ACHIEVEMENT THROUGH ELECTRONICS

RADIO RULES AND REGULATIONS

REFERENCE TEXT C111X

NATIONAL RADIO INSTITUTE • WASHINGTON, D. C.

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STUDY SCHEDULE

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RADIO RULES AND REGULATIONS

All forms of rf radiation are subject to the control of the Federal Communications Commission (FCC). Control of rf radiation is necessary in order to keep radio transmissions from interfering with one another, and in order to insure that the various groups that use rf energy will have sufficient frequencies available to them to carry on their functions.

For instance, the military must have special frequencies reserved so that it can carry out vital communications and other functions. In order to make sure that these frequencies are not interfered with, all those who use rf energy are licensed, and also, the various types of equipment they use are assigned frequencies that will not interfere with other essential services. The different uses that are made of rf energy are referred to as "services." Thus, we have "Amateur Service," Television Service, "FM Service," and so on.

The usual procedure is to license both the station and the operator. The licensing regulations for equipment are designed to insure that the equipment will do the job for which it is designed without interfering with other services. The licensing of operators helps make sure that the users of radio transmitters are familiar with the regulations relating to their use, and that they will be able to use them properly for their intended purpose.

The object of this book is to tell you where you can find the information that is necessary to obtain these licenses and what the licenses permit you to do. Most of this information is contained in the Rules and Regulations issued by the FCC. Your main problem in dealing with these extensive regulations will be to find what you want to know in them. This book will give you a good idea of where to look.

ORGANIZATION OF THE RULES AND REGULATIONS OF THE FCC

The various topics covered by the rules and regulations of the FCC are issued in separate parts. These parts have been gathered together in ten (10) separate volumes for publication. The contents of these ten volumes are as follows:

Volume 1

Part 0 -- Commission Organization.
Part 1 -- Practice and Procedure.
Part 13 -- Commercial Radio Operators.
Part 17 -- Construction, Marking, and Lighting of Antenna Structures.
Part 19 -- Employee Responsibilities and Conduct.

Volume 2

Part 2 -- Frequency Allocations and Radio Treaty Matters; General Rules and Regulations.
Part 5 -- Experimental Radio Services (other than Broadcast).
Part 15 -- Radio Frequency Devices.
Part 18 -- Industrial, Scientific, and Medical Equipment.

Volume 3

Part 73 -- Radio Broadcast Services.
Part 74 -- Experimental, Auxiliary, and Other Program Distributional Services.

Volume 4

Part 81 -- Stations on Land in the Maritime Services.
Part 83 – Stations on Shipboard in the Maritime Services.
Part 85 -- Public Fixed Stations and Stations of the Maritime Services in Alaska.

Volume 5

Part 87 -- Aviation Services.
Part 89 -- Public Safety Radio Services.
Part 91 -- Industrial Radio Services.
Part 93 -- Land Transportation Radio Services.

Volume 6

Part 95 -- Citizens Radio Service.
Part 97 -- Amateur Radio Service.
Part 99 -- Disaster Communications Service.

Volume 7

Part 21 – Domestic Public Radio Services (other than Maritime Mobile).
Part 23 -- International Fixed Public Radiocommunication Services.
Part 25 – Satellite Communications.

Volume 8

Part 31 -- Uniform System of Accounts for Class A and Class B Telephone Companies.
Part 33 -- Uniform System of Accounts for Class C Telephone Companies.

Volume 9

Part 34 – Uniform System of Accounts for Radiotelegraph Carriers.
Part 35 - Uniform System of Accounts for Wire-Telegraph and Ocean-Cable Carriers.

Volume 10

Part 41 -- Telegraph and Telephone Franks.
Part 42 -- Preservation of Records of Communication Common Carriers.
Part 43 -- Reports of Communication Common Carriers and Certain Affiliates.
Part 51 – Occupational Classification and Compensation of Employees of Telephone Companies.
Part 52 -- Classification of Wire-Telegraph Employees.
Part 61 -- Tariffs.
Part 62 -- Application to Hold Interlocking Directorates.
Part 63 – Extension of Lines and Discontinuance of Service by Carriers.
Part 64 -- Miscellaneous Rules Relating to Common Carriers.
Part 66 -- Applications Relating to Consolidation, Acquisition, or Control of Telephone Companies.
Part 67 -- Jurisdictional Separations.

You can see that the first seven volumes contain the information you are most likely to need. In fact, you will usually find that the material is grouped in these volumes in such a way that you will not need to get all of the first seven volumes in order to cover a particular field. You should find it a good investment in both time and money to buy and study the Rules and Regulations that apply to the particular field you are working in.

Copies of these volumes are not on sale

by the FCC. To buy a copy, you should write to the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

When you buy a copy of the regulations, the corrections for that volume are sent to you, as issued, as part of the price of the volume. This arrangement helps insure that the outstanding volumes will all be complete and up to date.

Licensing Requirements

As mentioned earlier, usually both the station and the operator of a transmitting radio station must be licensed. Since the main object of the licensing requirements is to make sure that radio transmissions are carefully controlled, there is no need for licensing radio receivers. In this section, we will discuss the requirements for both operator and station licenses. These licenses can be thought of as being of either one of two types: commercial or amateur.

COMMERCIAL OPERATOR LICENSES

Several different classes of operator licenses are issued to those who work in the commercial radio services. All but one of these licenses require the applicant to pass a written examination.

Examination Elements. The written examination for a particular class of commercial operator's license consists of one or more of the following parts, called Elements, that are described in Section 13.21 of the Rules of the FCC.

The elements are as follows:

1. **Basic Law. Provisions of laws, treaties and regulations with which every operator should be familiar.**
2. **Basic operating practice. Radio operating procedures and practices generally followed or required in communicating by means of radiotelephone stations.**
3. **Basic radiotelephone. Technical, legal and other matters applicable to the operation of radiotelephone stations other than broadcast.**
4. **Advanced radiotelephone. Advanced technical, legal and other matters particularly applicable to the operation of the various classes of broadcast stations.**
5. **Radiotelegraph operating practice. Radio operating procedures and practices generally followed or required in communicating by means of radiotelegraph stations primarily other than in the maritime mobile services of public correspondence.**
6. **Advanced radiotelegraph. Technical, legal and other matters applicable to the operation of all classes of radiotelegraph stations, including operating procedures and practices in the maritime mobile services of public correspondence, and associated matters such as radio-navigational aids, message traffic routing and accounting, etc.**
7. **Aircraft radiotelegraph. Basic theory and practice in the operation of radio communication and radio-navigational systems in general use on aircraft.**
8. **Ship radar techniques. Specialized theory and practice applicable to the proper installation, servicing and maintenance of ship radar equipment in general use for marine navigational purposes.**
9. **Basic Broadcast. Basic regulatory matters applicable to the operation of standard commercial FM, and noncommercial educational FM broadcast stations.**

Classes of Licenses. The different classes of operators' licenses, and the examinations they require are set forth in Section 13.22 as follows:

(a) Radiotelephone Second Class Operator License:

1. **Ability to transmit and receive spoken messages in English.**
2. **Written examination elements: 1, 2, and 3.**

(b) Radiotelephone First Class Operator License:

1. **Ability to transmit and receive spoken messages in English.**
2. **Written examination elements: 1, 2, 3, and 4.**

(c) Radiotelegraph Second Class Operator License:

1. **Ability to transmit and receive spoken messages in English.**
2. **Transmitting and receiving code test of twenty (20) words per minute plain language and sixteen (16) code groups per minute.**
3. **Written examination elements: 1, 2, 5, and 6.**

(d) Temporary limited radiotelegraph Second Class Operator License:

1. **Ability to transmit and receive spoken messages in English.**
2. **Transmitting and receiving code test of twenty (20) words per minute plain language and sixteen (16) code groups per minute.**

(e) Radiotelegraph First Class Operator License:

1. **Ability to transmit and receive spoken messages in English.**
2. **Transmitting and receiving code test of twenty-five (25) words per minute plain language and twenty (20) code groups per minute.**
3. **Written examination elements: 1, 2, 5, and 6.**

(f) Radiotelephone Third Class Operator Permit:

1. **Ability to transmit and receive spoken messages in English.**
2. **Written examination elements: 1 and 2.**

(g) Radiotelegraph Third Class Operator Permit:

1. **Ability to transmit and receive spoken messages in English.**
2. **Transmitting and receiving code test of twenty (20) words per minute plain language and sixteen (16) code groups per minute.**
3. **Written examination elements: 1, 2, and 5.**

(h) Restricted Radiotelephone Operator Permit:

No oral or written examination is required for this permit. In lieu thereof, applicants will be required to certify in writing to a declaration which states that the applicant has need for the requested permit; can receive and transmit spoken messages in English; can keep at least a rough written log in English or in some other language in general use that can be readily translated into English; is familiar with the provisions of treaties, laws, and rules and regulations governing the authority granted under the requested permit; and understands that it is his responsibility to keep currently familiar with all such provisions.

Section 13.45 provides that in computing the number of code groups in a code test, "Each five characters shall be counted as one word or code group. Punctuation marks or figures count as two characters."

Additional requirements also apply to applicants for Radiotelegraph First Class Operator Licenses. They must be at least 21 years old at the time the license is issued, and have at least 1 year's service as a radiotelegraph operator.

Examination Procedures. All written examinations must be handwritten in ink, but diagrams may be in pencil. It takes a grade of 75% to pass. Each element must be passed separately, and an applicant who fails any element may not be re-examined on that element for a period of 2 months. However, if you pass some elements and fail others, you do not need to be re-examined except on the elements you fail. Also, if you hold one class of license, and wish to qualify for another class, you need to pass only the additional elements that are contained in the requirements for the new licenses.

Your NRI course contains nearly all of the technical information that you will need in order to answer the questions on the FCC examinations. However, it is frequently helpful to use an examination study guide, which is put out by the FCC. This study guide has the information covered by the elements of the examination organized into the general headings covered. You can buy a copy of this

study guide, which is called, "Study Guide and Reference Material for Commercial Radio Operator Examinations," from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

A restricted radiotelephone operator's permit is usually issued for life, but other commercial operator's licenses run for 5 years. Most other licenses may be renewed within the last year of their term if the holder has completed sufficient service as a radio operator using the license. This arrangement makes it unnecessary for full-time operators who are actively engaged in communications to be reexamined every five years. In fact, first- and second-class licenses can often be renewed even without the service requirement.

You can see that the qualifications for an operator's license cover much more than simply the ability to operate radio equipment. Much of the licensing requirements have to do with the ability to understand the operation of rf transmitters well enough to be able to service them. For instance, in order to be permitted to service marine radar equipment, the holder of the first- or second-class operator's license must also pass a written examination on Element 8, and have his license specially endorsed to show that he is qualified to service this type of equipment.

Place of Examination. Operator examinations are held at the district offices and sub-offices of the Federal Communications Commission. These offices are located in cities all over the country. Table I shows the location of the various offices. The time of the examinations is not the same at the various offices. Therefore, if you wish to take an examination at an office near your home, write to the Engineer in Charge at that office to find out when the examination of the type you are interested in is to be given.

COMMERCIAL STATION LICENSES

Obtaining a station license for an AM, FM, or TV broadcast station is a long drawn-out affair. The procedure is set up to enable the applicants to *"satisfy the Commission that they are legally, technically, and financially qualified, and that operation of the proposed station would be in the public interest."*

Part 1 of the Commission's Rules contains the steps of the licensing procedure, and Part 73 contains the technical standards the station must be able to meet, and much other information that is needed in applying for a license.

For instance, the TV channel assignments by states and communities are contained in Part 73, so you can tell by referring to this part what channels are assigned to your community.

One of the first things you must do in applying for a broadcast AM, FM, or TV license is to determine what frequencies, if any, are available for assignment to your particular area. This may be much more difficult than it sounds. Frequently it requires the services of a competent engineer. Another step in the procedure, which can be highly technical, is the selection of a proper site for the transmitter.

Construction Permits. The first formal step in dealing with the Commission comes when applying for a construction permit. This application is made on a form that calls for information about the citizenship and character of the applicant, his financial, technical and other qualifications, as well as details about the transmitting equipment to be used, an-

DIST. NO.	LOCATION	DIST. NO.	LOCATION
1	1600 Customhouse India and State Streets Boston, Massachusetts 02109	11	U. S. Courthouse 312 N. Spring St. Los Angeles, California 90012
2	748 Federal Building 641 Washington Street New York, New York 10014	12	323A Courthouse 555 Battery Street San Francisco, California 94111
3	1005 New U. S. Customhouse 2nd & Chestnut Streets Philadelphia, Pennsylvania 19106	13	314 Multnomah Bldg. 319 S. W. Pine Street Portland, Oregon 97204
4	819 Federal Bldg. 31 Hopkins Plaza Baltimore, Maryland 21201	14	8012 Federal Office Building 909 First Avenue Seattle, Washington 98104
5	Military Circle 870 North Military Hwy. Norfolk, Virginia 23502	15	504 New Customhouse 19th St. bet. Calif. & Stout Sts. Denver, Colorado 80202
6	1602 Gas Light Tower 235 Peachtree St., N. E. Atlanta, Georgia 30303	16	691 Federal Building 4th and Robert Streets St. Paul, Minnesota 55101
7	919 Federal Building 51 S. W. First Avenue Miami, Florida 33130	17	1703 Federal Building 601 East 12th Street Kansas City, Missouri 64106
8	829 Federal Building South 600 South Street New Orleans, Louisiana 70130	18	1872 U. S. Courthouse 219 South Dearborn Street Chicago, Illinois 60604
9	5636 Federal Building 515 Rusk Avenue Houston, Texas 77002	19	1054 Federal Building Washington Blvd. & LaFayette St. Detroit, Michigan 48226
10	707 Thomas Building 1314 Wood Street Dallas, Texas 75202	20	328 Federal Office Building 121 Ellicott Street Buffalo, New york 14203

Table I. Mailing addresses for field engineering offices of the FCC are listed here and on the back of this page.

DIST. NO.	LOCATION	DIST. NO.	LOCATION
21	502 Federal Building P. O. Box 1021 Honolulu, Hawaii 96808	23	54 U. S. Post Office Building 4th Ave. between F & G Sts. Anchorage, Alaska 99501
22	322 Federal Building P. O. Box 2987 San Juan, Puerto Rico 00903	24	Room 216 1919 M. Street, N. W. Washington, D. C. 20554

SUB-OFFICES

DIST. NO.	LOCATION	DIST. NO.	LOCATION
6S	238 Post Office Building York & Bull Streets Savannah, Georgia 31402	9B	239 Federal Building 300 Willow Street Beaumont, Texas 77701
7T	738 Federal Building 500 Zack Street Tampa, Florida 33602	11SD	Fox Theatre Building 1245 Seventh Avenue San Diego, California 92101
8M	439 U. S. Courthouse 113 St. Joseph St. Mobile, Alabama 36602	11SP	300 South Ferry Terminal Island San Pedro, California 90731

SAMPLE ADDRESS

Engineer in Charge, FCC
238 Post Office Building
York & Bull Streets
Savannah, Georgia 31402

tenna and studio locations, and the type of broadcasting to be undertaken. Information must also be supplied that will show what interference problems, if any, will be caused by the proposed station, and how and to what extent these problems are to be solved.

The procedures followed in processing the construction permit application include provisions for hearings, if necessary, for protesting of the granting of the permit by other interested parties, and for appealing any ruling.

Sometimes, of course, more than one applicant will be trying to obtain a license for a station in a given area. Also, other stations on the same frequency in different areas may protest the granting of a permit if they feel that there is a possibility of interference from the new station. Such parties would be possible sources of objection to the granting of a construction permit.

Once a construction permit is granted, the construction of the station must begin promptly, and finish within a specified time fixed by the Commission. After the station is completed, the builder conducts equipment tests, submits the station to an inspection by the Engineer in Charge of the radio district in which he is located, and applies to the Commission for a license.

The application for a license must *"show compliance with the terms and conditions of the construction permit."* When the license application is made, the usual procedure is to request authority for *"program tests."* This authority permits the applicant to commence broadcast operations while his application for a license is being processed. Of course, broadcasting cannot be started until the authority for *"program tests"* is actually given by the Commission.

Type-Accepted and Type-Approved Lists. You can see from even this brief description that licensing a radio transmitting station can be quite complicated.

For some services, matters are simplified considerably by the use of equipment on lists put out by the FCC called *"type-accepted"* and *"type-approved"* lists. "Type-approved" means that the engineers of the FCC have tested a model of the equipment to make sure it will perform properly. "Type-accepted" means that the equipment has been checked out by private engineers employed by the manufacturer, who then submit a request for type acceptance to the FCC. Either kind of approval by FCC has the same effect.

These lists are kept at each field office of the FCC, and by the manufacturers of the type-accepted and type-approved equipment. Selecting equipment from these lists greatly simplifies the problem of satisfying the requirements for a suitable transmitter. This is another of several technical problems to be solved in obtaining a broadcast station license.

AMATEUR OPERATOR LICENSES

Obtaining an amateur operator's license is covered in Volume VI of the Rules and Regulations. Let's look at some of the requirements.

Examination Elements. Examinations for amateur operator's licenses are also broken down into elements. These elements are set forth in Section 97.21 of the Rules as follows:

Examinations for amateur operator privileges will comprise one or more of the following examination elements.

(a) Element 1(A): Beginner's code test at five (5) words per minute;(b) Element 1(B):

General code test at thirteen (13) words per minute;

(c) Element 1(C): Expert's code test at twenty (20) words per minute;

(d) Element 2: Basic law comprising rules and regulations essential to beginners' operation, including sufficient elementary radio theory for the understanding of those rules;

(e) Element 3: General amateur practice and regulations involving radio operation and apparatus and provisions of treaties, statutes, and rules affecting amateur stations and operators;

(f) Element 4(A): Intermediate amateur practice involving intermediate level radio theory and operation as applicable to modern amateur techniques, including, but not limited to, radiotelephony and radiotelegraphy;

(g) Element 4(B); Advanced amateur practice involving advanced radio theory and operation as applicable to modern amateur techniques, including, but not limited to, radiotelephony, radiotelegraphy, and transmissions of energy for measurements and observations applied to propagation, for the radio control of remote objects and for similar experimental purposes.

Classes of Licenses. Sections 97.9 and 97.23 set out the examination requirements for the various classes of licenses.

All applicants must be U. S. citizens. There is no age restriction.

Applicants for original licenses will be required to pass the following examination elements:

(a) Amateur Extra Class: Elements 1(C), 3, 4(A), and 4(B);

(b) Advanced Class: Elements 1(B), 3, and 4(A);

(c) General Class and Conditional Class: Elements 1(B) and 3;

(d) Technician Class: Elements 1 (A) and 3.

(e) Novice Class: Elements 1(A) and 2.

In addition, applicants for Amateur Extra Class licenses must have held an amateur license other than a Novice or Technician for a period of two years.

Examination Procedures. Section 97.29 describes the manner of conducting examinations:

(a) The examination for Amateur Extra, Advanced, and General Classes of amateur operator licenses will be conducted by an authorized Commission employee or representative at locations and at times specified by the Commission.

(b) Unless otherwise prescribed by the Commission, an examination for the Conditional, Technician, or Novice Class license will be conducted and supervised by a volunteer examiner selected by the applicant. A volunteer examiner shall be at least 21 years of age and shall be the holder of an Extra, Advanced, or General Class Amateur Radio operator license, or shall hold a Commercial radiotelegraph operator license issued by the Commission, or shall be employed in the service of the United States as the operator of .a manually operated radiotelegraph station.

The section continues with details about supervision, written portion of the examination, and administration of examinations by the Commission.

Section 97.27 states that: The examinations for Conditional Class will be available only under one or more of the following conditions:

(a) If the applicant's actual residence and proposed amateur station location are more than 175 miles airline distance from the nearest location at which examinations are conducted by an authorized Commission employee or representative at intervals of not more than 6 months for amateur operator license.

(b) If the applicant is shown by physician's certificate to be unable to appear for examination because of protracted disability.

(c) If the applicant is shown by certificate of the commanding officer to be in the armed forces of the United States at an Army, Navy, Air Force, or Coast Guard Station and, for that reason, to be unable to

appear for examination at the time and place designated by the Commission.

(d) If the applicant demonstrates by sufficient evidence that his temporary residence is for a continuous period of at least 12 months outside the continental limits of the United States, its territories or possessions, irrespective of other provisions of this section.

Code Tests. Section 97.29 describes the Code Test Procedure:

The code test required of an applicant for an amateur radio operator license, in accordance with the provisions of §§97.21 and 97.23 shall determine the applicant's ability to transmit by hand key (straight key or, if supplied by the applicant, any other type of hand-operated key such as a semi-automatic or electronic key), and to receive by ear, in plain language, messages in the International Morse Code at not less than the prescribed speed, free from omission or other error for a continuous period of at least 1 minute during a test period of 5 minutes counting five characters to the word, each numeral or punctuation mark counting as two characters.

Grading of Examinations. Passing the code test for a particular class of examination is a must. Section 97.31 provides:

(a) Code tests for sending and receiving are graded separately. Failure to pass the required code test for either sending or receiving will terminate the examination.

(b) Seventy-four percent (74%) is the passing grade for written examinations. For the purpose of grading, each element required in qualifying for a particular license will be considered as a separate examination. All written examinations will be graded only by Commission personnel.

Eligibility for Re-examination. Section 97.33 says:

An applicant who fails examination for an amateur operator license may not take another examination for the same or a higher class amateur operators license within 30 days, except that this limitation shall not apply to an examination for an Advanced or General Class license following an examination conducted by a volunteer examiner for a Novice, Technician, or Conditional Class license.

Volunteer Examiners. Some of the examinations are not conducted by Commission employees, but by volunteer examiners. Holders of licenses obtained under a volunteer examiner may be required to submit to an examination conducted by an employee of the Commission, as set forth in Section 97.35.

The Commission may require a licensee holding a Novice, Technician, or Conditional Class of operator license to appear for a Commission-supervised license examination at a location designated by the Commission. If the licensee fails to appear for this examination when directed to do so, or fails to pass such examination, the Novice, Technician, or Conditional Class operator license previously issued shall be subject to cancellation, and upon cancellation, a new license will not be issued for the same class operator license as that cancelled.

A holder of a Conditional Class License, obtained on the basis of an examination under the provisions of 97.29(b), is not required to be re-examined when changing residence and station location to within regular examination area, nor when a new examination location is established within 175 miles airline distance from such licensee's residence and station location.

Another distinction that is made between amateur examinations conducted by a Commission employee and those that are not, is in the matter of examination credit. Provisions of Section 97.25 state that credit is not given toward a

higher grade of license for elements that are passed during an examination conducted by a volunteer examiner:

(a) **An applicant for a higher class of amateur operator license who holds a valid amateur operator license issued upon the basis of an examination by the Commission will be required to pass only those elements of the higher class examination that were not included in the examination for the amateur license held when such application was filed. However, credit will not be allowed for licenses issued on the basis of an examination given under the provisions of § 97.29(b).**

(b) **An applicant for any class of amateur operator license, except the Extra Class, will be given credit for the telegraph code element if within five years prior to the receipt of his application by the Commission he held a commercial radiotelegraph operator license or permit issued by the Federal Communications Commission.**

(c) **An applicant for Amateur Extra Class operator license will be given credit for examination elements 1(C), 4(A), and 4(B) if he so requests and submits evidence of having held a valid amateur radio station or operator license issued by any agency of the U. S. Government during or prior to April 1917, and qualifies for or currently holds a valid amateur operator license of the General or Advanced Class.**

(d) **No examination credit, except as herein provided, shall be allowed on the basis of holding or having held any amateur or commercial operator license.**

AMATEUR STATION LICENSES

The granting of an amateur station license is much less complicated than the granting of a commercial station license. For instance, Section 97.37 provides:

> **A license for an amateur station will be issued in response to proper application therefor to a licensed amateur operator at a designated fixed location. An amateur station license may also be issued to an individual, not a licensed amateur operator (other than an alien or a representative of an alien or of a foreign government), who is in charge of a proposed amateur station for recreation under military auspices (only of the Armed Forces of the United States) which is to be located in approved public quarters but not operated by the United States Government.**

Location of Station. The license is not limited to one location or type of equipment. Section 97.43 sets forth the conditions for a more extensive installation along with those for a single location:

(a) **Every amateur station shall have a fixed transmitter location. Only one fixed transmitter location will be authorized and will be designated on the license for each amateur station, except that when remote control is authorized, the location of the remote control position as well as the location of the remotely controlled transmitter shall be considered as fixed transmitter locations and will be so designated on the station license. Unless remote control of the transmitting apparatus is authorized, such apparatus shall be operated only by a duly licensed amateur radio operator present at the location of such apparatus.**

(b) **Authority for operation of an amateur station with the licensed operator on duty at a specific remote control point in lieu of the remote transmitter location may be granted upon filing an application for an individual station license on FCC Form 610, or on FCC Form 610.B for an amateur club or military recreation station.**

NOTE: These conditions, six paragraphs (1) through (6) are not listed herein. The form should be obtained and the subsection studied when authorization by the Commission is desired.

(c) **An amateur transmitter may be operated from a remote control point in lieu of the remote transmitter location without special authorization by the Commission**

when there is direct mechanical control or direct control by wired connections of the transmitter from a point located in the same or closely adjoining building or structure provided there is full compliance with the conditions set forth in paragraphs (b) (1) through (6) of this section.

Antenna Systems. The antenna system that is used with an amateur transmitter must be within the limitations of the Rules and Regulations. Section 97.45 provides:

(a) Except as provided in paragraph (b) of this section, an antenna for a station in the Amateur Radio Service which exceeds the following height limitations may not be erected or used unless notice has been filed with both the FAA on FAA Form 7460-1 and with the Commission on Form 714 or on the license application form, and prior approval by the Commission has been obtained for:

(1) Any construction or alteration of more than 200 feet in height above ground level at its site (§17.7(a) of this chapter).

(2) Any construction or alteration of greater height than an imaginary surface extending outward and upward at one one of the following slopes (§17.7(b) of this chapter):

(i) 100 to 1 for a horizontal distance of 20,000 feet from the nearest point of the nearest runway of each airport with at least one runway more than 3,200 feet in length, excluding heliports and seaplane bases without specified boundaries, if that airport is either listed in the Airport Directory of the current Airman's Information Manual or is operated by a Federal military agency.

(ii) 50 to 1 for a horizontal distance of 10,000 feet from the nearest point of the nearest runway of each airport with its longest runway no more than 3,200 feet in length, excluding heliports and seaplane bases without specified boundaries, if that airport is either listed in the Airport Directory or is operated by a Federal military agency.

(iii) 25 to 1 for a horizontal distance of 5,000 feet from the nearest point of the nearest landing and takeoff area of each heliport listed in the Airport Directory or operated by a Federal military agency.

(3) Any construction or alteration on an airport listed in the Airport Directory of the Airman's Information Manual (§17.7(c) of this chapter).

(b) A notification to the Federal Aviation Administration is not required for any of the following construction or alteration:

(1) Any object that would be shielded by existing structures of a permanent and substantial character or by natural terrain or topographic features of equal or greater height, and would be located in the congested area of a city, town, or settlement where it is evident beyond all reasonable doubt that the structure so shielded will not adversely affect safety in air navigation. Applicants claiming such exemption shall submit a statement with their application to the Commission explaining the basis in detail for their finding (§17.14(a) of this chapter).

(2) Any antenna structure of 20 feet or less in height except one that would increase the height of another antenna structure (§17.14(b) of this chapter).

(c) Further details as to whether an aeronautical study and/or obstruction marking and lighting may be required, and specifications for obstruction marking and lighting when required, may be obtained from Part 17 of this chapter, "Construction, Marking, and Lighting of Antenna Structures." Information regarding the inspection and maintenance of antenna structures requiring obstruction marking and lighting is also contained in Part 17 of this chapter.

"Part 17 of this chapter" refers to Part 17 of the Rules and Regulations. This part describes the limitations placed on antenna structures, and the provisions that must be made for lighting them.

Transmitter Output. In the amateur service, transmitter output must also meet standards of performance set down by the FCC. These output standards are spelled out in Section 97.73 of the regulations:

Spurious radiation from an amateur station being operated with a carrier frequency below 144 megacycles shall be reduced or eliminated in accordance with good engineering practice. This spurious radiation shall not be of sufficient intensity to cause interference in receiving equipment of good engineering design including adequate selectivity characteristics, which is tuned to a frequency or frequencies outside the frequency band of emission normally required for the type of emission being employed by the amateur station. In the case of A3 emission (amplitude-modulated telephony – see Table III at the end of this book) the amateur transmitter shall not be modulated to the extent that interfering spurious radiation occurs, and in no case shall the emitted carrier wave be amplitude-modulated in excess of 100 percent. Means shall be employed to insure that the transmitter is not modulated in excess of its modulation capability for proper technical operation. For the purposes of this section, a spurious radiation is any radiation from a transmitter which is outside the frequency band of emission normal for the type of transmission employed, including any component whose frequency is an integral multiple or submultiple of the carrier frequency (harmonics and subharmonics), spurious modulation products, key clicks and other transient effects, and parasitic oscillations. When using amplitude modulation on frequencies below 144 megacycles, simultaneous frequency modulation is not permitted and when using frequency modulation on frequencies below 144 megacycles simultaneous amplitude modulation is not permitted. The frequency of the emitted carrier wave shall be as constant as the state of the art permits.

License Terms. The periods of operator and station licenses are set forth in section 97.59:

(a) An amateur operator license is valid for a period of 5 years from the date of issuance, except the Novice Class which is valid for a period of 2 years.

(b) An amateur station license is valid for a period of 5 years from the date of issuance, except that an amateur station license issued to a Novice Class amateur operator licensee is valid for a period of 2 years from the date of issuance.

(c) All amateur station licenses, regardless of when issued, will expire on the same date as the licensee's amateur operator license.

Citizens Radio Service

Licensing requirements for the Citizens Radio Service are quite simple. There is no operator's license required for the normal use of Citizens Radio equipment. However, a station license must be obtained, and a commercial radio operator's license of the proper grade is also required for manually operated telegraphy. A commercial license is also necessary for anyone making any adjustments to a Citizens Radio transmitter during installation, testing, or servicing which may cause the transmitter to operate off frequency or in some other manner that would violate the rules of the FCC. For this reason, many manufacturers make the frequency-determining components of their sets "tamper-proof." A tamper-proof transmitter is one that operates on the correct frequency if it operates at all. Sealed chasses with the frequency-determining components mounted in them, and crystal-controlled oscillators are two techniques that are used to make Citizens Radio transmitters tamper-proof.

Station licenses for Citizens Radio Service are issued by the FCC at Washington, D. C. 20554. Nearly all such licenses are issued by mail. The forms for these station licenses are frequently supplied by the manufacturer with the equipment itself, with much of the technical description of the equipment already filled out. This simple licensing procedure can be used because the manufacturers have their products type-accepted or type-approved before they are marketed.

Convenient licensing, and a certain amount of misunderstanding over the purpose of Citizens Radio have led to some misuse of this type of equipment. The Rules describe the purpose of this service in Section 95.1 as follows:

...to provide for private short-distance radiocommunications service for the business or personal activities of licensees, for radio signaling, for the control of remote objects or devices by means of radio; all to the extent that these uses are not specifically prohibited in this part. They also provide for procedures whereby manufacturers of radio equipment to be used or operated in the Citizens Radio Service may obtain type acceptance and/or type approval of such equipment as may be appropriate.

Classes of Stations. Licenses are granted in the four classes shown in Table II. Besides the limitations of the four classes shown in Table II, each class of transmitter is limited as to the type of emission. Section 95.47 of the Rules sets out the types of emission that may be used:

(a) Except as provided in paragraph (e) of this section, Class A stations in this service will normally be authorized to transmit radiotelephony only. However, the use of tone signals or signaling devices solely to actuate receiver circuits, such as tone operated squelch or selective calling circuits, the primary function of which is to establish or establish and maintain voice communications, is permitted. The use of tone signals solely to attract attention is prohibited.

(b) Class B stations in this service are authorized to use amplitude or frequency modulation, or on-off unmodulated carrier, and may be used for radiotelephony, to control remote objects or devices by means of radio, or to remotely actuate devices which are used as a means of attracting attention.

(c) Class C stations in this service are authorized to use amplitude tone modulation or on-off unmodulated carrier only, for the control of remote objects or devices by radio or for the remote actuation of devices which are used solely as a means of attracting attention. The transmission of any form of telegraphy, telephony or record communications by a Class C sta-

CLASS	USE	FREQUENCY RANGE (MHz)	POWER (Max. Watts Input)
A	Voice	462.550 - 462.725 467.550 - 467.725	60
B	Voice and Control	462.525 - 467.475	5
C	Control	26.995 - 27.225 27.255 72.08 - 75.64	5 30 1
D	Voice	26.965 - 27.225 27.255	5

Table II. Classes of Citizens Radio stations, frequencies, and power limitations. *

*** There is no provision here for random communications in the amateur bands. We will discuss this subject in more detail a little later on.**

tion is prohibited. Telemetering, except for the transmission of simple, short duration signals indicating the presence or absence of a condition or the occurrence of an event, is also prohibited.

(d) Class D stations in this service are authorized to use amplitude voice modulation, including single sideband and/or reduced or suppressed carrier, for radiotelephone communications only. However, the use of tone signals or signaling devices solely to actuate receiver circuits, such as tone operated squelch or selective calling circuits, the primary function of which is to establish or establish and maintain voice communications, is permitted. The use of tone signals solely to attract attention or for the control of remote objects or devices is prohibited.

(e) Other types of emission not described in paragraph (a) of this section may be authorized for Class A citizens radio stations upon a showing of need therefor. An application requesting such authorization shall fully describe the emission desired, shall indicate the bandwidth required for satisfactory communication, and shall state the purpose for which such emission is required. For information regarding the classification of emissions and the calculation of bandwidth, reference should be made to Part 2 of this chapter.

EMISSION LIMITATIONS

Section 95.49 shows the other limitations that apply to the emissions of the different classes of Citizens Radio transmitters (for the meaning of the different types of emission, see Table III at the end of this text):

(a) Each authorization issued to a Class A citizens radio station will show, as a prefix to the classification of the authorized emission, a figure specifying the maximum bandwidth to be occupied by the emission.

(b) All operation of a Class B citizens radio station (including tolerance and bandwidth occupied by the emission) shall be confined to the frequency band 462.525-467.475 MHz.

(c) (1) Except as provided in subparagraph (2) of this paragraph and except in the case of Class B citizens radio stations operating only on the frequency 465.00 MHz (see §95.41(b)), the maximum authorized bandwidth of the emission of any station employing amplitude modulation (Type A2 or A3 emission) shall be 8kHz and the maximum authorized bandwidth of the emission of any station employing frequency or phase modulation (Type F2 or F3 emission) shall be 40 kHz. The use of Type F2 or F3 emission in the frequency band 26.96-27.28 MHz is not authorized.

(2) Effective November 1, 1967, the maximum authorized bandwidth of Class A stations employing frequency or phase modulation (Type F2 or F3 emission) will be 20 kHz. Class A stations authorized before November 1, 1967 may continue to operate with maximum 40 kHz bandwidth until November 1, 1971.

(d) The mean power of emission shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 decibels;

(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 decibels;

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth, at least the amounts indicated in the following table:

Maximum authorized power input to final radio frequency stage:	Attenuation (db)
Over 3 watts	50
3 watts or less	[1]40

[1]In the case of Class B stations having a maximum power input to the final radio frequency stage of 3 watts or less, any emission appearing on any frequency within a band allocated to industrial, scientific, and medical equipment under the provisions of Part 2 of this chapter shall be attenuated at least 30 db.

(e) When an unauthorized emission results in harmful interference, the Commission may, in its discretion, require appropriate technical changes in equipment to alleviate the interference.

Modulation Requirements. The modulation of Citizens-Band transmitters is also limited as set out in Section 95.51:

(a) When the radio frequency carrier of a station in this service is amplitude modulated, such modulation shall not exceed 100 percent on positive or negative peaks.

(b) Except as provided in paragraph (c) of this section and except in the case of Class B citizens radio stations operating only on the frequency 465.00 MHz (see §95.41(b)), the frequency deviation of any frequency modulated transmitter operated in this service shall not exceed ±15 kHz and the simultaneous amplitude modulation and frequency or phase modulation of a transmitter is not authorized.

(c) Effective June 1, 1968, the maximum frequency deviation for Class A stations employing F2 or F3 emission is ±5 kHz: Provided, That stations authorized prior to November 1, 1967, located 100 miles or more from the center of urbanized areas of 200,000 or more population may continue to operate with a frequency deviation of ± 15 kHz until November 1, 1971.

(d) Class A stations authorized on or after November 1, 1967, shall be provided with a device which automatically will prevent modulation in excess of that specified in this subpart which may be caused by greater than normal audio level. Class A stations authorized before November 1, 1967, will be required to comply with the provisions of this paragraph by November 1, 1971: Provided, however, That the requirements of this paragraph shall not apply to transmitters authorized to operate as mobile stations with a maximum plate power input to the final radio frequency stage of 3 watts or less.

(e) Each transmitter of a Class A station which is equipped with a modulation limiter in accordance with the provisions of paragraph (d) of this section shall also be equipped with an audio low-pass filter. This audio low-pass filter shall be installed between the modulation limiter and the modulated stage and, at audio frequencies between 3 kHz and 20 kHz, shall have an attentuation greater than the attenuation at 1 kHz by at least:

$$60 \log_{10} (f/3) \text{ decibels}$$

where "f" is the audio frequency in kHz. At audio frequencies above 20 kHz, the attenuation shall be at least 50 decibels greater than the attenuation at 1 kHz.

OPERATING REQUIREMENTS

The operating requirements set out in subpart D of Part 95 of the Rules reflect some of the misunderstandings that have cropped up about the use of Citizens Radio equipment.

§95.83 Prohibited Uses.

(a) A Citizens radio station shall not be used:

(1) For engaging in radio communications as a hobby or diversion, i.e., operating the radio station as an activity in and of itself.

NOTE: The following are typical, but not all inclusive, examples of the types of communications evidencing a use of Citizens radio as a hobby or diversion which are prohibited under this rule:

"You want to give me your handle and I'll ship you out a card the first thing in the morning;" or "Give me your 10-20 so I can ship you some wallpaper." (Communications to other licensees for the purpose of exchanging so-called "QSL" cards.)

"I'm just checking to see who is on the air."

"Just calling to see if you can hear me. I'm at Main and Broadway."

"Just heard your call sign and thought I'd like to get acquainted;" or "Just passing through and heard your call sign so I thought I'd give you a shout."

"Just sitting here copying the mail and thought I'd give you a call to see how you were doing." (Referring to an intent to communicate based solely on hearing another person engaged in the use of his radio.)

"My 10-20 is Main and Broad Streets. Thought I'd call so I can see how well this new rig is getting out."

"Got a new mike on this rig and thought I'd give you a call to find out how my modulation is."

"Just thought I would give you a shout and let you know I am still around. Thanks for coming back."

"Clear with Venezuela. Just thought I'd let you know I was copying you up here."

"Thought I'd give you a shout and see if you knew where the unmodulated carrier was coming from."

"Just thought I'd give you a call to find out how the skip is coming in over at your location."

"Go ahead breaker. What kind of a rig are you using? Come back with your 10-20."

(2) For any purpose, or in connection with any activity, which is contrary to Federal, State, or local law.

(3) For the transmission of communications containing obscene, indecent, or profane words, language, or meaning.

(4) To carry communications for hire, whether the remuneration or benefit received is direct or indirect.

(5) To communicate with stations authorized or operated under the provisions of other parts of this chapter, with unlicensed stations, or with U. S. Government or foreign stations, except for communications pursuant to §§95.85(b) and 95.121 and, in the case of Class A stations, for communications with U. S. Government stations in those cases which require cooperation or coordination of activities.

(6) For any communication not directed to specific stations or persons, except for: (i) Emergency and civil defense communications as provided in §§95.85(b) and 95.121, respectively, (ii) test transmissions pursuant to §95.93, and (iii) communications from a mobile unit to other units or stations for the sole purpose of requesting routing directions, assistance to disabled vehicles or vessels, information concerning the availability of food or lodging, or any other assistance necessary to a licensee in transit.

(7) To convey program material for retransmission, live or delayed, on a broadcast facility.

NOTE: A Class A, Class B, or Class D station may be used in connection with the administrative, engineering, or maintenance activities of a broadcasting station; a Class A, Class B, or Class C station may be used for control functions by radio which do not involve the transmission of program material; and a Class A, Class B, or Class D station may be used in the gathering of news items or preparation of programs: Provided, That the actual or recorded transmissions of the Citizens radio station are not broadcast at any time in whole or in part.

(8) To interfere maliciously with the communications of another station.

(9) For the direct transmission of any material to the public through public address systems or similar means.

(10) To transmit superfluous communications,

i.e., any transmissions not necessary to communications which are permissible.

(11) For the transmission of music, whistling, sound effects, or any material for amusement or entertainment purposes, or solely to attract attention.

(12) To transmit the word "MAYDAY" or other international distress signals, except when a ship, aircraft, or other vehicle is threatened by grave and imminent danger and requests immediate assistance.

(13) For transmitting communications to stations of other licensees which relate to the technical performance, capabilities, or testing of any transmitter or other radio equipment, including transmissions concerning the signal strength or frequency stability of a transmitter, except as necessary to establish or maintain the specific communication.

(14) For relaying messages or transmitting communications for a person other than the licensee or members of his immediate family, except: (i) Communications transmitted pursuant to §§95.85(b), 95.87(b)(7), and 95.121; and, (ii) upon specific prior Commission approval, communications between citizens radio stations at fixed locations where public telephone service is not provided.

(15) For advertising or soliciting the sale of any goods or services.

(16) For transmitting messages in other than plain language. Abbreviations, including nationally or internationally recognized operating signals, may be used only if a list of all such abbreviations and their meaning is kept in the station records and made available to any Commission representative on demand.

(b) A Class D station may not be used to communicate with, or attempt to communicate with, any unit of the same or another station over a distance of more than 150 miles.

(c) A licensee of a Citizens radio station who is engaged in the business of selling Citizens radio transmitting equipment shall not allow a customer to operate under his station license. In addition, all communications by the licensee for the purpose of demonstrating such equipment shall consist only of brief messages addressed to other units of the same station.

§95.85 Emergency Use.

(a) All Citizens radio stations shall give priority to the emergency communications of other stations which involve the immediate safety of life of individuals or the immediate protection of property.

(b) Any station in this service may be utilized during an emergency involving the immediate safety of life or the immediate protection of property for the transmission of emergency communications. When so used, certain provisions in this part concerning use of frequencies (§95.41(d)); prohibited uses (§95.83(a)(5) and (6)); operation by or on behalf of persons other than the licensee (§95.87); and duration of transmissions (§95.91(a) and (b)) shall not apply. However, any emergency use that necessitate taking advantage of these exceptions to usual requirements shall be subject to the following conditions:

(1) As soon as possible after the beginning of such emergency use, notice shall be sent to the Commission in Washington, D.C., and to the Engineer in Charge of the radio district in which the station is located, stating the nature of the emergency and the use to which the station is being put.

(2) The emergency use of the station shall be discontinued as soon as possible, and the Commission in Washington, D.C., and the Engineer in Charge, shall be notified immediately when such special use of the station is terminated. If the emergency use is of less than 24-hour duration, a single notice containing all of the required information will serve to comply with the notice requirements of this paragraph.

(3) Discontinuance of such special use of the authorized facilities.

(c) If the emergency use under paragraph (b) of this section extends over a period of 12 hours or more, notice shall be sent to the Commission in Washington, D.C., as soon as it is evident that the emergency has or will exceed 12 hours. The notice should include the identity of the stations participating, the nature of the emergency, and the use made of the stations. A single notice covering all participating stations may be submitted.

§ 95.87 Operation by, or on behalf of, persons other than the licensee.

(a) Transmitters authorized in this service must be under the control of the licensee at all times. A licensee shall not transfer, assign, or dispose of, in any manner, directly or indirectly, the operating authority under this station license, and shall be responsible for the proper operation of all units of the station.

(b) Citizens radio stations may be operated only by the following persons, except as provided in paragraph (c) of this section:

(1) The licensee;

(2) Members of the licensee's immediate family living in the same household;

(3) The partners, if the licensee is a partnership, provided the communications relate to the business of the partnership;

(4) The members, if the licensee is an unincorporated association, provided the communications relate to the business of the association;

(5) Employees of the licensee only while acting within the scope of their employment;

(6) Any person under the control or supervision of the licensee when the station is used solely for the control of remote objects or devices, other than devices used only as a means of attracting attention; and

(7) Other persons, upon specific prior approval of the commission shown on or attached to the station license, under the following circumstances:

(i) Licensee is a corporation and proposes to provide private radiocommunication facilities for the transmission of messages or signals by on or behalf of its parent corporation, another subsidiary of the parent corporation, or its own subsidiary. Any remuneration or compensation received by the licensee for the use of the radiocommunication facilities shall be governed by a contract entered into by the parties concerned and the total of the compensation shall not exceed the cost of providing the facilities. Records which show the cost of service and its nonprofit or cost-sharing basis shall be maintained by the licensee.

(ii) Licensee proposes the shared or cooperative use of a Class A station with one or more other licensees in this service for the purpose of communicating on a regular basis with units of their respective Class A stations, or with units of other Class A stations if the communications transmitted are otherwise permissible. The use of these private radiocommunication facilities shall be conducted pursuant to a written contract which shall provide that contributions to capital and operating expense shall be made on a nonprofit cost-sharing basis, the cost to be divided on an equitable basis among all parties to the agreement. Records which show the cost of service and its nonprofit, cost-sharing basis shall be maintained by the licensee. In any case, however, licensee must show a separate and independent need for the particular units proposed to be shared to fulfill his own communications requirements.

(iii) Other cases where there is a need for other persons to operate a unit of licensee's radio station. Requests for authority may be made either at the time of filing of the application for station license or thereafter by letter. In either case, the licensee must show the nature of the proposed use and that it relates to an activity of the licensee, how he proposes to maintain control over the transmitters at all times, and why it is not appropriate for such other person to obtain a station license in his own name. The authority, if granted, may be specific with respect to the names of persons who are permitted to operate, or may authorize operation by unnamed persons for specific purposes. This authority may be revoked by the Commission in its discretion, at any time.

(c) An individual who was formerly a citizen radio station licensee shall not be permitted to operate any citizens radio station of the same class licensed to another person until such time as he again has been issued a valid radio station license of that class, when his license has been:

(1) Revoked by the Commission.

(2) Surrendered for cancellation after the institution of revocation proceedings by the Commission.

(3) Surrendered for cancellation after a notice of apparent liability to forfeiture has been served by the Commission.

§95.91 Duration of Transmissions.

(a) All communications or signals, regardless of their nature, shall be restricted to the minimum practicable transmission time.

The radiation of energy shall be limited to transmissions modulated or keyed for actual permissible communications, tests or control signals. Continuous or uninterrupted transmissions from a single station or between a number of communicating stations is prohibited except for communications involving the immediate safety of life or property.

(b) Communications between or among Class D stations shall not exceed 5 consecutive minutes. At the conclusion of this 5-minute period, or upon termination of the exchange if less than 5 minutes, the station transmitting and the stations participating in the exchange shall remain silent for a period of at least 5 minutes and monitor the frequency or frequencies involved before any further transmissions are made. However, for the limited purpose of acknowledging receipt of a call, such a station or stations may answer a calling station and request that it stand by for the duration of the silent period. The time limitations contained in this paragraph may not be avoided by changing the operating frequency of the station and shall apply to all transmissions of an operator who, under other provisions of this part, may operate a unit of more than one citizens radio station.

(c) The transmission of audible tone signals or a sequence of tone signals for the operation of the tone operated squelch or selective calling circuits in accordance with §95.47 shall not exceed a total of 15 seconds duration. Continuous transmission of a subaudible tone for this purpose is permitted. For the purposes of this section, any tone or combination of tones having no frequency above 150 Hertz shall be considered subaudible.

(d) The transmission of permissible control signals shall be limited to the minimum practicable time necessary to accomplish the desired control or actuation of remote objects or devices. The continuous radiation of energy for periods exceeding 3 minutes duration for the purpose of transmission of control signals shall be limited to control functions requiring at least one or more changes during each minute of such transmission. However, while it is actually being used to control model aircraft in flight by means of interrupted tone modulation of its carrier, a citizens radio station may transmit a continuous carrier without being simultaneously modulated if the presence or absence of the carrier also performs a control function. An exception to the limitations contained in this paragraph may be authorized upon a satisfactory showing that a continuous control signal is required to perform a control function which is necessary to insure the safety of life and property.

§95.93 Tests and Adjustments.

All tests or adjustments of citizens radio transmitting equipment involving an external connection to the radio frequency output circuit shall be made using a nonradiating dummy antenna. However, a brief test signal either with or without modulation, as appropriate, may be transmitted when it is necessary to adjust a transmitter to an antenna for a new station installation or for an existing installation involving a change of antenna or change of transmitters, or when necessary for the detection, measurement, and suppression of harmonic or other spurious radiation. Test transmissions using a radiating antenna shall not exceed a total of 1 minute during any 5-minute period, shall not interfere with communications already in progress on the operating frequency, and shall be properly identified as required by §95.95, but may otherwise be unmodulated as appropriate.

§95.95 Station Identification.

(a) The call sign of a citizens radio station shall consist of three letters followed by four digits.

(b) Each transmission of the station call sign shall be made in the English language by each unit, shall be complete, and each letter and digit shall be separately and distinctly transmitted. Only standard phonetic alphabets, nationally or internationally recognized, may be used in lieu of pronunciation of letters for voice transmission of call signs. A unit designator or

special identification may be used in addition to the station call sign but not as a substitute therefor.

(c) Except as provided in paragraph (d) of this section, all transmissions from each unit of a citizens radio station shall be identified by the transmission of its assigned call sign at the beginning and end of each transmission or series of transmissions directed to or exchanged with a unit of the same station or units of other stations. Each required identification shall include not only the call sign of the station unit transmitting, but also the call sign of the station or stations with which the transmitting unit is communicating, or attempting to communicate. In the case of communications between units of the same station (intrastation), after identifying itself by its assigned call sign, the transmitting unit may identify the other units by unit designators. For communications between units of different stations (interstation), the complete sign of all stations involved must be transmitted. If the call sign of the station being called is not known, the name or trade name may be used, but when contact has been made the called station shall thereafter be identified by its call sign. Examples of proper identification procedure are set forth at the end of this paragraph. Where transmissions or exchanges of transmissions of greater length are permitted by this part, the identification shall also be transmitted at least every 15 minutes. Each transmission or exchange of transmissions conducted on different frequencies shall be fully and separately identified in accordance with the foregoing on each frequency used.

EXAMPLES OF PROPER IDENTIFICATION

Intrastation communications:

(1) Calling: "KZZ 0001 base, calling unit 2."
Response: "KZZ 0001 unit 2, to base, over."
Clearing: "KZZ 0001 base, clear with unit 2" and "KZZ 0001 unit 2, clear with base."

(2) Calling: "KZZ 0001 unit 1, calling unit 3."
Response: "KKZ 0001 unit 3, to unit 1, over."
Clearing: "KZZ 0001 unit 1, clear with unit 3" and "KZZ 0001 unit 3, clear with unit 1."

Interstation communications:

Calling: "KZZ 0001 calling KZZ 0002," or "KZZ 0001 calling KZZ 0002 unit 3" (if appropriate).
Response: "KZZ 0002 to KZZ 0001, over."
Clearing: "KZZ 0001 clear with KZZ 0002," and "KZZ 0002 clear with KZZ 0001."

(d) Unless specifically required by the station authorization, the transmission of a citizens radio station need not be identified when the station (1) is a Class A station which automatically retransmits the information received by radio from another station which is properly identified or (2) is not being used for telephony emission.

(e) In lieu of complying with the requirements of paragraph (c) of this section, Class A base stations, fixed stations, and mobile units when communicating with base stations may identify as follows:

(1) Base stations and fixed stations of a Class A radio system shall transmit their call signs at the end of each transmission or exchange of transmissions, or once each 15-minute period of a continuous exchange of communications.

(2) A mobile unit of a Class A station communicating with a base station of a Class A radio system on the same frequency shall transmit once during each exchange of transmissions any unit identifier which is on file in the station records of such base station.

(3) A mobile unit of Class A stations communicating with a base station of a Class A radio system on a different frequency shall transmit its call sign at the end of each transmission or exchange of transmissions, or once each 15-minute period of a continuous exchange of communications.

§95.105 Current copy of rules required.

Each licensee in this service shall maintain as a part of his station records a current copy of Part 95, Citizens Radio Service, of this chapter.

We have gone into the details of Citizens Radio operating requirements because of misunderstandings about this type of radio service and misuse of it. Each radio service has its own operating requirements as you will see in the next section. The Citizens Radio Service has less demanding requirements than other radio services but they are important nonetheless.

Operational Requirements

The operational requirements of radio stations fall into two types -- the technical operation, whereby the required technical standards are maintained, and the actual operation, or use, of the transmitter.

TECHNICAL OPERATION

The Technical operation requirements of the different classes of radio stations are set out in the Rules and Regulations. As an example of the kind of technical operation that is required, we can take the regulations that apply to standard AM broadcasting stations.

Determination of Operating Power. Section 73.51 tells how operating power is determined:

(a) Except as provided in paragraph (b) of this section, the operating power shall be determined by the direct method, i.e., as the product of the antenna resistance at the operating frequency (see §73.54) and the square of the antenna current at this frequency, measured at the point where the antenna resistance has been determined.

(b) The operating power shall be determined on a temporary basis by the indirect method described in paragraphs (c) and (d) of this section, in the following circumstances: (1) In an emergency, where the authorized antenna system has been damaged by causes beyond the control of the licensee or permittee (see §73.45), or (2) pending completion of authorized changes in the antenna system, or (3) if changes occur in the antenna system or its environment which affect or appear likely to affect the value of antenna resistance or (4) if the antenna current meter becomes defective (see §73.58). Prior authorization for determination of power by the indirect method is not required. However, an appropriate notation shall be made in the operating log.

(c) (1) Operating power is determined by the indirect method of applying an appropriate factor to the plate input power, in accordance with the following formula:

$$\text{Operating power} = E_p \times I_p \times F$$

Where:
E_p = Plate voltage of the final radio stage
I_p = Total plate current of the final radio stage
F = Efficiency factor

(2) The value of F applicable to each mode of operation shall be entered in the operating log for each day of operation, with a notation as to its derivation. This factor shall be established by one of the methods described in paragraph (d) of this section, which are listed in order of preference. The product of the plate current and plate voltage, or alternatively, the computed operating power, shall be entered in the operating log under an appropriate heading for each log entry of plate current and plate voltage.

(d) (1) If the transmitter and the power utilized during the period of indirect power determination are the same as have been authorized and utilized for any period of regular operation, the factor F shall be the ratio of such authorized power to the corresponding plate input power of the transmitter for regular conditions of operation, computed with values of plate voltage and plate current obtained from the operating logs of the station for the last week of regular operation. However, if the station has been regularly authorized for operation with directional antenna, and temporary authority has been granted for nondirectional operation with regularly authorized power, during the period that power is being determined indirectly, an adjusted factor F shall be employed, which is derived by dividing the factor, as determined above, by a constant (0.925 for authorized powers of 5 kw, or less; 0.95 for powers above 5 kw.).

(2) If a station has not been previously in regular operation with the power authorized for the period of indirect power determination, if a new transmitter has been installed, or if, for any other reason, the determination of the factor F by the method described in paragraph (d) (1) of this section is impracticable:

(i) The factor F shall be obtained from the transmitter manufacturer's letter or test report retained in the station's files, if such a letter or test report specifies a unique value of F for the power level and frequency utilized; or

(ii) By reference to the following table:

Factor (F)	Method of modulation	Max. rated carrier power	Class of amplifier
0.70	Plate	0.25-1.0 kw	
.80	Plate	5 kw. & over	
.35	Low level	0.25 kw. & over	B
.65	Low level	0.25 kw. & over	BC[1]
.35	Grid	0.25 kw & over	

[1] All linear amplifier operation where efficiency approaches that of Class C operation.

(3) When the factor F is obtained from the table, this value shall be used even though the operating power may be less than the maximum rated carrier power of the transmitter.

Maintenance of Operating Power. Section 73.52 tells within what limits the operating power is to be maintained:

(a) The operating power of each station shall be maintained as near as practicable to the licensed power and shall not exceed the limits of 5 percent above and 10 percent below the licensed power, except that in an emergency when due to causes beyond control of the licensee it becomes impossible to operate with full licensed power, the station may be operated with reduced power for a period not to exceed 10 days, provided the Commission and the Engineer in Charge of the radio district in which the station is located shall be notified immediately after the emergency develops and also upon the resumption of licensed power.

(b) In addition to maintaining the operating power within the above limitations, stations employing directional antenna systems shall maintain the ratio of the antenna currents in the elements of the system within 5 percent of that specified by the terms of the license or other instrument of authorization.

How Antenna Resistance and Reactance Is Determined. Section 73.54 prescribes these measurement standards, procedures and record keeping:

(a) The resistance of an omnidirectional series fed antenna shall be measured at the base of the antenna, without intervening coupling networks or components. For a shunt-excited antenna, the antenna resistance shall be measured at the point when the radiofrequency energy is fed to the slant wire or other feed wire circuit without intervening networks or components.

(b) The resistance and reactance of a directional antenna shall be measured at the point of common radiofrequency input to the directional antenna system. The following conditions shall obtain:

(1) The antenna shall be finally adjusted for the required radiation pattern.

(2) The reactance at the operating frequency and at the point of measurement shall be adjusted to zero, or as near thereto as practicable.

(c) (1) The resistance of an antenna shall be determined by the following procedure: A series of discrete measurements shall be made over a band of frequencies extending from approximately 25 kHz below the operating frequency to approximately 25 kHz above that frequency, at intervals of approximately 5 kHz. The measured values shall be plotted on a linear graph, with frequency as the abscissa and resistance as the ordinate. A smooth curve shall be drawn through the plotted values. The resistance value corresponding to the point of intersection of the curve and the ordinate representing the operating frequency of the station shall be the resistance of the antenna.

(2) For a directional antenna, the reactance of the antenna shall be determined by a procedure similar to that described in subparagraph (1) of this paragraph.

(d) The license of a station with a directional antenna, and authorized power of 5 kilowatts or less shall specify an antenna resistance 92.5 percent of that determined at the point of common input; for a station with directional antenna and authorized power exceeding 5 kilowatts the license shall specify an antenna resistance 95 percent of that determined at the point of common input.

(e) Applications for authority to determine power by the direct method shall specify the antenna or common point resistance, and shall include the following supporting information.

(1) Description of measurement method.

(2) A schematic diagram showing clearly all components of coupling circuits, the point of resistance measurement, location of antenna ammeter, connections to and characteristics of all tower lighting isolation circuits, static drains, and any other fixtures, sample lines, etc., connected to or supported by the antenna, including other antennas and associated circuits.

(3) Make and type of each calibrated instrument employed, manufacturer's rated accuracy, together with the date of last calibration of the instrument, the accuracy of the calibration, and the identity of the person or firm making the calibration.

(4) A tabulation of all measured data.

(5) Graph(s) plotted from this data.

(6) The qualifications of the engineer(s) making the measurements.

Modulation Requirements. Section 73.55 sets the modulation percentage requirements:

> The percentage of modulation shall be maintained as high as possible consistent with good quality of transmission and good broadcast practice. In no case is it to exceed 100 percent on negative peaks of frequent recurrence. Generally, it should not be less than 85 percent on peaks of frequent recurrence; but where necessary to avoid objectionable loudness modulation may be reduced to whatever level is necessary, even if the resulting modulation is substantially less than 85 percent on peaks of frequent recurrence.

Section 73.56 describes the requirements for modulation monitors:

(a) Each station shall have in operation, either at the transmitter or at the place the transmitter is controlled, a modulation monitor of a type approved by the Commission.

> NOTE: Approved modulation monitors are included on the Commission's "Radio Equipment List, Part B, Aural Broadcast Equipment." Copies of this list are available for inspection at the Commission's office in Washington, D. C. and at each of its field offices.

(b) In the event that the modulation monitor becomes defective the station may be operated without the monitor pending its repair or replacement for a period not in excess of 60 days without further authority of the Commission: Provided, That:

(1) Appropriate entries shall be made in the maintenance log of the station showing the date and time the monitor was removed from and restored to service.

(2) The Engineer in Charge of the radio district in which the station is located shall be notified both immediately after the monitor is found to be defective and immediately after the repaired or replacement monitor has been installed and is functioning properly.

(3) The degree of modulation of the station shall be monitored with a cathode ray oscilloscope or other acceptable means.

(c) If conditions beyond the control of the licensee prevent the restoration of the monitor to service within the above allowed period, informal request in accordance with § 1.549 of this chapter may be filed with the Engineer in Charge of the radio district in which the station is operating for such additional time as may be required to complete repairs of the defective instrument.

(d) Each station operated by remote control shall continuously, except when other readings are being taken, monitor percent of modulation or shall be equipped with an automatic device to limit percent of modulation on negative peaks to 100.

Indicating Instruments. Section 73.58 describes the indicating instruments that are required:

(a) Each standard broadcast station shall be equipped with indicating instruments which conform with the specifications set forth in § 73.39 for measuring the dc plate circuit current and voltage of the last radio frequency amplified stage; the radio frequency base current of each antenna element; and, for stations employing directional antenna systems, the radio frequency current at the point of common input to the directional antenna.

(b) In the event that any one of these indicating instruments becomes defective when no substitute which conforms with the required specifications is available, the station may be operated without the defective instrument pending its repair or replacement for a period not in excess of 60 days without further authority of the Commission: Provided, That:

(1) Appropriate entries shall be made in the maintenance log of the station showing the date and time the meter was removed from and restored to service.

(2) The Engineer in Charge of the radio district in which the station is located shall be notified both immediately after the instrument is found to be defective and immediately after the repaired or replacement instrument has been installed and is functioning properly.

(3) If the defective instrument is the antenna current meter of a nondirectional station which does not employ a remote antenna ammeter, or if the defective instrument is the common point meter of a station which employs a directional antenna, and does not employ a remote common point meter, the operating power shall be determined by the indirect method in accordance with § 73.51 (c) and (d) during the entire time the station is operated without the antenna current meter or common point meter. However, if a remote antenna ammeter or a remote common point meter is employed and the antenna current meter or common point meter becomes defective, the remote meter may be used in determining operating power by the direct method pending the return to service of the regular meter, provided other meters are maintained at same value previously employed.

(c) If conditions beyond the control of the licensee prevent the restoration of the meter to service within the above allowed period, informal request in accordance with § 1.549 of this chapter may be filed with the Engineer in Charge of the radio district in which the station is located for such additional time as may be required to complete repairs of the defective instrument.

(d) Remote antenna ammeters and remote common point meters are not required; therefore, authority to operate without them is not necessary. However, if a remote antenna ammeter or common point meter is employed and becomes defective, the antenna base currents may be read and logged once daily for each mode of operation, pending the return to service of the regular remote meter.

Frequency Requirements. Section 73.59 sets out the frequency tolerance:

The operating frequency of each station shall be maintained within 20 Hz of the assigned frequency.

§73.60 describes the frequency monitor requirements:

(a) The licensee of each station shall have in operation, either at the transmitter or at the place where the transmitter is controlled, a frequency monitor of a type approved by the Commission which shall be independent of the frequency control of the transmitter.

NOTE: Approved frequency monitors are included on the Commission's "Radio Equipment List, Part B, Aural Broadcast Equipment". Copies of this list are available for inspection at the Commission's office in Washington, D. C. and at each of its field offices.

(b) In the event that the frequency monitor becomes defective the station may be operated without the monitor pending its repair or replacement for a period not in

excess of 60 days without further authority of the Commission: Provided, That:

(1) Appropriate entries shall be made in the maintenance log of the station showing the date and time the monitor was removed from and restored to service.

(2) The Engineer in Charge of the radio district in which the station is located shall be notified both immediately after the monitor is found to be defective and immediately after the repaired or replacement monitor has been installed and is functioning properly.

(3) The frequency of the station shall be measured by an external source at least once each 7 days and the result entered in the maintenance log.

(c) If conditions beyond the control of the licensee prevent the restoration of the monitor to service within the above allowed period, informal request in accordance with § 1.549 of this chapter may be filed with the Engineer in Charge of the radio district in which the station is located for such additional time as may be required to complete repairs of the defective instrument.

You can see from these quotations from the Rules that nearly every aspect of the technical operation requirements for radio stations and equipment is closely regulated. These Rules help to insure that the many radio services and classes of stations will be able to perform their functions without interfering with one another.

OPERATING SCHEDULES

In addition to the equipment requirements in the operation of a radio transmitter, the operating or broadcasting schedule is also closely regulated by the FCC Rules.

Section 73.71 describes the minimum operating schedule for AM (standard broadcast) stations:

(a) All standard broadcast stations are required to maintain an operating schedule of not less than two-thirds of the total hours they are authorized to operate between 6 a.m. and 6 p.m., local standard time, and two-thirds of the total hours they are authorized to operate between 6 p.m. and midnight, local standard time, on each day of the week except Sunday: Provided, however, That stations authorized for daytime operation only need comply only with the minimum requirement for operation between 6 a.m. and 6 p.m.

(b) In the event that causes beyond a licensee's control make it impossible to adhere to the operating schedule in paragraph (a) of this section or to continue operating, the station may limit or discontinue operation for a period of not more than 10 days, without further authority of the Commission. However, the Commission and the Engineer in Charge of the radio district in which the station is located shall be immediately notified in writing if the station is unable to maintain the minimum operating schedule and shall be subsequently notified when the station resumes regular operation.

The "experimental period" in broadcasting is the time from 12 midnight to local sunrise (nighttime is the period from local sunset to 12 midnight). Section 73.72 provides for the control of operation of standard broadcast stations during this period:

> The licensee of each standard broadcast station shall operate or refrain from operating its station during the experimental period as directed by the Commission in order to facilitate frequency measurement or for the determination of interference.

Section 73.73 provides for operation of stations pursuant to the schedule of operation specified by the FCC license.

> If the license of a station specifies the hours of operation, the schedule so speci-

fied shall be adhered to except as provided in §§ 73.71 and 73.72.

LOGS

Much of the information about the operation of radio stations must be set down in the station logs. There are three separate logs: (1) Program log; (2) Operating log; and (3) Maintenance log. Section 73.111 covers the general requirements relating to logs for standard broadcast stations. Similar provisions apply to other commercial radio stations:

(a) The licensee or permittee of each standard broadcast station shall maintain program, operating and maintenance logs as set forth in §§ 73.112, 73.113, and 73.114. Each log shall be kept by the station employee or employees (or contract operator) competent to do so, having actual knowledge of the facts required, who in the case of program and operating logs shall sign the appropriate log when starting duty, and again when going off duty.

(b) The logs shall be kept in an orderly and legible manner, in suitable form, and in such detail that the data required for the particular class of station concerned is readily available. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log. Each sheet shall be numbered and dated. Time entries shall be either in local standard or daylight saving time and shall be indicated accordingly.

(c) No log or preprinted log or schedule which becomes a log, or portion thereof, shall be erased, obliterated, or willfully destroyed within the period of retention provided by the provisions of this part. Any necessary correction shall be made only pursuant to §§ 73.112, 73.113, and 73.114, and only by striking out the erroneous portion, or by making a corrective explanation on the log or attachment to it as provided in those sections.

(d) Entries shall be made in the logs as required by §§ 73.112, 73.113, and 73.114. Additional information such as that needed for billing purposes or for the cueing of automatic equipment may be entered on the logs. Such additional information, so entered, shall not be subject to the restrictions and limitations in the Commission's rules on the making of corrections and changes in logs.

Section 73.115 provides for retaining the logs as records:

> Logs of standard broadcast stations shall be retained by the licensee or permittee for a period of 2 years: Provided, however, That logs involving communications incident to a disaster or which include communications incident to or involved in an investigation by the Commission and concerning which the licensