It is used as a standby and referred to only during an emergency
2. It presents noncorrected information to be relayed to the pilot
3. It is usually slaved to one in the weather service department
4. It must be slaved to one in the weather service department

8-32. The weather service wind direction indicator readings indicate that the wind is from 074° magnetic at 14 knots at the time the wind indicator readings from the control tower are compared with them. Corrective action must be taken on the control tower indicator if its direction and speed indications are
1. 070° at 16 kt
2. 071° at 18 kt
3. 072° at 17 kt
4. 079° at 10 kt

8-33. If comparison between the altimeter setting indicator in the control tower and the weather service official indicator shows the reading of the former to be 0.02 inch greater than that of the latter, maintenance personnel must be advised of the discrepancy immediately.

8-34. The initial input into a digital-type altimeter setting indicator is accomplished automatically.

Learning Objective: Indicate uses, capabilities, and operating procedures for portable traffic control lights, navaid monitors, and runway visual range indicators (RVR).

8-35. The portable traffic control light can be used for directing takeoffs and landings of aircraft NOT equipped with radio and also for directing the movement of vehicles and personnel on the landing area.

8-36. When the selector handle of the portable traffic control light is turned fully counterclockwise and the operator holds the spring-loaded toggle switch in the pistol-type grip in its depressed position, a flashing red light is produced.

8-37. What is the visual range of the portable traffic control light during daylight hours?
1. 10 mi
2. 15 mi
3. 20 mi
4. 25 mi

8-38. What are the extremities for a flight check of the portable traffic control light?
1. 3 miles at the lowest pattern altitude
2. 3 miles at the highest pattern altitude
3. 10 miles at 2,000 feet
4. 15 miles at 2,000 feet

8-39. Which of the following statements about the performance of the AN/GSA-35 navaid monitor is NOT correct?
1. It voice modulates VOR, TACAN, and UHF HOMER transmitters
2. It establishes voice communications between the remote locations and the console
3. It provides manual control of TACAN, VOR, and UHF HOMER transmitters
4. It shuts down or restores to operation any of the transmitters at the transmitter location

8-40. RVR may be used by the tower, in lieu of the reported visibility, in the approval of straight-in instrument approach procedures.

8-41. When RVR equipment is operated, to obtain an actual value the reading in the window must be multiplied by
1. the distance from the aircraft
2. 10
3. 100
4. 1,000

Learning Objective: Indicate uses, capabilities, and operating principles of Bright RADAR Indicator-Tower Equipment--Model 1 (BRITE-1).

8-42. What control tower position utilizes this system to assist in the spacing of arriving and departing aircraft?
1. Ground controller
2. Tower supervisor
3. Local controller
4. Flight data controller

8-43. The requirement for such a system as this one is made necessary by which of the following factors?
1. The wide range of approach speeds
2. The large airport landing areas
3. The varying visibility conditions
4. All of the above

8-44. In addition to providing the control tower with surveillance coverage, this system also provides a precision radar display to facilitate monitoring the final approach course.

8-45. The system's TV camera is located in the equipment room where it views the radar information presented on the cathode ray tube (CRT) of the plan position indicator (PPI) and transmits this information via coaxial cable to the TV display unit located in the tower cab.

8-46. When a controller selects the 30 nmi range scale on the range selector, the corresponding range marks will automatically adjust to
1. 3 nmi
2. 5 nmi
3. 6 nmi
4. 10 nmi

8-47. Control tower equipment out of adjustment or otherwise inoperative creates hardships for yourself.

Learning Objective: Recognize factors to be considered in selecting an airport site, and identify airport construction features, uses, and operating procedures.

8-48. In selecting a site for an airport, careful consideration must be given to an area adequate for both present needs and needs created by possible future expansion. In addition, what other factor(s) must be considered?
1. Terrain
2. Accessibility
3. Weather conditions
4. All of the above

8-49. Shifting winds, downdrafts, and air eddies are some of the many elements to be considered when selecting an airport site. These elements are classified under the general category of
1. area
2. terrain
3. weather conditions
4. accessibility

8-50. The orientation of an airport's primary runway is determined by the
1. direction of the prevailing wind
2. location of the control tower
3. location of the hangar area
4. local terrain

8-51. Which of the following factors is NOT taken into consideration when the length of an airport's primary runway is determined?
1. Location of the control tower
2. Principal types of aircraft that will be operated from the airport
3. Mean maximum temperature of the airport
4. Field elevation of the airport

8-52. Which of the following areas is used for checking aircraft instruments and radio equipment prior to takeoff?
1. Mat
2. Warmup
3. Runway
4. Overrun

8-53. Wind tees, tetrahedrons, and windcones are classified as wind indicators.

8-54. How are the colored lights arranged on a wind tee so that an airborne pilot can accurately determine wind direction at night?
1. Green on the fore and aft bar, green on the crossbar
2. Red on the fore and aft bar, green on the crossbar
3. Red on the fore and aft bar, amber on the cross bar
4. Green on the fore and aft bar, amber on the crossbar

8-55. Tetrahedron lights flashing between sunset and sunrise indicate a ground visibility of
1. more than 3 miles with a ceiling less than 1,000 feet
2. less than 3 miles and/or a ceiling less than 1,000 feet
3. less than 3 miles with a ceiling greater than 1,000 feet
4. more than 3 miles and/or a ceiling greater than 1,000 feet

8-56. Restriction or suspension of VFR operations within the control zone is indicated between sunset and sunrise by flashing lights on the
1. windcone
2. tetrahedron
3. control tower
4. airport beacon

8-57. An approximation of wind velocity is given by which of the following types of wind direction indicators?
1. Windcone
2. Wind tee
3. Tetrahedron
4. All of the above

8-58. What minimum wind velocity is required to cause a standard type windcone to stand out parallel to the ground?
1. 5 to 10 kt
2. 10 to 15 kt
3. 15 to 20 kt
4. 20 to 25 kt

8-59. Mat facilities are often used for which of the following purposes?
1. To provide a location for the compass rose
2. To facilitate the taking off and landing of large aircraft
3. To facilitate the taking off and landing of several small aircraft at the same time
4. All of the above

8-60. Compass calibration pads are marked every 15 degrees to indicate magnetic bearings beginning with
1. magnetic south
2. true south
3. magnetic north
4. true north

Learning Objective: Identify standard airport pavement markings.

8-61. A runway having the number 9 painted on one end has what number painted on its other end?
1. 5
2. 11
3. 16
4. 27

8-62. Which runway is most likely to be found at an airport where the prevailing wind is from the west?
1. 5
2. 11
3. 16
4. 27

8-63. An airport with runway 16R must also have a runway numbered
1. 34L
2. 29
3. 23
4. 9R

In items 8-64 through 8-66, select from column B the type of line used to indicate each portion of a Navy airfield pavement markings listed in column A.

A. Paved surface	B. Type of line
8-64. Primary runway centerline	1. Solid line, 12 feet wide, 150 feet long, painted retroreflective white
8-65. Primary runway edge	2. Broken line, 2 feet wide, painted retroreflective yellow
8-66. Threshold markings (runway 200 feet wide)	3. Solid line, 3 feet wide, painted retroreflective white
	4. Broken line, 3 feet wide, painted retroreflective white

8-67. A displaced threshold is a threshold at the beginning of the full strength runway pavement.

8-68. Runway distance markers are used as an aid to the pilot in determining which of the following?
1. The location of the arresting gear
2. The amount of runway left
3. The amount of runway used
4. Both 2 and 3 above

8-69. Lighted signs consisting of large yellow plexiglass arrows and white letters on a black background are placed on both sides of a runway to indicate the
1. FCLP areas
2. landing gear warnings
3. arresting gear locations
4. VOR/TACAN checkpoints

8-70. Taxiway centerline strips are 6 inches wide and painted
1. white
2. yellow
3. retroreflective white
4. retroreflective yellow

8-71. Upon reaching a position marked by two solid and two broken painted lines across the taxiway, the pilot should
1. stop, look around, and proceed if there is no traffic in sight
2. stop and then proceed at a minimum taxiing speed
3. stop and request further clearance
4. proceed at normal taxiing speed

8-72. A pilot is able to check his VOR/TACAN for proper functioning prior to flight by placing his aircraft on a special circle painted on the taxiway and utilizing the data painted on a sign adjacent to the taxiway.

In items 8-73 through 8-75, select from column B the marking used to indicate each type of area listed in column A.

A. Areas	B. Markings
8-73. Deceptive	1. Retroreflective yellow painted markings
8-74. Hazardous	2. Diagonal black stripes painted on an orange colored background
8-75. Closed runway	3. Two yellow bands 10 feet wide and 60 feet long in the shape of an X
	4. Aviation surface orange and aviation white normally in a checkerboard pattern

Assignment 9

Airport Traffic Control and Airfield Equipment

Text: Pages 193 - 217

Learning Objective: Identify standard airport pavement markings.

9-1. Runway shoulder markings are painted nonretroreflective yellow stripes and are placed 100 feet apart at a 45-degree angle to the approach end of the runway beginning at the runway midpoint.

9-2. Every airport will have at least one of the deceptive, closed, or hazardous area type of markings painted somewhere within those areas designated for aircraft operation.

9-3. Which of the following statements about an airport beacon is INCORRECT?
1. It always rotates at a constant speed to produce the effect of flashes at regular intervals
2. Its flashes may be of one color or two colors alternately at the rate of 12 to 15 per minute
3. It should be located within 750 ft of the centerline or centerline extended of the primary runway
4. It is operated in daylight hours when the visibility is under 3 miles and/or the ceiling is under 1,000 ft

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Learning Objective: Recognize standards applicable to airfield lighting systems, and indicate functions of and operating rules for related components.

In items 9-4 through 9-6, select from column B the light display from a rotating beacon that has each meaning listed in column A.

A. Meanings	B. Displays
9-4. The location of a landmark or navigational point	1. Alternating green and white flashes
9-5. A lighted airport or landing field within 2 miles	2. White flashes alone
9-6. The presence of an obstruction or obstructions hazardous to air navigation	3. Alternating red and white flashes
	4. Red flashes alone

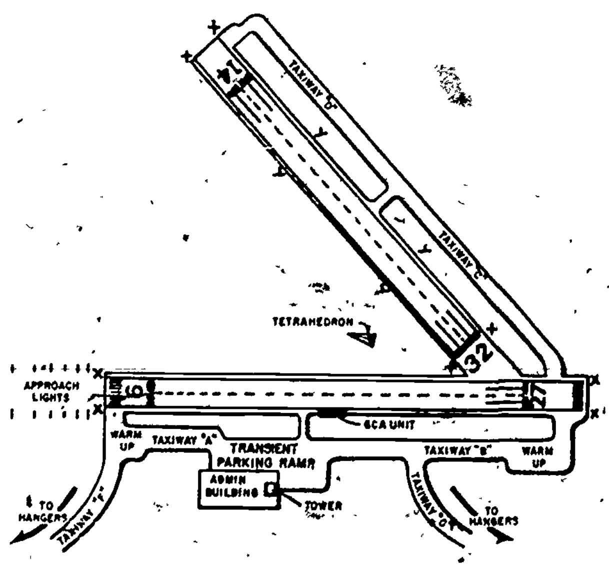

Figure 9A.--NAS Leadville

Refer to figure 9A in answering items 9-7 and 9-8.

9-7. If runway 14-32 is 5,000 feet long, what is the minimum number of pairs of lights required to light it?
1. 20
2. 25
3. 40
4. 50

9-8. What type and color lights are installed at the points marked with Xs?
1. Pairs of blue range lights
2. Split green and red threshold lights
3. Groups of yellow contact lights
4. Pairs of split yellow-white contact lights

In items 9-9 through 9-11, select from column B the color associated with each airport light listed in column A.

	A. Lights	B. Colors
9-9.	Runway	1. Bluish-white
9-10.	Threshold	2. White
9-11.	Runway center-line	3. Bidirectional green and red
		4. Red

9-12. Runway End Identification Lights (REIL) rotate at a constant speed of
1. 10 rpm
2. 20 rpm
3. 30 rpm
4. 40 rpm

9-13. On a straight segment of taxiway over 300 feet in length, the spacing between taxiway lights may approach but NOT exceed
1. 5 ft
2. 50 ft
3. 100 ft
4. 200 ft

9-14. The halo effect sometimes produced by high intensity approach lights can be caused by the
1. aircraft's approach being too low
2. intensity being set too high
3. intensity being set too low
4. aircraft's approach being too high

9-15. Refer to table 10-2 in your textbook. What is the recommended intensity setting for high intensity approach lights when the visibility at night is less than 1 mile?
1. One
2. Two
3. Three
4. Four

9-16. The Visual Approach Slope Indicator (VASI) is designed for use during IFR conditions.

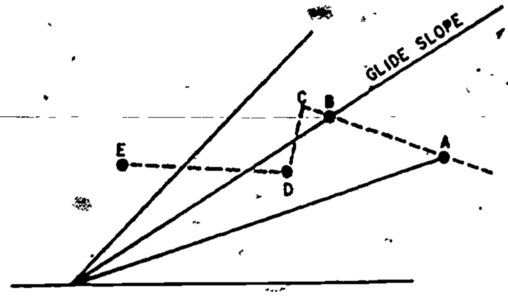

Figure 9B.--VASI glide slope

Items 9-17 through 9-19, refer to table 10-3 in your textbook and to figure 9B. Select from column B the combination of lights a pilot will observe while flying through the various points of the VASI glide slope indicated in column A.

	A. Points on the VASI glide slope	B. Light combinations
9-17.	A	1. White White
9-18.	B	2. Red Red
9-19.	C	3. Red White
		4. White Red

9-20. What is the function of the red lights that are spaced along the approach end of the runway in clusters 800 feet apart and that flash 90 times a minute when activated?
1. To warn the pilot of obstructions along the runway
2. To identify the runway distance markers
3. To serve as a wheels-up warning
4. To identify the runway

9-21. An airport's red obstruction lights are turned on during daylight hours whenever flight visibility is restricted.

9-22. A Fresnel Lens optical landing system installed along the side of a heavily-used runway permits pilots to
1. practice field carrier takeoffs
2. practice field carrier landing approaches (FCLP)
3. check their landing gear on approaches
4. ensure that no aircraft are behind and above them while landing

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Learning Objective: Recognize responsibilities of pilots and tower personnel relative to control tower operations.

9-23. The controller's repetitious, routine approval of pilot actions is NOT necessary under preventive control unless traffic conflicts develop.

9-24. Mobile control facilities are used to serve which of the following functions?
1. To provide coordination with the primary control tower controllers when special aircraft operations or tests/evaluations are being conducted on the field
2. To provide coordination with the landing signal officer (LSO) during times when field carrier landing practice (FCLP) is being conducted
3. To provide temporary operating facilities during periods of equipment outage in the main control tower
4. All of the above

9-25. Which of the following is NOT considered a dual responsibility between the pilot and air traffic controller?
1. Publications
2. Communications
3. Coordination
4. Cooperation

9-26. For tower controllers to be considered fully qualified, they must possess a Facility Rating for the airport to which they are assigned.

In items 9-27 through 9-29, select from column B the air traffic control tower operating position which exercises supervision over each operational function listed in column A.

	A. Operational Functions	B. Operating Positions
9-27.	Separation of IFR traffic	1. Local control
		2. Ground control
9-28.	Control of VFR traffic	3. Approach control
9-29.	Handling taxiing traffic	4. Flight data position

Learning Objective: Identify airport operating conditions and procedures and information pertinent to both air traffic controllers and pilots.

9-30. Traffic conditions are the only basis upon which a request to make a low approach can be denied.

9-31. Under which of the following conditions can the pilot of a turbine-powered aircraft be granted permission to cross an airport traffic area at 260 knots?
1. The aircraft requires a higher minimum speed
2. The normal military operating procedures require it
3. The pilot prefers it as crew morale factor
4. Either 1 or 2 above

9-32. If an aircraft makes a low pass to allow a visual check of its landing gear and the controller suspects that it is malfunctioning, he should immediately inform the pilot and alert the crash and rescue crew.

9-33. Thrust stream turbulence and wingtip vortexes are collectively termed "wake turbulence".

9-34. Once formed by an aircraft, which type of rotational trailing air disturbance may create a hazardous condition behind the aircraft for an undetermined distance?
1. Jet blast
2. Prop wash
3. Wingtip vortexes
4. Thrust stream turbulence

9-35. The approximate vertical drop of wingtip vortexes produced by an aircraft with an 85-foot wingspan is
1. 24 ft
2. 43 ft
3. 85 ft
4. 170 ft

9-36. Which of the following descriptions should a controller use to identify a Navy F-8 to a civilian pilot?
1. NAVY FIGHTER
2. NAVY EIGHT F
3. F EIGHT NAVY
4. FIGHTER EIGHT NAVY

9-37. Which of the following items might NOT be considered field condition information?
1. A maintenance truck is on the left side of the runway in use
2. Construction is in progress in a flag-marked area
3. A mower is operating in the center of the field
4. All traffic patterns are left-hand patterns

9-38. Which of the following statements correctly describes to a pilot that a mower is parked near the runway?
1. WATCH OUT FOR THAT MOWER
2. DON'T WORRY ABOUT THAT MOWER
3. MOWER TO LEFT OF RUNWAY
4. MOWER PARKED ON RIGHT SIDE OF RUNWAY NEAR THE INTERSECTION OF RUNWAY 28

9-39. Which transmission of a weather element may an AC make without consulting a weather report or weather service personnel?
1. VISIBILITY ONE ZERO
2. MEASURED CEILING FOUR THOUSAND OVERCAST
3. PATCHY FOG EAST OF AIRPORT
4. GROUND FOG DEPTH FIFTY FEET

9-40. Unless deemed unnecessary due to visual tracking or canceling reports, a tower operator should keep pilots informed of bird migrations, sizes, species, and courses of flight in the control area for what length of time after receiving bird activity information?
1. 5 min
2. 15 min
3. 30 min
4. 45 min

9-41. If an aircraft has an inoperative radio transmitter but the radio receiver is operating satisfactorily, the control tower operator can communicate instructions with a radio transmitter or a light gun. The pilot should indicate the receipt of instructions by blinking his navigational lights at night. How should he make this acknowledgment during the day?
1. By moving his ailerons or rudder when on the ground
2. By flying a triangular pattern when airborne
3. By rocking his wings when airborne
4. Either 1 or 3 above

9-42. If a runway use program is NOT established for a particular airport and the surface wind velocity is 25 knots, the duty runway will normally be the runway most nearly aligned with the wind.

9-43. The pilot of a departing aircraft must use the runway specified by the controller even though it is operationally advantageous to use another.

9-44. For the purpose of airport traffic control, which of the following types of propeller-driven aircraft is classified in category 2?
1. Heavy twin-engine
2. Lightweight twin-engine
3. Lightweight single-engine
4. Higher performance single-engine

In items 9-45 and 9-46, assume that an airport is equipped with parallel runways on which same-direction landings and takeoffs may be performed. VFR conditions exist and two-way voice radio is maintained.

9-45. Refer to table 10-4 in your textbook. Two C-130s may be cleared to land simultaneously providing the runway centerlines are at least
1. 400 ft apart
2. 600 ft apart
3. 700 ft apart
4. 850 ft apart

9-46. Refer to table 10-5 in your textbook. Simultaneous opposite-direction operations may be authorized for individual aircraft of a squadron of F-4s at night if the runway centerlines are a minimum of 2,800 feet apart.

9-47. Minimum separation between two category 1 aircraft taking off requires that the first aircraft be
1. 3,000 feet ahead of the second and airborne
2. 4,500 feet ahead of the second and airborne
3. 6,000 feet ahead of the second and airborne
4. 7,500 feet ahead of the second

9-48. What distance is required when a category 1 aircraft has taken off and is airborne before a category 3 aircraft may be cleared for takeoff?
1. 3,000 ft
2. 4,500 ft
3. 5,000 ft
4. 6,000 ft

9-49. Refer to figure 10-22 in your textbook. The departing aircraft must NOT begin its takeoff roll until the arriving aircraft has met which of the following conditions?
1. Completed its landing roll and is holding short of the intersection
2. Completed its landing roll and is holding past the intersection
3. Taxied off the runway
4. Any of the above

9-50. Refer to figure 10-26 in your textbook. What separation must exist between an arriving category 2 aircraft and a departing category 3 aircraft at the time the category 2 aircraft crosses the landing threshold?
1. 1,000 ft
2. 3,000 ft
3. 4,500 ft
4. 6,000 ft

9-51. A departing helicopter is NOT permitted to take off until an arriving helicopter has taxied off the landing area.

9-52. Two helicopters may perform simultaneous landings and/or takeoffs if a distance of 200 feet exists between their landing and takeoff points and their flight paths do NOT cross.

9-53. Regarding the use of ground control and local control frequencies, the pilot should switch from the ground control frequency to the local control frequency when instructed by the ground controller or when he
1. requests ATC clearance
2. is ready for takeoff clearance
3. starts to taxi
4. becomes airborne

9-54. Navy pilots are required to "read back" all ATC clearances.

9-55. The pilot of multiengine aircraft departing on an IFR flight should be informed over the clearance delivery frequency of his departure control frequency.

9-56. An IFR flight may depart and remain VFR until receipt of an ATC IFR flight clearance providing the
1. ceiling is below VFR minimums
2. pilot requests it and the issuing authority approves
3. control tower decides this is the best method
4. pilot decides that he does NOT want to be involved with waiting

9-57. A pilot with a Standard instrument rating is authorized to depart your station with a reported ceiling of 300 feet and visibility of 1 statute mile.

9-58. Pilots of aircraft carrying very important persons (VIPs) should notify the tower when entering the airport traffic area.

Refer to figure 10-33 in your textbook in answering items 9-59 through 9-63 and assume that the control tower is adjacent to, and south of the midpoint of runway 27.

9-59. In what general direction should the controller normally look to see an aircraft on the downwind leg for runway 9?
1. North
2. East
3. South
4. West

9-60. A pilot radios the tower that he is turning base for runway 9. What is his approximate heading after he has completed the turn onto the base leg?
1. 90°
2. 180°
3. 270°
4. 360°

9-61. The breakpoint for a standard overhead approach pattern for high performance military aircraft is usually over
1. a point 3 miles ahead of the approach end of the runway
2. the center of the runway
3. the jet initial point
4. the threshold of the runway

9-62. In a standard jet approach pattern, when the rollout on final approach is made, the distance of the aircraft from the threshold of the runway and its altitude above the ground should NOT be less than
1. 1/4 mi and 300 ft, respectively
2. 1/2 mi and 400 ft, respectively
3. 3/4 mi and 500 ft, respectively
4. 1 mi and 600 ft, respectively

9-63. The pilot of a propeller-driven aircraft has received instructions from the tower to enter the traffic pattern downwind. If landing traffic is using runway 9, his aircraft's heading to intercept the pattern will be
1. 45°
2. 135°
3. 225°
4. 325°

9-64. After the prescribed separation has been accomplished and the pilot has reported "wheels down," landing clearance is normally issued when he turns onto
1. final approach
2. crosswind leg
3. downwind leg
4. base leg

9-65. Even though a violation may be apparent, landing clearance can NOT be withheld indefinitely.

9-66. Pilots of arriving aircraft normally switch to the ground control frequency when they
1. turn on the base leg
2. turn on the final approach leg
3. cross the threshold of the duty runway
4. clear the duty runway

9-67. A "FOLLOW ME" truck is normally used at air stations to help pilots unfamiliar with the field to move about expeditiously.

9-68. If a jet is ready for takeoff and another aircraft is coming in for a landing, priority will be granted to the jet if the pilot requests it; the other aircraft will be instructed to circle the field unless it is another jet, an aircraft in an emergency, or a hospital evacuation aircraft.

9-69. Control tower permission must be obtained by the pilot of a Navy helicopter to
1. exceed an altitude of 500 feet within the control zone only
2. cross a runway not in use only
3. cross the duty runway only
4. exceed an altitude of 500 feet within the control zone or cross the duty runway.

9-70. Under what condition(s) may a helicopter pilot practice autorotations?
1. He remains within the boundaries of the airport
2. He operates over a surface safe for the maneuver
3. He remains accessible to crash and firefighting equipment
4. All of the above

Refer to figure 10-34 in your textbook in answering items 9-71 and 9-72.

9-71. The recommended altitude for an aircraft conducting the precautionary simulated flameout (SFO) approach illustrated in position 1 should be between
1. 3,500 and 5,500 ft
2. 3,500 and 10,000 ft
3. 5,500 and 15,000 ft
4. 10,000 and 15,000 ft

9-72. The low key altitude is recommended to be between
1. 3,500 and 5,500 ft
2. 3,500 and 10,000 ft
3. 5,500 and 10,000 ft
4. 5,500 and 15,000 ft

9-73. When an aircraft towing a target is in or near the traffic pattern, the primary interest that an AC has in tow target operations is to see that flight safety is maintained.

9-74. Instructions for which of the following operations are given by the landing signal officer (LSO) to the pilot of an aircraft conducting field carrier landing practice (FCLP)?
1. Landing
2. Taxiing
3. Initial takeoff
4. All of the above

9-75. What are used at night to simulate flight deck boundaries on a runway for practicing FCLP landings?
1. Runway lights
2. Portable lights
3. Smudge pots
4. Either 2 or 3 above

Assignment 10

Airport Traffic Control and Airfield Equipment

Text: Pages 218 - 239

Learning Objective: Identify personnel responsibilities, crash bills, alarm systems, and procedures and signals for emergency and crash situations.

10-1. Who has the responsibility for providing firefighting, crash, ambulance, and rescue equipment, and for ensuring that this equipment is properly staffed, alertly manned, and is in good operating condition during flight operations?
1. The operations officer
2. The flight officer
3. The commanding officer
4. The safety officer

10-2. Although the crash bill normally incorporates the details and personnel responsibilities to be executed should an aircraft crash occur, instructions for specific handling of accidents involving which of the following are normally separate from the crash bill?
1. Hazardous cargo
2. VIP personnel
3. Helicopters
4. All of the above

10-3. The primary crash alarm system is normally wired directly between the control tower and what other facility(ies)?
1. The crash/rescue alarm room and the structural fire alarm room
2. The air operations dispatcher and the AirOps duty office
3. The station hospital or dispensary
4. All of the above

10-4. All of the emergency facilities at an air station are normally connected to a crash phone circuit which is activated from either the tower or flight clearance desk. This allows amplifying information to be transmitted by the flight clearance dispatcher and permits the tower operator to return to his duties without further interruption.

10-5. The secondary emergency radio network utilized as a standby for the primary crash radio network which the tower uses to communicate with mobile units is called the
1. operational control network
2. crash truck network
3. safety control network
4. internal security network

10-6. In the event of an aircraft crash, control tower personnel activate the crash phone system to inform the units concerned of the crash and its location. In addition, they also give the essential personnel which of the following items of information?
1. The ordnance load, if known
2. The type of aircraft
3. The number of persons aboard
4. All of the above

10-7. The location of a crashed aircraft with reference to a grid chart should be given in terms such as
1. FIVE DELTA
2. ONE-HALF MILE SOUTH OF TOWER
3. TWO MILES OFF THE END OF RUNWAY THREE SIX
4. JUST INSIDE THE FENCE NEAR THE SOUTHEAST CORNER OF THE FIELD

10-8. Personal survival equipment worn by aircrewmen of fighter and attack-type aircraft is equipped with an emergency locator beacon.

10-9. A wheels watch, equipped with a set of LSO paddles, is posted at the approach end of the duty runway. His duties are to monitor the wheels of approaching aircraft. Which of the following is a correct signal to the pilot?
1. A roger sign indicating the wheels are "down"
2. A roger sign indicating the wheels are "up"
3. A roger sign indicating the wheels "appear down and in place"
4. A waving motion indicating the wheels "appear down and in place"

In items 10-10 through 10-12, select from column B the signal the wheel watch equipped with LSO paddles and a flare gun will use to inform the pilot of a landing aircraft of each landing gear condition listed in column A.

	A. Landing Gear Conditions		B. Signals
10-10.	The landing gear appears to be down and in position	1.	He fires a pyrotechnic flare
10-11.	The landing gear is not extended	2.	He waves his arms from overhead to his sides
10-12.	The landing gear appears to be down, but the watch is not certain it is in the proper position	3.	He extends his arms parallel to the ground

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Learning Objective: Identify different types of emergency recovery equipment and related operations, including their advantages, operating principles, and characteristics.

10-13. When using the emergency chain-type arresting gear, the force that arrests an aircraft is caused by the transfer of energy from

1. the arrested aircraft to the chain
2. the chain to the arrested aircraft
3. the cross desk pendants to the arrested aircraft
4. the arrested aircraft to the cross deck pendants

In items 10-14, through 10-16, select from column B the type of arresting gear to which each statement in column A applies.

	A. Statements		B. Types
10-14.	The kinetic energy of an arrested aircraft is absorbed by a rotary friction arresting engine	1.	Morest emergency
		2.	E-28
		3.	Emergency chain
10-15.	It is a mobile, portable, self-sustaining unit	4.	E-15 or E-27
10-16.	It utilizes the principle of dragging weight to stop an aircraft		

Items 10-17 through 10-21 refer to the E-28 emergency runway arresting gear.

10-17. This gear requires no initial preparation to accommodate aircraft of various weights and landing speeds.

10-18. It is anticipated that this gear will eventually replace all other types of arresting gear ashore because of its

1. fast recycle time only
2. reliability only
3. simplicity only
4. simplicity, reliability, and fast recycle time

10-19. During an arrestment, the motion of the rotor is resisted by

1. movement of the cam release post
2. turbulence of the fluid in the housing
3. engagement of the retrieve drive sprocket
4. movement of the tape drum in the opposite direction

10-20. The size and exposed area of the cooling tank provide the means by which the excess heat generated by resistance to the turbulence is dissipated to the outside air.

10-21. In cases where the overrun barrier must be located near the end of the runway, it is necessary that its installation be made in such a manner as to permit the control tower operators to

1. warn the aircraft to clear the obstacles
2. leave it in a ready position
3. let the aircraft's pilot trigger the barrier
4. raise and lower it

10-22. The operations officer's decision to apply a foam blanket to a runway where there is a likelihood of fuel spillage upon the landing of an aircraft with a landing gear malfunction is made to decrease the possibility of

1. arresting gear damage
2. runway damage
3. fire
4. landing gear damage

10-23. If an aircraft is to make a "belly landing," a foam blanket should be laid down from the 2,000-foot to the 5,000-foot positions and 40 feet wide along the center of the runway.

Learning Objective: Identify procedures in making radio checks and volume adjustments, and in monitoring frequencies.

10-24. When a control tower watch is relieved, the oncoming watch will normally check the usability of both the radio transmitters and receivers by making short transmissions on each of the assigned frequencies from each operating position with the receivers off at the transmitting position but on at the other positions.

10-25. Regardless of the desired level of volume, the controller must ascertain that the volume of his headset or speaker is NOT reduced to the extent that transmissions from aircraft within his area of responsibility can NOT be clearly heard.

10-26. Proper modulation of a transmitter at one operating position is determined audibly by setting the receiver switch of another operating position to ON and speaking into the microphone in a normal conversational manner.

10-27. At most naval ATC facilities, all tower and approach control radio frequencies are continuously monitored by controllers utilizing headsets and/or speakers.

Learning Objective: Recognize proper radio transmission procedures including phraseology and station identification.

10-28. Which of the following is NOT an accurate response to a request for a radio check?
1. LOUD AND GARBLED
2. WEAK AND UNREADABLE
3. WEAK BUT CLEAR
4. UNREADABLE

In items 10-29 through 10-31, select from column B the organization responsible for the control facility associated with each abbreviation listed in column A.

	A. Abbreviations	B. Organizations
10-29.	ARACs	1. Air Force
10-30.	RAPCONs	2. Army
10-31.	ARTCCs	3. Navy
		4. FAA

10-32. Memphis International Airport is in close proximity to and provides approach control service for NAS Memphis. What is the correct phraseology to identify the precision approach radar (PAR) at NAS Memphis?
1. MEMPHIS GCA
2. MEMPHIS PRECISION APPROACH
3. NAVY MEMPHIS GCA
4. NAVY MEMPHIS PAR

10-33. The word AIRWAYS identifies communications stations operated by what activity?
1. The Navy
2. The Air Force
3. A commercial airline
4. The Federal Aviation Administration

10-34. If Navy aircraft 53142 is on a search and rescue mission, it is identified in which of the following ways?
1. NAVY SAR FIVE THREE ONE FOUR TWO
2. NAVY RESCUE FIVE THREE ONE FOUR TWO
3. NAVY RESCUE FIFTY THREE ONE FORTY TWO
4. SIERRA ALFA ROMEO FIVE THREE ONE FOUR TWO

In items 10-35 through 10-38, select from column B the type of operating activity associated with each aircraft identification listed in column A.

	A. Aircraft Identification	B. Operating Activity
10-35.	NOVEMBER TWO ONE FIVE FOUR	1. Foreign Civil
10-36.	XRAY YANKEE TWO TWO	2. Interceptor
10-37.	C-F-M-R-C	3. Civil
10-38.	CANFORCE FIVE SIX ONE FOUR	4. Canadian Military

10-39. If the members of the President's family are aboard a civil aircraft and an identification designation is necessary, the words used will be
1. EXECUTIVE ONE
2. EXECUTIVE TWO
3. EXECUTIVE ONE FOXTROT
4. EXECUTIVE TWO FOXTROT

10-40. If a pilot uses an aircraft call sign identification other than those recommended, the Air Controlman should use the same in his reply.

In items 10-41 through 10-43, select from column B the word associated with each special meaning listed in column A.

	A. Meanings	B. Words
10-41.	Let me know that you have received and understand this message	1. ROGER
		2. WILCO
		3. ACKNOWLEDGE
10-42.	I have received your message, understand it, and will comply	4. AFFIRMATIVE
10-43.	I have received all of your transmission	

10-44. If an Air Controlman wishes to convey the information to a pilot that the transmission is ended and a reply is expected, what word will he use?
1. ACKNOWLEDGE
2. ROGER
3. OVER
4. OUT

10-45. An altitude of 1,800 feet is transmitted as
1. EIGHTEEN HUNDRED
2. ONE EIGHT HUNDRED
3. ONE EIGHT ZERO ZERO
4. ONE THOUSAND EIGHT HUNDRED

10-46. A flight level equivalent of 24,000 feet is transmitted as
1. TWO FOUR ZERO ZERO ZERO
2. FLIGHT LEVEL TWENTY FOUR
3. FLIGHT LEVEL TWO FOUR THOUSAND
4. FLIGHT LEVEL TWO FOUR ZERO

10-47. In response to a request for a time check, how is the time 5:15 and 20 seconds a.m. transmitted?
1. TIME, FIVE FIFTEEN
2. TIME, ZERO FIVE ONE FIVE
3. TIME, ZERO FIVE ONE FIVE AND ONE QUARTER
4. TIME, ONE SEVEN ONE FIVE AND ONE QUARTER

10-48. An airport that has a field elevation of 1,800 feet will transmit this information as
1. FIELD ELEVATION EIGHTEEN HUNDRED
2. FIELD ELEVATION EIGHTEEN ZERO ZERO
3. FIELD ELEVATION ONE EIGHT ZERO ZERO
4. FIELD ELEVATION ONE THOUSAND EIGHT HUNDRED

10-49. How is an altimeter setting of 29.86 spoken?
1. ALTIMETER TWO NINER EIGHT SIX
2. ALTIMETER TWENTY NINER DECIMAL EIGHTY SIX
3. ALTIMETER TWO NINER POINT EIGHT SIX
4. ALTIMETER TWENTY NINER POINT EIGHTY SIX

10-50. NAS control tower has received a weather report from the local Naval Weather Service (NWS) office which indicates a surface wind of 110 degrees, velocity 25 knots. In relaying this information to an aircraft, the correct phraseology would be
1. WIND ONE TEN DEGREES AT TWO FIVE
2. WIND, ONE ONE ZERO DEGREES AT TWO FIVE
3. WIND FROM ONE ONE ZERO DEGREES, TWO FIVE KNOTS
4. WIND, ONE ONE ZERO AT TWENTY FIVE KNOTS

10-51. The word KNOTS must be used when utilizing speed adjustment procedures.

10-52. If a controller intends to spell out the word AZIMUTH using the standard phonetic alphabet, what will he say?
1. ALFA ZERO INDIA MIKE UNIFORM TREE HOTEL
2. ABLE ZULU INDIA MIKE UNIFORM TREE HOTEL
3. ALFA ZULU INDIA MIKE UNIFORM TANGO HOTEL
4. ABLE ZERO INDIA MIKE UNIFORM TREE HOTEL

10-53. Stating the letter J and a route number in group form is the proper way to describe a/an
1. VOR/VORTAC/TACAN JET ROUTE
2. VOR/VORTAC/TACAN AIRWAY
3. RNAV ROUTE
4. ARC ABOUT VOR-DME/VORTAC/TACAN NAVAID

10-54. When describing a particular arc about a TACAN that is 25 nmi SE of a navaid, a controller would transmit this information to an aircraft as

1. TWO FIVE MILE ARC SOUTHEAST OF MEMPHIS
2. TWENTY FIVE MILE ARC OF MEMPHIS TACAN, SOUTHEAST
3. MEMPHIS TACAN TWO FIVE MILE ARC, SOUTHEAST
4. SOUTHEAST OF MEMPHIS TACAN, TWENTY FIVE MILE ARC

10-55. The initial radio callup normally ends with which word?

1. WILCO
2. ROGER
3. OVER
4. OUT

10-56. The pilot of an F-8 contacts a Navy tower using NAVY 12345 as his call sign and identifies the type of aircraft. After the tower has acknowledged by repeating this call sign, what shorter version may be used?

1. NAVY TWO THREE FOUR FIVE
2. NAVY THREE FOUR FIVE
3. NAVY FOUR FIVE
4. NAVY FIVE

10-57. Which of the following items of a taxi clearance to a departing aircraft may be omitted when so requested in writing by a local aircraft operator?

1. The runway in use
2. The altimeter setting
3. The surface wind
4. The departure control frequency

10-58. When a taxi clearance is issued, the omission of any holding instruction authorizes the aircraft to cross all runways the taxi route intersects except the runway to which cleared.

10-59. What instruction will the controller give to a pilot granting permission to take off and make a requested turn to the left when airborne?

1. TAKE OFF, TURN LEFT
2. CLEARED FOR TAKEOFF AND LEFT TURN
3. LEFT TURN APPROVED, CLEARED FOR TAKEOFF
4. CLEARED FOR TAKEOFF, LEFT TURN APPROVED

10-60. A control tower that does NOT possess override capability on the departure frequency prefixes IFR takeoff clearances with

1. CHANGE TO DEPARTURE CONTROL, MONITOR GUARD
2. CHANGE TO DEPARTURE CONTROL FREQUENCY, MONITOR GUARD CHANNEL
3. CONTACT DEPARTURE CONTROL, MONITOR GUARD FREQUENCY
4. MONITOR GUARD CHANNEL, CHANGE TO DEPARTURE CONTROL

10-61. Except when single piloted jet aircraft will level off and operate at an altitude below 2,500 feet, the pilots will NOT be instructed to change radio frequencies prior to reaching 2,500 feet.

10-62. If an aircraft approaches a traffic pattern which requires the aircraft to circle the airport to the right, the controller must furnish specific traffic pattern information to the pilot.

10-63. If a pilot turns his aircraft onto the final approach leg and requests a touch-and-go landing that can NOT be approved but a full stop can be approved, which of the following instructions should the controller transmit to the pilot?

1. UNABLE TOUCH-AND-GO, MAKE FULL STOP LANDING OR GO AROUND
2. UNABLE TOUCH-AND GO, RIGHT/LEFT TURN APPROVED
3. UNABLE TOUCH-AND-GO, MAKE FULL STOP LANDING OR CIRCLE THE FIELD
4. Either 1 or 3 above

10-64. Which of the following constitutes the most acceptable description of the location of an airborne obstacle that might affect the pilot of an aircraft in the traffic pattern?

1. TO YOUR RIGHT, ABOVE YOU, ONE MILE AHEAD OF YOU
2. ABOVE YOU AND ONE MILE EAST OF YOU
3. ONE MILE EAST OF THE TELEVISION TOWER ON YOUR LEFT AND ABOVE
4. ONE MILE EAST OF THE TELEVISION TOWER WHICH IS EAST OF YOU AND DIRECTLY ABOVE THE TOWER

10-65. After a pilot reports WHEELS DOWN, the tower controller is no longer concerned with confirming that this situation actually exists.

10-66. If a pilot requests a landing gear check by control tower personel and the check shows the gear to be in a normal down position, the controller should transmit LANDING GEAR APPEARS DOWN AND IN PLACE.

Learning Objective: Identify the purpose, contents, and procedures associated with the Automatic Terminal Information Service (ATIS).

10-67. The primary purpose of ATIS at airports is to provide arriving and departing passengers with current arrival and departure schedules.

10-68. A system of identifying ATIS messages has been established which precludes a pilot from receiving outdated information. This identification includes the
1. airport name and datetime group
2. alphabet code of message, datetime group, and airport name
3. airport name and phonetic alphabet code of message
4. alphabet code of message, airport name, and time

10-69. If the sky condition and/or visibility is missing from an ATIS message, this will normally indicate a
1. 1,000-ft ceiling and 1-mi visibility
2. 3,000-ft ceiling and 3-mi visibility
3. 5,000-ft ceiling and 5-mi visibility
4. 10,000-ft ceiling and 7-mi visibility

Assignment 11

Air Traffic Control Communications and IFR/SVFR Control Procedures

Text: Pages: 239 - 258

Learning Objective: Recognize the various forms of communications security control and identify procedures for implementing and/or testing them.

11-1. Procedures designed to deny the enemy valuable information concerning military operations transmitted by radio are referred to by which abbreviation?
1. SECCOM
2. COMSEC
3. COMGUARD
4. RADSEC

11-2. Defensive measures which should be employed to guard against possible enemy interception of radio transmissions include which of the following?
1. Using the lowest transmitter power possible and minimum transmission time
2. Alternating frequencies on a daily basis
3. Maintaining correct adjustment of equipment and circuit discipline
4. Both 1 and 3 above

11-3. Procedures employed to reduce the possibility of enemy interception of radar and radio transmissions from a carrier task force are called
1. EMCON
2. RADCOM
3. CONELRAD
4. ECOMCON

11-4. The responsibility for determining the requirements and implementation of electronic emission control rests with the
1. operations officer
2. communications officer
3. appropriate fleet commander
4. commanding officer

11-5. FAR 99.7 refers to special security instructions issued by the FAA Administrator which apply equally to the FAA and DOD.

11-6. The U.S. Navy Instruction that promulgates the participation of naval units in the SCATANA plan is OPNAVINST
1. 3222.30 (Series)
2. 3722.30 (Series)
3. 3730.22 (Series)
4. 2237.30 (Series)

11-7. The instruction that outlines the responsibilities and actions for the SCATANA plan also provides for testing the plan at least once every
1. 15 days
2. 30 days
3. 45 days
4. 60 days

11-8. When a SCATANA test is conducted, all but which of the following actions will be simulated?
1. Interrupting communications
2. Completing the SCATANA Test Report
3. Grounding or diverting aircraft
4. Shutting down air navaids

Learning Objective: Identify emergency communication reports by name and recognize correct procedures for forwarding these reports to appropriate agencies.

11-9. Emergency communications are communications associated with which of the following?
1. An aircraft that is in distress
2. A pilot who is lost
3. Alerting a pilot to a dangerous situation
4. Each of the above

11-10. What frequencies are emergency frequencies and must be guarded by all military and most civil control towers?
1. 121.5 MHz and 243.0 MHz
2. 121.5 MHz and 500 kHz
3. 243.0 MHz and 500 kHz
4. 500 kHz and 2182 kHz

In items 11-11 and 11-12, select from column B the radio-telephone transmission associated with each type of emergency signal listed in column A.

	A. Emergency Signals		B. Transmissions
11-11.	Distress	1.	PAN PAN PAN
11-12.	Urgency	2.	SECURITY SECURITY SECURITY
		3.	MAYDAY MAYDAY MAYDAY
		4.	URGENT URGENT URGENT

11-13. If a message from an aircraft is preceded with the words CIRVIS CIRVIS CIRVIS, the frequencies must be cleared of all other communications.

11-14. Which of the following examples contains information that would most likely be the subject of an initial sighting CIRVIS report?
1. The Air Force identified the formation of six jet aircraft as B-52s flying from Kansas City to Oregon on a heading of 270° at an altitude of 35,000 feet with an airspeed of 330 knots
2. Six Air Force B-52s were observed 20 nautical miles from a lightship at approximately 35,000 feet heading north over the continental limits of the United States
3. A formation of jet aircraft, no insignia observed, was sighted flying over the Pacific ocean at 35,000 feet on an easterly course
4. The lightship HOTEL identified jet aircraft previously identified on a westerly heading at 35,000 feet as six USAF B-52s

11-15. Navy towers pass CIRVIS reports directly to the appropriate Air Division Control center.

Learning Objective: Recognize equipment and procedures for making visual light communications and their meanings.

11-16. A controller uses a portable traffic light as a means of visual communication to control all but which of the following?
1. Vehicles and personnel on the ground
2. Airborne aircraft
3. Aircraft on the landing area without radio
4. Aircraft in the hangar area

11-17. If the only means of communication with the pilot of an A-4 is a portable traffic control light and he appears to be positioning his aircraft on final approach to runway 18 when the duty runway is 9, and the surface wind is 090° at 35 knots and NO other traffic exists, what type of signal should the pilot be given?
1. Alternating red and green followed by a steady red
2. Alternating red and green followed by a steady green
3. Flashing red
4. Flashing green

Refer to table 11-1 in your textbook in answering items 11-18 through 11-23.

In items 11-18 through 11-20, select from column B the meaning for aircraft on the ground of each traffic control light signal indicated in column A.

	A. Signals		B. Meanings
11-18.	Flashing green	1.	Return to starting point on the airport
11-19.	Flashing red	2.	Taxi clear of the runway in use
11-20.	Flashing white	3.	Cleared for takeoff
		4.	Cleared to taxi

In items 11-21 through 11-23, select from column B the traffic control light signal for aircraft in flight associated with each meaning in column A.

	A. Meanings	B. Signals
11-21.	Give way to other aircraft and continue circling	1. Steady green
		2. Steady red
11-22.	Cleared to land	3. Flashing green
11-23.	Airport unsafe—do not land	4. Flashing red

11-24. The information that ground visibility in the control zone is less than 3 miles and/or that the ceiling is less than 1,000 feet may be indicated between sunset and sunrise by
1. the lighting of the airport rotating beacon
2. flashing lights outlining the traffic or wind direction indicator
3. a flashing light located on top of the airport rotating beacon
4. a flashing amber light on top of the control tower

Learning Objective: Recognize steps in the development of the National Airspace System, and identify terms and procedures relating to this system.

11-25. The first step in the development of the National Airspace System was the installation of radio equipment near telephones for air and ground communications.

11-26. Which of the following contributions did military technology make in providing the best possible navigation aids for use within national airspace?
1. IFF
2. Radar
3. TACAN
4. All of the above

11-27. Congress charged which organization with the responsibility for the safe and efficient use of the national airspace of the United States?
1. ADC
2. ATC
3. CAA
4. FAA

11-28. Victor airways are designed for use at what altitudes?
1. Below 18,000 ft
2. From 18,000 ft to FL 450
3. From FL 450 to FL 600
4. Above FL 600

Refer to figure 12-1 in your textbook. In items 11-29 through 11-31, select from column B the airspace structure defined by each of the boundaries listed in column A.

	A. Boundaries	B. Airspace Structures
11-29.	1,200 ft AGL to FL 180	1. Continental control area
11-30.	FL 180 to FL 450	2. Positive control area
11-31.	FL 180 to FL 600	3. Federal airways
		4. Jet routes

11-32. IFR ATC service is provided in/on all but which of the following areas?
1. Federal airways and jet routes
2. Control areas and transition areas
3. Control zones and the continental control area
4. Noncontrolled airspace

11-33. Area Navigation (RNAV) utilizes signals received from
1. compass locators
2. ILS
3. LFMH
4. VOR/DME

11-34. RNAV eliminates the requirement for the pilot to fly directly to or from a ground station.

11-35. When filing a flight plan, which of the following letters is used to identify an RNAV route?
1. V
2. J
3. R
4. G

11-36. Area navigation (RNAV) is advantageous to pilots in that it provides longitudinal, lateral, and vertical data.

11-37. Requests for authorization to deviate from the requirements for flight in a PCA must be submitted at least how many days prior to the proposed operation?
1. One day
2. Two days
3. Three days
4. Four days

11-38. Pilots flying in formation within positive controlled airspace must request and receive permission from ATC before they can deviate from their approved flight plan.

11-39. When military activities assume responsibility for separation of aircraft in established local flying areas, the aircraft must remain
1. free of ATC control
2. in the control area
3. in VFR conditions
4. in IFR conditions

11-40. An abbreviated flight plan should be filed at least 30 minutes before a pilot operating VFR or VFR on top (on IFR flight plan) estimates he will penetrate a positive control area. In addition to the identification and true airspeed (TAS), the plan should also include all but which of the following?
1. The VFR position and altitude/flight level
2. The estimated time and point of penetration
3. The requested route and flight level
4. Number of aircraft in the flight

Learning Objective: Recognize control procedures specified for IFR traffic control.

11-41. The procedures and minima contained in a letter of agreement or other appropriate military document can NOT be less than those specified in the Terminal Air Traffic Control Handbook 7110.8 (Series) unless the appropriate military authority permits special procedures which
1. reduce the separation between military aircraft
2. reduce the separation between all aircraft, civil and military
3. exclude all military aircraft
4. permit civil aircraft to fly through the area

11-42. Who has direct responsibility for the establishment of an approach control facility at a naval air station?
1. ARTCC
2. CNO
3. CO
4. FAA

11-43. Which of the following functions does NOT require a letter of agreement between your air station and the FAA?
1. Ground Controlled Approach (GCA) procedures
2. Approach control procedures
3. Control tower procedures
4. Landline communications

11-44. A pilot may cancel his IFR flight plan and thereby obtain landing clearance priority over all other VFR aircraft.

11-45. Transfer of control responsibility to another controller or facility can only be effected at a specified fix, time, or altitude. Additionally, transfer can be effected after any potential conflict with other aircraft being transferred and other aircraft under the jurisdiction of the receiving controller has been eliminated.

11-46. Formation flights operating IFR within the national airspace system are normally treated as
1. VFR aircraft
2. a group of aircraft, with the size determined by the number of aircraft involved
3. a single aircraft or a group of aircraft, depending on the capability of ATC to provide the service
4. a single aircraft

11-47. If a non-ATC facility relays a clearance issued by an ATC facility, it must relay the message word-for-word and prefix the message with the phrase "ATC clears."

11-48. A pilot reports hazardous weather at his assigned altitude and requests a change to evade it. If the controller knows that there is conflicting traffic at the requested altitude, he will most likely
1. disapprove the request because the pilot must continue his assigned altitude according to the flight plan
2. change the altitude or route of the conflicting traffic if the conflicting traffic will not be endangered and will approve the request
3. disapprove the request because it would involve changing the altitude or route of the conflicting traffic
4. approve the request and assign the pilot the same altitude as that of the conflicting traffic

11-49. At 1300, IFR flight Navy 123 reported over Olathe. The last altimeter setting Kansas City ARTCC had received from Olathe weather service was at 1155 and was issued to the pilot as follows:

NAVY ONE TWO THREE ALTIMETER TWO NINER NINER TWO

Why is this report in error?
1. Because the time of the setting was not given
2. Because the setting was not currently obtained from ARTCC's altimeter setting
3. Because the source of the setting was not given
4. Both 1 and 3 above

In items 11-50 and 11-51, select from column B the rule for the issuance of altimeter settings which applies to each IFR situation described in column A.

	A. IFR Situations		B. Rules
11-50.	An aircraft has been cleared to descend from a flight level to an altitude below the lowest usable flight level	1.	The controller must issue the setting for the reporting point
11-51.	An aircraft under radar contact below FL 180 flies over or near a compulsory reporting point	2.	The controller must request the aircraft's altitude
		3.	The controller must issue the setting for the nearest weather reporting station

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Learning Objective: Recognize nonradar separation minima and related procedures.

11-52. Upon initial radio contact with a descending aircraft, controllers are required to verify the passing altitude even though a new altitude will be assigned.

11-53. A position report has NOT been received from Navy 65432, an A-4 westbound at FL 270 which was due over Podunk intersection at 1300. ARTCC is dependent upon this report to effect separation between other traffic. The center should attempt to obtain this report no later than
1. 1255
2. 1300
3. 1305
4. 1310

11-54. At 1340, an F-14 on an IFR flight plan was delivered an Expected Approach Clearance (EAC) time of 1500. The aircraft has NOT been heard from since, and the time is now 1510. Other IFR traffic must be restricted and/or suspended until
1. 1510
2. 1530
3. 1545
4. 1600

11-55. Unless broadcast via ATIS and received by the pilot, specific items of approach control information which should normally be issued to aircraft upon initial contact include
1. approach clearance, weather, runway condition, and type of approach
2. approach clearance, runway, surface wind, altimeter setting, ceiling and visibility
3. approach clearance, runway conditions, surface wind, and time check
4. approach clearance, weather, surface wind, and runway dimensions

11-56. Before a pilot can fly within controlled airspace under the instrument flight rules of FAR 91, he must NOT only file an IFR flight plan but must also obtain an ATC clearance.

11-57. What are the three types of nonradar separation used to separate IFR traffic?
1. Vertical, diagonal, and lateral
2. Vertical, longitudinal, and diagonal
3. Vertical, lateral, and longitudinal
4. Lateral, diagonal, and longitudinal

11-58. Each type of nonradar separation has established minimums to which controllers must adhere for safe operations.

11-59. If an aircraft is flying IFR at FL 290, two additional aircraft may fly IFR in the same area with minimum vertical separation if they are at which FLs?
1. 270 and 300
2. 280 and 300
3. 280 and 310
4. 300 and 310

11-60. A pilot reports turbulence while operating IFR at FL 180. He requests and is issued clearance to climb to and maintain FL 200. Another aircraft may NOT be assigned to FL 180 until the first pilot reports that he is
1. leaving FL 180
2. passing through FL 185
3. passing through FL 190
4. approaching FL 200

11-61. Two IFR aircraft take off from adjacent airports and intend to follow the same course and altitude. If the first aircraft is flying at 340 knots and the second at 290 knots, they must be longitudinally separated by at least
1. 1 min
2. 5 min
3. 3 min
4. 10 min

11-62. An IFR aircraft has taken off from the Kansas City airport and is flying at 200 knots on the same course and altitude as an en route IFR aircraft flying at 250 knots and which has previously reported over the Kansas City fix. With DME operable on both aircraft, the longitudinal distance between them must be at least
1. 1 mi
2. 5 mi
3. 3 mi
4. 10 mi

11-63. If IFR aircraft A has taken off and is flying at 325 knots and IFR aircraft B takes off from the same airport and flies the same route and altitude at 300 knots, the longitudinal separation between them must be at least
1. 1 min
2. 2 min
3. 3 min
4. 5 min

11-64. What is the minimum longitudinal separation that must be maintained between two en route aircraft that are flying at the same altitude on the same course if the leading aircraft is flying at 300 knots and the trailing aircraft at 250 knots and both have reported over the same fix?
1. 15 min
2. 10 min
3. 3 min
4. 5 min

11-65. Assume that two IFR aircraft, A and B, are both using DME, they are both flying the same course from the same fix, that A is preceding B, and that A is flying at 5,000 feet and B at 3,000 feet. If B is to climb to 7,000 feet, what minimum separation must be met when B reaches 5,000 feet?
1. 5 mi
2. 10 mi
3. 15 mi
4. 20 mi

11-66. IFR aircraft B reports over a fix flying at 7,000 feet behind IFR aircraft A which had previously reported over the same fix flying at 9,000 feet. If aircraft B climbs to 11,000 feet within 10 minutes after reporting, what should be the minimum longitudinal separation between them?
1. 1 min
2. 5 min
3. 3 min
4. 10 min

11-67. What is the minimum longitudinal separation that is required when a leading IFR aircraft is flying at 280 knots and a trailing IFR aircraft is flying at the same altitude at 260 knots if both aircraft are equipped with DME?
1. 5 mi
2. 10 mi
3. 15 mi
4. 20 mi

11-68. IFR aircraft A, using DME, obtained distance information from a station having a DME navaid. IFR aircraft B, NOT equipped with DME, reports over the same station at the same altitude as aircraft A. The minimum longitudinal separation between A and B must be
1. 30 mi
2. 20 mi
3. 10 mi
4. 5 mi

11-69. If two opposite direction IFR aircraft are separated by minimum vertical separation, this minimum must be maintained for how long longitudinally if they request a conflicting altitude change?

1. 15 minutes before and after their estimated time to pass
2. 10 minutes before and after their estimated time to pass
3. 3 minutes before their estimated time to pass
4. 5 minutes before their estimated time to pass

11-70. If the pilots of two IFR aircraft on the same course and altitude agree to keep longitudinal separation, they may be authorized to maintain a time lapse of 10 minutes or a distance of 20 miles between their aircraft if they communicate directly with one another.

11-71. The airspace to be protected when applying airway or route-type lateral separation is determined by reference to the description of airways or routes in publication FAR 71.5.

11-72. What is the minimum lateral DME separation between the arc of a navigational aid and the boundary of a holding pattern airspace area?

1. 15 nmi
2. 10 nmi
3. 3 nmi
4. 5 nmi

11-73. Off established airways, how wide is the protected airspace a pilot flying at 10,000 feet will have to maneuver in if he makes a course change of less than 15 degrees 130 miles from a navaid?

1. 20 nmi
2. 10 nmi
3. 8 nmi
4. 4 nmi

11-74. On routes other than established routes where a course change of more than 15 degrees but less than 91 degrees is made, the lateral route and airway separation to be provided on the overflown side at FL 500 is

1. 9 nmi
2. 10 nmi
3. 17 nmi
4. 22 nmi

11-75. IFR aircraft A has just taken off and immediately turns 45 degrees away from the course to be followed by IFR aircraft B which is ready for takeoff on the same runway. The controller may clear aircraft B for takeoff after the time lapse of

1. 1 min
2. 2 min
3. 3 min
4. 1/2 min

Assignment 12

JFR/SVFR Control Procedures

Text: Pages 258 - 282

Learning Objective (continued): Recognize nonradar separation minima and related procedures.

12-1. If the pilots of two similar aircraft propose to fly the same course immediately after takeoff and then fly divergent courses 45 degrees or more apart within 5 minutes, action must be taken to ensure that a separation minimum of how many minutes be maintained during the period they are following the same course?
1. One
2. Two
3. Three
4. Four

12-2. Which of the following statements is applicable to two aircraft taking off in the same direction from parallel runways whose centerlines are 3,600 feet apart if the aircraft are to fly 45-degree divergent courses immediately after takeoff?
1. They must be separated by at least 1 minute
2. They must be separated by at least 3 1/2 minutes
3. They may take off simultaneously
4. They must be separated by the length of the runway used by the first aircraft

12-3. Simultaneous takeoffs of two aircraft that are to fly 45-degree divergent courses are permitted from runways that diverge by 24 degrees if the distance between the runway centerlines at and beyond the point where the takeoffs begin is at least
1. 1,500 ft
2. 2,000 ft
3. 2,500 ft
4. 3,500 ft

12-4. If two aircraft are to takeoff from intersecting runways that diverge by 27 degrees and fly 45-degree divergent courses, the succeeding aircraft can be cleared to takeoff immediately after the preceding aircraft is airborne and has commenced a turn past the point of runway intersection.

12-5. Two DME-equipped aircraft takeoff from the same runway and are flying on the same course. If the succeeding aircraft will climb through the preceding aircraft's altitude, the aircraft must be separated by what minimum distance until the succeeding aircraft passes through the preceding aircraft's altitude?
1. 12 mi
2. 2 mi
3. 5 mi
4. 4 mi

12-6. When approach control service is provided, a departing aircraft can be cleared for takeoff on a heading that differs by at least 45 degrees from the reciprocal course of an arriving aircraft making an instrument approach any time before the arriving aircraft leaves a fix inbound that is NOT less than what distance from the airport?
1. 10 mi
2. 5 mi
3. 3 mi
4. 4 mi

12-7. At a non-approach control facility, an IFR flight may takeoff in a direction that differs by at least 45 degrees from the reciprocal of the final approach course. The departing aircraft must takeoff 3 minutes before the arriving aircraft is estimated at the airport.

12-8. Assume that aircraft A is making a straight-in instrument approach on a heading of 090 degrees and is estimated to arrive at the airport at 1000. Aircraft B is ready to takeoff from runway 24 and turn left to fly a course of 210 degrees. Aircraft B may be cleared for departure provided it can be established on the course of 210 degrees by
1. 0955
2. 0956
3. 0957
4. 0958

12-9. At 2100 local time a pilot requested a VFR on-top clearance while in a holding pattern where there were several other aircraft. His request was denied because
1. the pilot was trying to avoid delay by coming in before his turn
2. ATC was not disposed to grant it
3. there was no report available on the tops of the clouds
4. a VFR on-top clearance may not be issued

12-10. An aircraft operating in positive controlled airspace may be granted a VFR or VFR-conditions-on-top type of clearance any time the weather conditions are suitable.

- Refer to table 12-1 in your textbook in answering items 12-11 and 12-12.

12-11. What is an appropriate VFR altitude for an aircraft flying on a magnetic heading of 112 degrees above FL 290?
1. FL 360
2. FL 380
3. FL 400
4. FL 440

12-12. What is an appropriate VFR altitude for an aircraft flying on a magnetic heading of 227 degrees between 3,000 feet AGL and FL 290?
1. FL 180
2. FL 250
3. 10,500 ft
4. 13,500 ft

12-13. Special VFR operations are requested by the
1. pilot only
2. tower operator only
3. operations officer only
4. tower operator and operations officer

12-14. During Special VFR operations, a climb to VFR may be authorized provided the only weather limitation is restriction to visibility.

12-15. It is permissible for you as a controller to assign a fixed altitude to a Special VFR aircraft.

12-16. Reported ground visibility at your airport is below one mile, and an arriving aircraft is operating in your control zone. What is the first action you should take?
1. Ask the pilot if he can depart the control zone with a flight visibility of one mile
2. Issue landing clearance
3. Deny landing clearance
4. Have the pilot remain in the control zone until flight visibility increases to one mile

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Learning Objective: Identify IFR separation minima and related procedures.

12-17. Radar separation may be provided IFR aircraft under various situations. One such case is between a departing aircraft and an identified IFR aircraft providing the aircraft taking off will be
1. tracked visually from the end of the runway for 1 mile
2. identified within 1 mile from the runway's end
3. identified within the last 1/2 mile of the runway
4. identified within 1/4 mile after takeoff

12-18. A radar-identified IFR aircraft can NOT be cleared through the altitude of an unidentified IFR aircraft using radar separation only.

12-19. A controller may apply minimum radar separation between which of the following?
1. The ends of beacon control slashes
2. The end of a beacon control slash and the center of a primary target
3. The centers of primary targets
4. Any of the above

12-20. What is minimum radar separation between two aircraft under radar control if both of them are within 40 miles of the radar antenna site?
1. 3 min
2. 5 min
3. 3 mi
4. 5 mi

12-21. Vertical separation applied between two radar-identified aircraft may be stopped if their targets pass and no longer touch, and if the aircraft are on courses diverging by a minimum of
1. 5 degrees
2. 10 degrees
3. 15 degrees
4. 20 degrees

12-22. Aircraft A may be cleared for takeoff from the instrument runway of an airport 45 miles distant from the antenna site of the controlling radar facility with a minimum of 2 miles separation from aircraft B on an instrument radar-controlled approach, provided the separation will increase to how many miles within 1 minute after takeoff?
1. One
2. Three
3. Five
4. Ten

In items 12-23 through 12-25, select from column B the distance between runway centerlines that is required for each simultaneous radar-controlled parallel runway operation listed in column A.

	A. Parallel Runway Operations	B. Distances Required
12-23.	A departing aircraft is taking off from one runway, and an arriving aircraft is approaching the other. The threshholds are even	1. 3,300 ft
		2. 3,400 ft
		3. 3,500 ft
		4. 3,600 ft
12-24.	An arriving aircraft is approaching the nearest runway, and a departing aircraft is taking off from the other. The threshholds are staggered by 500 feet	
12-25.	An arriving aircraft is approaching the farthest runway, and a departing aircraft is taking off from the other. The threshholds are staggered by 500 feet	

12-26. What is the required relationship between the departure course and the missed approach course to authorize simultaneous arrival and departure operations from parallel runways until minimum radar separation can be provided such aircraft?
1. The departure course must diverge from the missed approach course by at least 45 degrees
2. The missed approach course must be flexible so as to permit divergence of 45 degrees from the departure course
3. The departure course must diverge from the missed approach course by at least 60 degrees
4. Both aircraft must continue on courses parallel to the runways

12-27. If an arriving aircraft deviates from its approach/missed approach to a parallel runway, and on the other parallel is an aircraft ready but NOT committed for takeoff, the departing aircraft will be held.

12-28. Simultaneous radar-controlled arrival and departure operations may be authorized on nonintersecting runways that diverge by 35 degrees if the distance between the centerline of the takeoff runway, measured from the point where the takeoff is commenced, and the centerline of the landing runway is at least
1. 1,000 ft
2. 2,000 ft
3. 3,400 ft
4. 3,500 ft

12-29. With what minimum lateral distance must radar-controlled aircraft be separated from the boundary of an adjoining radar-controlled airspace that is more than 40 miles from the radar antenna site?
1. 1 1/2 mi
2. 2 1/2 mi
3. 3 mi
4. 5 mi

12-30. What minimum separation, if any, is required between an aircraft climbing and/or descending and the boundary of nonradar-controlled airspace?
1. Six miles
2. Five miles
3. Three miles
4. None

12-31. Until nonradar separation has been established, a minimum of 3 miles separation from the edge of the scope is necessary for a radar-separated aircraft that is climbing or descending through the altitude of another aircraft that has been tracked to the edge of the scope.

12-32. When a radar-controlled aircraft is within 40 miles of the antenna site, it may be separated from prominent obstructions displayed on the radar scope by a minimum of
1. 10 mi
2. 6 mi
3. 3 mi
4. 5 mi

Learning Objective: Identify functions of radar system components and types and uses of various displays.

12-33. When the radiated electromagnetic waves strike an object, some of the energy is reflected to the transmitter site where it is amplified by the
1. transmitter
2. receiver
3. modulator
4. waveguide

In items 12-34 through 12-36, select from column B the function of each basic radar transmitting system component listed in column A.

	A. Components	B. Functions
12-34.	Synchronizer	1. Converts the dc pulses received from the modulator into extremely high frequency radio energy
12-35.	Transmitter	2. Acts as an electronic switch or valve to furnish high ac voltage to the transmitter in brief pulses
12-36.	Reflector	3. Concentrates and shapes the RF energy into the desired beam
		4. Furnishes a sharp, low pulse to trigger the modulator and the sweep generator simultaneously

In items 12-37 through 12-39, select from column B the basic radar receiving system component that performs each function listed in column A.

	A. Functions	B. Components
12-37.	Converts the RF pulses into sharp video pulses	1. Sweep generator
12-38.	Converts the video pulses received from the video into light indications	2. Indicator
		3. Receiver
12-39.	Receives the echo energy from the reflector and transmits it to the waveguide	4. Antenna

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Items 12-40 and 12-41 refer to radar displays.

12-40. The type of radar display used in air traffic control depends on the
1. location of the time reference on the scope face
2. spacing of the rangemarkers on the scope face
3. use to be made of the radar data
4. distance to be covered

12-41. Which type of radar display can you use to increase the maximum range of coverage on a scope face for a selected azimuth sector?
1. Moving target indicator (MTI)
2. Plan position indicator (PPI)
3. Identification friend or foe (IFF)
4. Offcenter plan position indicator

Learning Objective: Identify capabilities, characteristics, and utilization of auxiliary radar equipment, including the moving target indicator, circular polarization, and surveillance application.

12-42. Which auxiliary component of a radar system eliminates stationary targets (clutter) from the basic display?
1. Automatic volume control (AVC)
2. Moving target indicator (MTI)
3. Automatic frequency control (AFC)
4. Plan position indicator (PPI)

12-43. The ability of MTI to display any specific aircraft target depends on the radial velocity of the aircraft. Radial velocity is the speed an aircraft flies toward or away from the radar antenna.

12-44. Which of the following radar presentations may be selected by an AC who operates a radar system with both normal and MTI?
1. A normal display utilizing signals from both moving and stationary targets
2. A display in which the MTI signals are range-gated at a desired range with normal signals beyond
3. An MTI display showing only moving targets
4. Any of the above

12-45. During heavy thunderstorms, you should select linear polarization to prevent the targets from being obscured on the radar scope.

Items 12-46 through 12-50 refer to the mapping systems.

12-46. What information does a controller observe from a PPI display by using the rangemarks on the scope and the compass rose?
1. Altitude and azimuth
2. Azimuth and range
3. Range and geographical location
4. Altitude and geographical location

12-47. Which of the following statements about a map overlay is INCORRECT?
1. It is made of transparent plastic
2. It provides the necessary reference marks and the location of navaids
3. It is mounted directly on the cathode ray tube
4. Obstructions and runways are etched into its surface

12-48. What inherent disadvantage of the map overlay must you be careful to avoid when observing a target?
1. Parallax
2. Clutter
3. Polarization
4. Radiation

12-49. The video map's biggest advantage over the map overlay is that the video map expands and contracts as the range on the scope is changed.

12-50. Which of the following conditions affecting a radar display of video mapping is likely to be listed as a disadvantage of a video mapping system?
1. The map is good for only one range setting
2. The targets may not appear in proper relation to the map
3. The radar information is not presented with map data
4. The mapping unit is subject to failure

12-51. A controller can relay accurate information to a pilot concerning the heading of his aircraft by utilizing information provided by the surveillance radar.

12-52. The surveillance radar operator should inform the pilot of which of the following factors so that the pilot can maintain the proper glide angle during a surveillance final approach?
1. Azimuth only
2. Range only
3. Range and desired altitude
4. Altitude and azimuth

Learning Objective: Recognize causes of undesirable radar performance characteristics and actions to be taken when they occur.

12-53. Cancellation of an aircraft's target on an MTI display is a result of the aircraft flying at a speed such that the distance covered between pulses is equal to one-half the wavelength of the transmitting frequency. This is called
1. target fade
2. MTI harmonics
3. synchronized velocity
4. MTI blind speed

12-54. The effect of MTI blind speed is possible for a period of several minutes if the aircraft changes speed and direction frequently.

12-55. Which of the following determine(s) the degree and length of target fades when aircraft pass directly over the antenna site?
1. Atmospheric conditions
2. Surrounding terrain
3. Antenna height
4. Tilt angle of the antenna

12-56. What action should be taken if a previously unknown fade area is suspected after a radar facility has been commissioned?
1. The equipment capabilities must be studied
2. Another flight check must be requested
3. The flight data must be reviewed
4. The height of the antenna must be increased

12-57. Anomalous propagation is the binding of a radar beam as it passes through the atmosphere, and it is most likely to occur over areas where there is a difference between air and surface temperatures.

12-58. An AC who observes apparent radar targets traveling at tremendous speeds and frequently changing directions would probably be correct in assuming that they are the results of temperature inversions.

12-59. Large areas of clutter appearing on a radar scope as a result of passive radar jamming are produced by
1. standby channel interference
2. thin metal strips
3. generated radar energy
4. dual channel interference

12-60. If a nearby radar installation operating on a similar frequency interferes with proper operation of your radar system, you should request that installation to
1. retune its standby channel
2. relay its log of false targets to you
3. realign its modulator
4. check its frequency calibration

Learning Objective: Recognize the capabilities, limitations, and associated equipment of the Air Traffic Radar Beacon System (ATCRBS) and its application as an invaluable tool.

12-61. Which of the following types of radar can be operated independently but also can be used with surveillance radar in the control of air traffic?
1. RACON
2. Secondary surveillance
3. Primary
4. Both 2 and 3 above

12-62. Which of the following groupings identifies the components of a secondary surveillance radar system?
1. An interrogator on the ground, a transponder in the aircraft, and a display on an air traffic control radarscope
2. An interrogator in the aircraft, a transponder on the ground, and a display on an air traffic control radarscope
3. An interrogator on the ground, a transponder on the ground, and a display on an aircraft radarscope
4. An interrogator in the aircraft, a transponder in the aircraft, and a display on an air traffic control radarscope

12-63. The difference between secondary surveillance radar and primary radar is that in secondary surveillance radar the signals displayed are transmitted by a transponder in the aircraft rather than being reflected by the aircraft.

Items 12-64 through 12-69 refer to the basic radar beacon system.

12-64. What is the transmission characteristic of the interrogation signals of a radar beacon system?
1. The paired pulses are spaced the same for all modes
2. The paired pulses are spaced according to the mode in use
3. The paired pulses are spaced at random
4. The paired pulses are spaced the same as the primary radar pulses

12-65. What systems sequence of events and antenna arrangement will provide the AC with a display of correlated information simultaneously from beacon and radar systems?
1. The radar pulse must be transmitted at a preset time before the beacon pulse pair, and each system antenna must be mounted on a separate pedestal
2. The radar pulse must be transmitted at a preset time before the beacon pulse pair, and both systems' antennas must be mounted on a common pedestal
3. The beacon pulse pair must be transmitted at a preset time, and each system antenna must be mounted on a separate pedestal
4. The beacon pulse pair must be transmitted at a preset time before the radar pulse, and both systems' antennas must be mounted on a common pedestal

12-66. In which component of the ground equipment system will the beacon video signals be processed when the transponder in an aircraft responds to a challenge by an I/R unit?
1. Video mixer
2. Decoder
3. Interrogator
4. Receiver

12-67. Before the transmitter of a radar transponder will transmit a reply, the transponder must
1. receive primary pulses and process them into echoed pulses
2. receive, key, and process echoed radar pulses
3. receive and process special keyed pulses
4. receive echoed pulses and convert them into primary pulses

12-68. Which of the following is an INCORRECT statement about the transponder?
1. The strength of the response is dependent upon the intensity of the interrogating signal received
2. Different frequencies are used for interrogation and reply
3. The interrogation signal is different from the reply signal which may be coded or uncoded
4. There is an inherent delay between the receipt and reply to an interrogation

12-69. If the beacon target is at a great distance from the ground antenna and the decoder switch is set for RAW VIDEO, the scope display of the transponder reply will appear as
1. concentric circles for each framing and information pulse
2. a maximum of two slashes
3. arc segments for each framing and information pulse
4. a maximum of one slash

Item 12-70 refers to the factors affecting operation of secondary radar.

12-70. A controller who knows the internal and external variances that affect operation of his equipment will most likely decide that which of the following factors is the cause of false secondary radar targets appearing on his scope?
1. The aircraft is at too high an altitude
2. The beacon pulse pair is being blocked by the aircraft wing or fuselage in a turn
3. The antenna is not in line of sight with the target
4. There are obstructing surfaces within two miles of the beacon antenna site

Assignment 13

Radar and Allied Equipment and Procedures

Text: Pages 282 - 311

Learning Objective: Recognize the capabilities, limitations, and associated equipment of the Air Traffic Control Radar Beacon System (ATCRBS) and its application as an invaluable tool.

13-1. What will cause a beacon target close to the antenna to appear as a concentric circle around the main bang on a radarscope?
1. Two aircraft with transponders are operating within 3.3 nautical miles of each other
2. The beacon target is outside the antenna coverage pattern
3. The interrogator's sensitivity is maladjusted
4. Each of the above

13-2. Which of the following have been designated "air traffic control modes"?
1. A and 3
2. B and 2
3. C and 3
4. D and 1

13-3. Which of the following statements about SIF equipment is correct?
1. Common usage of the term SIF includes both the decoder and transponder
2. Operation of SIF transponders and decoders is similar
3. SIF equipment was designed for use in RAPCONs
4. The SIF decoders are 10-channel decoders

13-4. Which code selector switch is used in conjunction with the left-hand Mode 1 code selector switch to determine the second digit of the desired code when decoding Mode 1 responses?
1. Left-hand Mode 3
2. Right-hand Mode 1
3. Left-hand Mode 2
4. Right-hand Mode 2

13-5. Which switch enables you to select IFF signals alone for presentation on the radarscope?
1. Challenge switch
2. Mode selector switch
3. Video switch
4. IFF-RDR-MIX switch

13-6. Refer to table 13-1 in your textbook. When a UPA-24 receives a correct reply to a challenge made in Mode 3 and the operator selects the CODE position of the VID switch and the MIX position of the IFF-RDR-MIX switch, what type of display will be observed on the radarscope?
1. One slash for each pulse in the code train
2. One slash for each pulse in the code train plus the primary radar target
3. One slash for each pulse in 3 successive code trains
4. One slash for each pulse in 3 successive code trains plus the primary radar target

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Learning Objective: Identify types, uses, components, and operating characteristics of ATC radar systems and equipment.

13-7. Ground controlled approach (GCA) is accomplished by coordinating the use of air surveillance radar on the ground and precision approach radar in the aircraft.

13-8. Surveillance radar in a GCA unit is displayed on what type of radarscope?
1. A
2. B
3. AZ-EL
4. PPI

13-9. The AN/CPN-4 is a self-contained, mobile radar unit used to control the approach of aircraft during reduced ceiling and visibility.

13-10. The AN/FPN-36 radar system is capable of displaying information that relates to
1. height finding, surveillance, precision approach, and VDL only
2. airport and taxi control only
3. surveillance and precision approach only
4. airport taxi control, height finding, surveillance, and precision approach

13-11. Which of the following is a disadvantage of the FPN-36 radar system?
1. It does not have IFF/SIF capability
2. Only one aircraft can be worked at a time
3. Search and precision cannot be monitored simultaneously
4. Each of the above

13-12. With precision mode selected on the FPN-36, the surveillance antenna scans a sector in what manner?
1. Left and right of the runway centerline
2. 360 degrees around the unit
3. Out to 50 mi
4. To a height of 70,000 ft

13-13. What is the scan of the azimuth antenna of the AN/FPN-36 radar in the search mode?
1. 360 degrees out to 50 mi
2. 270 degrees out to 40 mi
3. 360 degrees out to 40 mi
4. 180 degrees out to 50 mi

13-14. Which of the following statements about the AN/FPN-47 radar may be correct when the 200-mile range is selected?
1. Radar video only may be displayed for the first 60 miles of the sweep, and SIF/beacon video may be displayed from 60 to 200 miles
2. SIF/beacon video only may be displayed for the first 60 miles of the sweep, and radar video may be displayed from 60 to 200 miles
3. Radar and SIF/beacon video may be displayed simultaneously for the first 60 miles of the sweep, and radar video only may be displayed from 60 to 200 miles
4. Radar and SIF/beacon video may be displayed simultaneously for the first 60 miles of the sweep, and SIF/beacon video only may be displayed from 60 to 200 miles

13-15. The AZ-EL scope of the AN/FPN-52 radar provides what information for use by an operator when controlling an aircraft on an instrument approach?
1. Centerline of the runway
2. Glidepath
3. Distance from touchdown
4. All of the above

13-16. The two primary objectives of the AIMS program are to improve air traffic control through ATCRBS and to provide a military identification system that is
1. accurate
2. secure
3. versatile
4. improved

13-17. The interrogator equipment of the DAIR system can use existing PPI consoles.

13-18. In addition to the assigned beacon code that the aircraft is squawking, the AN/TXP-42 data block displayed adjacent to the aircraft's actual position consists of the aircraft's
1. route
2. destination
3. groundspeed
4. altitude

13-19. The remote control indicator C-8625/T should be located at or near the
1. master control unit
2. source of power
3. PPI console
4. control tower

13-20. When a controller sets the desired upper and lower limits on the control indicator, replies from only those aircraft within these limits are displayed on the AN/TPX-42, with the exception of aircraft which are having communications failure or which are
1. making a change of flight plan
2. experiencing an emergency
3. making a change in altitude
4. encountering IFR weather

13-21. The C-8625/T operator's control indicator is equipped with which of the following attention-getting devices?
1. A bell only
2. A buzzer only
3. A red light only
4. A bell and buzzer

Learning Objective: Recognize the purposes and location of ATC facilities and the qualifications, duties, and responsibilities of assigned personnel.

13-22. To meet the needs for continuous IFR flight service, ATC facilities were established at major air stations.

13-23. The IFR control room of a naval ATC facility should be located in
1. the control tower
2. a trailer near the GCA trailer
3. the operations building
4. a trailer near the touchdown end on the instrument runway

13-24. The mission of a Navy ATC facility is to provide safe, orderly, and expeditious movement of air traffic in which of the following areas?
1. Into and from the national airspace system
2. Within the facility's area of control
3. To and from operating areas
4. All of the above

13-25. Which of the following statements reflects the policy that is strongly recommended in OPNAV Instruction 3721.1 (Series) in reference to competent controllers?
1. They must possess a general knowledge of the precision approach controller position only
2. They must possess a general knowledge of the duties of all operating positions
3. They must possess a general knowledge of their operating positions only
4. They must possess a detailed knowledge of all operating positions

13-26. What action is directed by OPNAV Instruction 3721.1 (Series) when a controller becomes properly qualified to control instrument traffic?
1. The commanding officer must make a suitable entry in the controller's service record
2. The controller must make the required entries in his service record
3. The commanding officer must enclose a letter of commendation in the controller's service record
4. The controller must make sure his service record has the required entries

13-27. A watch supervisor must be qualified and FAA certified in all positions of the facility and must be specifically designated by the commanding officer.

13-28. All but which of the following are considered general duties of an approach controller?
1. Determining the time to be used between successive approaches by considering all aspects of air traffic control situations at the time
2. Controlling and coordinating the movement of all instrument traffic within the ATC facility's area of responsibility
3. Collecting, calculating, and posting flight data
4. Issuing air traffic clearances and information to aircraft under jurisdiction of approach control

13-29. What information must the final controller provide a pilot to assist him in maintaining the correct approach path to the designated instrument runway?
1. Azimuth
2. Range
3. Elevation data
4. All of the above

13-30. The duties of the departure control position in an ATC facility may be combined with those of another position.

Learning Objective: Identify qualifications and responsibilities of air traffic controllers, and recognize procedures and regulations that must be followed in directing aircraft including terminal radar services and pilot procedures.

13-31. When an AC completes a training course at a Class C school, he is assigned a Naval Enlisted Classification Code indicating a specialty within the Air Controlman rating.

13-32. When a radar controller assumes responsibility for a control position, he should check the radar alignment so that he can be personally satisfied that the radar presentation and equipment performance are adequate for the service to be provided.

13-33. You may establish secondary radar identification of an aircraft by directing the pilot to activate the IDENT feature of his transponder and then observing the
1. identification display
2. target display changes
3. appearance of the radar beacon
4. disappearance of the radar beacon

13-34. A pilot must be informed of which of the following?
1. Radar identification of his aircraft is initially established
2. Radar contact with his aircraft is lost
3. Radar identification is reestablished after radar contact was lost or radar service was terminated
4. All of the above

13-35. The pilot of an aircraft must be advised of his position if radar identification is established by means of
1. position correlation only
2. identifying turns only
3. radar beacon procedures only
4. identifying turns or radar beacon procedures

13-36. When an aircraft has been radar-identified and is being vectored to the final approach course, the controller must, as soon as practical, inform the pilot of the procedure to follow if radio communications are lost for a specified period of time NOT to exceed 1 minute.

13-37. Under which of the following conditions may IFR and Special VFR aircraft be vectored?
1. When requested by the pilot
2. When it is operationally advantageous to the pilot or controller
3. When required for noise reduction consideration
4. All of the above

13-38. Before providing a radar vector, the controller must ensure the aircraft can be returned to its original route within radar coverage.

13-39. Which vector method is being used when the controller informs the pilot to TURN THIRTY DEGREES LEFT/RIGHT?
1. The direction of turn and the magnetic heading to be flown after the completion of the turn
2. The number of degrees to turn and the direction of turn, in group form
3. The magnetic heading to be flown
4. The type of vector and manner in which turns are to be made

13-40. A pilot should be informed of the existence of which of the following conditions?
1. Radar contact with him is lost or established
2. Radar service is terminated
3. His aircraft is about to deviate from its protected airspace
4. Each of the above

13-41. After radar contact is established, a pilot discontinues reporting over compulsory reporting points. He will resume normal reporting when
1. radar service is terminated only
2. radar contact is doubtful only
3. radar contact is lost only
4. radar service is terminated or contact is lost

13-42. A controller may effect a radar handoff to another controller by
1. informing the receiving controller that radar contact has been established
2. requesting the receiving controller to change to his frequency
3. asking the receiving controller to acknowledge the fix for the target
4. physically pointing out the target to the receiving controller

13-43. Communications and responsibility for control of an aircraft to be handed off using radar can only be transferred to a receiving controller after the aircraft enters his area of responsibility.

13-44. What radar beacon code is assigned to an IFR en route aircraft between FL 240 and FL 330 inclusive?
1. 0700
2. 1100
3. 2000
4. 2100

13-45. What does the disappearance, from the radarscope, of an emergency squawk indicate to other ATC facilities who are observing the same emergency squawk?
1. The aircraft is under ATC control
2. The emergency is over
3. The aircraft has landed
4. ATC has refused control

13-46. If an aircraft's transponder is no longer required, what transmission should the terminal controller make to the pilot approximately 15 miles from the terminal destination?
1. SQUAWK LOW
2. SQUAWK STANDBY
3. SQUAWK NORMAL
4. SQUAWK HIGH

13-47. If a radar beacon reply is required immediately after takeoff, what should be assigned to the pilot of a departing aircraft before he takes off?
1. The initial heading to be flown
2. The channelized altitude
3. The aircraft vector
4. The appropriate mode/code

13-48. When providing radar vectors to a departing aircraft, it must be vectored to maintain at least a 3-mile lateral separation from prominent obstructions shown on the radarscope when the takeoff path is 3 miles or more from the obstruction.

13-49. If only radar separation is in effect, which of the following must be accomplished by the receiving controller for arriving IFR aircraft to be handed off?
1. Communicate with the pilot of the first aircraft before the aircraft reaches the clearance limit fix
2. Not delay the first aircraft at a fix to or over which the second aircraft is cleared
3. Establish communications with the pilot of the first aircraft before establishing communications with the pilot of the second aircraft
4. All of the above

13-50. If an aircraft is to be provided a radar approach and the radar approach is to be made on a different frequency, at what point in the approach will he be advised of the frequency?
1. Passing the final approach fix
2. When the aircraft is in sight of the controller
3. Prior to passing the final approach fix
4. Crossing the field boundary

13-51. Arriving aircraft may be vectored to the VFR traffic pattern and cleared for a visual approach if the reported ceiling is at least 500 feet above the minimum vectoring altitude and the visibility is at least 3 miles.

13-52. For complete information on speed adjustment, you should refer to the appropriate section of TATC Handbook 7110.8 (Series).

13-53. Which of the following factors may prevent a controller from providing a pilot with additional service such as observed traffic information through the use of radar?
1. Communications congestion
2. Limitation of the radar
3. Controller workload
4. Each of the above

13-54. Other than when the aircraft is operating in positive controlled airspace, when should traffic information NOT be issued to an IFR flight?
1. The aircraft is squawking 1500
2. The aircraft is over 30 miles away
3. The omission is requested by the pilot
4. The aircraft has passed the final approach fix

In items 13-55 through 13-57, select from column B the type of facility to which each terminal radar service variance in column A applies.

	A. Variances	B. Facilities
13-55.	Stage I	1. A designated Terminal Service Area (TRSA) where a program has been established for this specific purpose
13-56.	Stage II	2. An approach control facility utilizing radar
13-57.	Stage III	3. A facility where a formal approved program has been established for this specific purpose

13-58. If a radar controller in a facility, other than a center, observes an emergency flight pattern, what action must he take?
1. He must notify the appropriate center immediately
2. He must request immediate instructions from the operations officer
3. He must coordinate action pertinent to the emergency
4. He must notify the branch supervisor immediately so that he can coordinate actions pertinent to the emergency

13-59. A turbojet aircraft flies a triangular pattern to the left, following the heading for each side of the pattern for 1 minute. The pilot completes the pattern twice, returns to his original course, and repeats the pattern 20 minutes later. What information is he attempting to relay to the radar controller?
1. The aircraft transmitter and receiver are both inoperative
2. The aircraft transmitter is inoperative, but the receiver is operative
3. The aircraft receiver is inoperative, but the transmitter is operative
4. Either 2 or 3 above

Learning Objective: Recognize the responsibilities and general operating procedures of the Carrier Air Traffic Control Center (CATCC) during carrier operations and be able to differentiate between CATCC and LPH procedures.

13-60. Preparation and distribution of the daily air plan in the evening before the next day's scheduled operations is the responsibility of the

1. precision approach controller
2. surveillance controller
3. air operations officer
4. operations officer

13-61. A desirable method of indoctrinating personnel in all phases of the center's tasks is to

1. ensure that they are not rotated between the two major branches
2. ensure that they are rotated within and between the two major branches
3. train each person to become specialized in one position
4. limit each person's specialization to not more than two positions

13-62. What is the mission of air operations?

1. To coordinate the carrier's search and rescue operations
2. To furnish pertinent flight information to pilots
3. Scheduling and coordinating the carrier's flight operations
4. Both 2 and 3 above

13-63. Information concerning the fuel state of an aircraft is relayed to and recorded by the

1. radio operator
2. teletype operator
3. status board keeper
4. land/launch recordkeeper

13-64. Who maintains the accuracy of the navigational information posted on the status board?

1. DRT operator
2. Teletype operator
3. Sound-powered telephone talker
4. Land/launch recordkeeper

13-65. An ideal manning level required to provide CCA radar control of airborne aircraft consists of two officers, one supervisor, six controllers, three status-board keepers, and two talkers.

13-66. The CCA departure controller performs which of the following functions?

1. He requests navaid checks as necessary
2. He maintains advisory control of departing point-to-point flights until pilots shift to en route frequencies
3. He properly transfers control of departing flights to CIC and ensures that CIC acknowledges assumption of control
4. All of the above

13-67. Which CCA controller provides inbound flights with information concerning the type of approach and final bearing before commencing an approach?

1. The approach controller
2. The final controller
3. The marshal controller
4. The bolter waveoff controller

13-68. How many approach controllers are normally used during a CCA recovery?

1. One
2. Two
3. Three
4. Four

13-69. At what distance from the ramp will a CCA final controller normally assume positive control of an aircraft if radar contact has been established?

1. 4 to 6 mi
2. 7 to 9 mi
3. 10 to 12 mi
4. 13 to 15 mi

13-70. When is positive control of an inbound aircraft assumed by the final controller?

1. When radio contact is established
2. When radar contact is established
3. When visual contact is established
4. Both 2 and 3 above

13-71. To ensure that aircraft approaching from the bolter/waveoff pattern are positioned properly with respect to other arriving aircraft, the bolter/waveoff controller must closely coordinate with the

1. marshal controller
2. CCA officer
3. final controller
4. approach controller

In items 13-72 through 13-74, select from column B the CATCC term identified by each definition listed in column A.

	A. Definitions	B. CATCC Terms
13-72.	An order to an aircraft to proceed immediately to a divert field	1. Coupled
		2. Inbound bearing
13-73.	Aircraft automatic flight control system engaged and linked to data link command	3. Bingo
		4. CCA
13-74.	Carrier Controlled Approach	

Assignment 14

Radar and Allied Equipment and Procedures

Text: Pages 311 - 328

Learning Objective: Recognize the responsibilities and general operating procedures of the Carrier Air Traffic Control Center (CATCC) during carrier operations and be able to differentiate between CATCC and LPH procedures.

In items 14-1 through 14-3, select from column B the definition of each CATCC term in column A.

	A. CATCC Terms	B. Definitions
14-1.	Charlie	1. A report from a pilot indicating that the flight is ready to proceed on its mission
14-2.	Clara	2. A signal for aircraft to land
14-3.	Kilo	3. A collective radio call prefixed by the ship's code name
		4. A report from a pilot that he does not have the meatball in sight

14-4. A control zone around a carrier (LPH) extends from the surface up to and including
1. 1,000 ft
2. 2,000 ft
3. 3,000 ft
4. 4,000 ft

14-5. During VFR weather conditions, helicopters shall clear the control zone at an altitude of
1. 100 ft or less
2. 200 ft or less
3. more than 200 ft
4. more than 500 ft

Learning Objective: Recognize the uses and limitations of CCA equipment.

14-6. SPS-30 has IFF capability, low minimum usable range, and a maximum range of how many miles?
1. 50 mi
2. 90 mi
3. 240 mi
4. 300 mi

14-7. What system of the SPN-35 radar compensates for pitching and rolling of the ship?
1. Compensation
2. Indicator
3. Stabilization
4. Azimuth

14-8. All but which of the following are basic components of the Automatic Carrier Landing System (ACLS)?
1. Computer
2. Surveillance radar
3. Precision tracking radar
4. Independent beam scanning transmitter

14-9. AN/SPN-42 radar can be used to land an aircraft by means of which of the following modes of operation?
1. Manual approach as in a conventional ILS approach
2. Fully automatic approach
3. Conventional CCA approach
4. Each of the above

14-10. The AN/SPN-41 system was developed so that a pilot can monitor his progress during a fully automatic (ACLS) approach.

14-11. Refer to figure 13-32 in your textbook. Which of the following instrument panel presentations on an aircraft equipped with an AN/SPN-41 receiving system indicates the aircraft is on the glide slope and should fly left?
1. 
2. 
3. 
4. 

14-12. If aircraft are equipped to receive signals from either the SPN-41 or SPN-42 systems for an ACLS approach to a carrier, the need for a CCA controller is eliminated.

Learning Objective: Be cognizant of the data the pilot derives from the Fresnel lens optical landing system and the Pilot landing aid television system.

14-13. The purpose of the Fresnel lens optical landing system is to provide the pilot with an electronic indication of his relative position with respect to the glide slope.

14-14. If a pilot is correctly approaching a carrier for landing, he should see on the Fresnel lens a yellow bar of light (meatball) in what position?
1. In line with the green datum lights
2. Slightly above the green datum lights
3. Slightly below the green datum lights
4. Each of the above

14-15. If a pilot is making an approach to a carrier equipped with a Fresnel lens landing system and the meatball appears red rather than yellow, he knows that he is
1. at least one degree below the glide slope
2. below the glide slope
3. at least one-half degree above the glide slope
4. either above or below the glide slope, depending on where he sees the red meatball on the lens box

14-16. The video tape produced by the PLAT system records which of the following?
1. The approach and touchdown of each aircraft with the recovery sequence and date/time group superimposed on the tape if the LSO signals for it
2. The approach, touchdown, and recovery of each aircraft as well as its landing speed, the wind velocity, and the date/time group
3. Only the approach and landing of each aircraft
4. Only the approach, landing, and recovery of those aircraft the LSO designates at the beginning of the aircraft's final approach

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Learning Objective: Recognize safety precautions applicable to handling electrical and electronic equipments, and procedures to follow in case of electrical fire or shock.

14-17. What will compare equally in importance with the development of the technical knowledge and skills of the rating to the AC?
1. A good speaking voice
2. The formation of safe and intelligent work habits
3. Clear pronunciation
4. All of the above

14-18. Inasmuch as a burned-out fuse is often the result of a faulty circuit, maintenance personnel should carefully check the circuit before replacing the fuse.

14-19. The handles of metal tools used for working on high-voltage equipment should be covered with
1. friction tape only
2. cambric sleeving only
3. rubber insulating tape only
4. friction tape, cambric sleeving, or rubber insulating tape

14-20. Which of the following precautions should be observed by a maintenance worker repairing electronic equipment?
1. He should short-circuit the terminals of a capacitor with shorting prods to ensure that the capacitor is completely discharged
2. He should work on equipment only when his hands and clothing are dry
3. He should wear shoes with nonconducting soles and a cap with a nonflammable visor
4. All of the above

14-21. If you are performing maintenance on an energized circuit, where should your helper be stationed?
1. Near the main switch or circuit breaker
2. On the other side of the equipment
3. Near the control panel of the equipment
4. By the nearest doorway or hatch

14-22. What is the first step you should take in fighting an electrical fire?
1. Deenergize the circuit
2. Call the Fire Department
3. Control or extinguish the fire
4. Report the fire to the proper authority

14-23. Which of the following types of fire extinguishers should be used for fighting fire in electrical equipment?
1. CO_2
2. Foam
3. Carbon tetrachloride
4. Trichloroethylene

14-24. What should you do if a person has stopped breathing as a result of electrical shock?
1. Apply artificial respiration
2. Wrap him in a blanket and get him to a doctor
3. Determine if his heart has stopped beating and, if not, apply artificial respiration
4. Ascertain the amount of current that has passed through his body in order to proceed with the proper treatment

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Learning Objective: Recognize contents, uses, and procedures for issuing commonly used FAA publications.

Items 14-25 through 14-30 pertain to the Airman's Information Manual.

14-25. This manual is used as a pilot's operational manual within the United States as a ready reference for ACs assisting pilots and as part of an AC's practical test for a Facility Rating.

14-26. A glossary of aeronautical terms will be found in which part of the manual?
1. Part 1, Basic Flight Manual and ATC Procedures
2. Part 2, Airport Directory
3. Part 3, Operational Data
4. Part 3A, NOTAMs

14-27. Which of the following is contained in Part 2 of the manual?
1. Parachute jump areas
2. Air Defense Identification Zones (ADIZs)
3. Health and medical facts of interest to pilots
4. A list of airports and heliports available for transient civil use in the conterminous U.S., Puerto Rico, and the Virgin Islands

14-28. What part of the manual includes a master index?
1. Part 1
2. Part 2
3. Part 3
4. Part 3A

14-29. What part of the manual lists the major airports with communications?
1. Basic Flight Manual
2. Airport Directory
3. Operational Data
4. ATC Procedures

14-30. The part of the manual that contains NOTAMs considered essential to flight safety is issued every
1. 14 days
2. 28 days
3. 90 days
4. 180 days

14-31. A requirement for all three-letter location identifiers is that they begin with the initial letter of the facility that is being identified.

14-32. The primary purpose of the publication, Contractions Handbook 7340.1 (Series), is to provide an approved listing of shortened words and phrases that may be used instead of the original words and phrases.

In items 14-33 through 14-35, select from column B the handbook that prescribes each of the procedures listed in column A.

A. Procedures	B. Handbooks
14-33. Procedures and phraseology for use by personnel who provide flight assistance and communications services	1. Terminal Air Traffic Control Handbook 7110.8 (Series)
14-34. Procedures and phraseology for use by personnel providing terminal air traffic control services	2. En Route Air Traffic Control Handbook 7110.9 (Series)
14-35. Services A and B teletypewriting procedures	3. Flight Services Handbook 7110.10 (Series), Part I
	4. Flight Services Handbook 7110.10 (Series), Part II

14-36. What OPNAV Instruction directs the use of the FAA publication, Terminal Air Traffic Control Handbook, at naval ATC facilities ashore?
1. 3172.1 (Series)
2. 3721.1 (Series)
3. 3271.1 (Series)
4. 3321.1 (Series)

14-37. Flight plan handling of military flight plans via FAA communications systems is described in the Terminal Air Traffic Control Handbook 7110.8 (Series).

14-38. To inform the general public of widely published nonregulatory information which concerns federal avaition, the FAA issues
1. notices
2. instructions
3. circular letters
4. advisory circulars

14-39. Weather elements and how they are observed are described in Federal Meteorological Handbook #1 Surface Observations.

Learning Objective: Identify the general scope of the flight information program, and types, contents, and issuance procedures of the various publications.

14-40. The flight information publications (FLIP) program is concerned with which of the following phases of flight?
1. Operations at NASs
2. Planning and terminal only
3. Planning, en route, and terminal
4. En route and weather information only

14-41. FLIP Planning is functionally arranged into two parts; General Planning (GP) and Area Planning (AP).

In items 14-42 through 14-45, select from column B the FLIP Planning section in which the item of information listed in column A is contained.

A. Items of Information	B. FLIP Planning Sections
14-42. World-wide conversion tables	1. AP/1A, 2A, and 3A
14-43. Planning and procedure data for a specific geographical area of the world	2. AP/1, 2, and 3
14-44. Restricted, Prohibited, and Danger areas	3. General Planning
14-45. Military Training Routes	4. AP/1B

14-46. The charts which depict the Federal airway system and the related information for IFR operation at altitudes below 18,000 feet MSL are covered by what sheets of the FLIP En Route Low Altitude--U.S. Charts?
1. L-1 through L-13
2. L-1 through L-26
3. L-13 through L-26
4. L-20 through L-26

14-47. Which of the following is contained in the FLIP En Route IFR Supplement--U.S.?
1. The low-altitude instrument approach procedures
2. A cross-reference to IFR aerodromes
3. The sketches of IFR aerodromes in alphabetical order
4. An alphabetical listing of all IFR aerodromes

14-48. FLIP Terminal publications contain information relating primarily to
1. runway surface conditions and lighting
2. radio communications facilities
3. instrument approaches
4. aerodrome layout

14-49. Military Aviation Notices (MANs) are issued to update the
1. Standard Instrument Departure procedures
2. U.S. Low Altitude Terminal FLIPs
3. U.S. High Altitude Terminal FLIPs
4. Foreign Clearance Guide

14-50. What information does the Foreign Clearance Guide contain?
1. The transportation of material aboard aircraft
2. The aircraft movements to, from, and between foreign areas
3. The USAF worldwide foreign clearance requirements and information on personal travel
4. All of the above

14-51. How often are Foreign Clearance Guide Change Notices (FCCN) issued?
1. Weekly
2. Monthly
3. Quarterly
4. Semiannually

14-52. The procedures to follow to requisition aeronautical charts and flight information publications are contained in the
1. Memorandum for Aviators
2. DOD Catalog of Aeronautical Charts and Flight Information Publications
3. DOD Aeronautical Chart Bulletin
4. DOD Aeronautical Chart Bulletin Digest

14-53. What publication is used to keep charts, other than those contained in the FLIP series, current?
1. DOD Aeronautical Chart Bulletin
2. DOD Aeronautical Updating Manual (CHUM)
3. DOD Aeronautical Chart Bulletin Digest
4. DOD Catalog of Aeronautical Charts and Flight Information Publications

14-54. The issuance of a new DOD Aeronautical Chart Bulletin automatically makes all prior issues obsolete.

Learning Objective: Recognize contents of various Navy publications.

In items 14-55 through 14-57, select from column B the Navy publication in which each type of information listed in column A is contained.

A. Types of Information	B. Publications
14-55. Administrative and operational procedures applicable to the operation of naval ATC facilities on a world-wide basis	1. LPH Naval Air Training and Operating Procedures Standardization Manual
14-56. General flight and operating instructions and procedures applicable to the operation of naval aircraft and related activities	2. CVA/CVS Naval Air Training and Operating Procedures Standardization (NATOPS) Manual
14-57. Standardized procedures for the control and handling of aircraft aboard amphibious assault ships	3. General Flight and Operating Instructions Manual, OPNAV 3710.7 (Series)
	4. Air Traffic Control Facilities Manual, OPNAV 3721.1 (Series)

14-58. ACs are directly concerned with the chapters of General Flight and Operating Instructions Manual, OPNAV 3710.7 (Series), that deal with
1. flight authorization, planning, and approval only
2. air traffic control only
3. flight rules only
4. flight authorization, planning, approval, air traffic control, and flight rules

14-59. Air operations manuals are prepared locally under the supervision of the operations officer.

14-60. The withdrawing of a naval LORAN facility from service for temporary repair would ba a proper subject for a/an

1. speedletter
2. OPNAV Notice
3. Memorandum for Aviators
4. Notice to Aviators

14-61. The operations chapter of electronic equipment systems manuals contains detailed descriptions of the procedures for

1. starting the equipment only
2. operating the equipment only
3. stopping the equipment only
4. starting, stopping, and operating the equipment

Assignment 15

Publications, Records, and Security Measures

Text: Pages 329 - 336

Learning Objective: Identify contents of and procedures for maintaining various records and reports.

15-1. The information entered in the control tower log is limited by regulations to entries relating to tower equipment, airport lighting facilities, runways, and communications.

15-2. The procedure for tower log entries concerning weather conditions, emergencies, and crashes can and does vary from one control tower to another.

15-3. How long are flight strips normally kept?
1. One year
2. Until the persons who entered the data on them are transferred
3. Three months
4. As long as considered necessary

15-4. As an AC3 assigned to the air traffic control division of a naval air station, you could be responsible for maintaining flight data and status boards that display information relative to which of the following?
1. Inbound flights only
2. The status of the station's navigational aids only
3. The status of aircraft and crew assigned to search and rescue (SAR) duty only
4. All of the above

Learning Objective: Recognize the necessity for classified material security, techniques used in effecting a security program, security classification categories, and procedures associated with stowage, use, transmission, accounting, disposition, and destruction of classified material.

15-5. Security of classified material is as important in peacetime as in wartime because
1. wars are planned in peacetime only
2. potential enemies are always active only
3. defensive measures are developed in peacetime only
4. wars are planned and defensive measures are developed during peacetime, and potential enemies are continually active

15-6. What is the best way for an organization to maintain an adequate classified materials security program?
1. Frequent reading of OPNAVINST 5510.1 (Series)
2. Frequent classes for all hands in security methods
3. Continuous day-to-day practice in proper handling methods
4. Close supervision of handling methods by the commanding officer

15-7. Which of the following statements best describes the phrase "need to know" when used with respect to the security of classified material?
1. Although an individual has received a security clearance, his access to classified material is governed by his need to know about such information in order to carry out his duties
2. Everyone in the Navy needs to know and be fully aware of a situation confronting his organization because history has shown that a well-informed military man does the best job
3. No individual below the rank of chief petty officer should have any need to know anything of a classified nature because security may be compromised
4. Both 1 and 3 above

In items 15-8 through 15-11, select from column B the security classification applicable to each classification requirement listed in column A.

A. Requirements	B. Classifications
15-8. Material that would compromise military plans important to the national defense	1. Top Secret
15-9. Material which would reveal important intelligence operations	2. Secret
15-10. Material which would compromise technological developments vital to national defense	3. Confidential
15-11. Material which would be prejudicial to national defense	

15-12. An increased degree of security should be applied to documents concerning the handling, manufacture, or utilization of atomic weapons. What phrase or classification would be utilized to indicate the proper degree of security?
1. Secret
2. Confidential
3. Restricted Data
4. For Official Use Only

15-13. The term For Official Use Only is assigned to official documents NOT pertaining to the interest of national defense but which require protection under statutory requirements.

15-14. It is important for any person concerned with classified material and the classification of material to realize that any type of classification infers that the material is NOT to be disclosed to any foreign government, unless authorized by proper authority, whether or not the material is designated NOFORN or NO FOREIGN DISSEM.

15-15. The administrative responsibility for any special access program rests with the command having the need for a special access program.

15-16. The combination to a security container should be changed at least once every
1. 6 mo
2. 12 mo
3. 18 mo
4. 24 mo

15-17. The Top Secret Control Officer ensures continuous positive control of the Top Secret material under his jurisdiction by
1. requiring all people who require it to remain in the security office while they use it
2. requiring each person who uses it to sign a receipt for it in order to have a record of all who have had access to it
3. requiring the messenger who delivers it to sign for and accept custodianship of it
4. issuing a numbered copy of it to everyone who needs one, thus transferring custodianship of it to him

15-18. The use of a scrambler device will ensure security if classified information is to be discussed over a telephone.

15-19. What is the minimum number of turns the dial of a combination lock should be rotated when securing the lock?
1. One in either direction
2. Two in opposite directions
3. Four in the same direction
4. Four in opposite directions alternately

15-20. In the event of an emergency, who is responsible for the safeguarding of classified material that is out of its proper storage area?
1. The Top Secret Control Officer
2. The Intelligence Officer
3. The Operations Officer
4. The person in possession of it at the time

15-21. Top Secret material may be transmitted by Armed Forces Courier Service, by electric means in encrypted form, and by
1. U. S. Registered mail and foreign registered mail facilities
2. U. S. mail and foreign postal systems
3. U. S. registered mail
4. direct personal contact

15-22. A receipt form must be used for the receipt of all Top Secret material. This form must be enclosed in
1. or attached to the inner container
2. the material in the inner container
3. or attached to the outer container
4. an envelope which is attached to the outer container

15-23. If classified material has been properly prepared for transmission by registered mail through the U. S. postal system, the outer container will look like the container for ordinary registered mail.

15-24. Classified material may be destroyed by
1. burning only
2. burning, shredding, and pulverizing only
3. burning, shredding, pulverizing, and pulping only
4. burning, shredding, pulverizing, pulping, melting or chemical decomposition

15-25. Witnessing officials must observe the complete destruction of classified material.

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1. The following comments are hereby submitted: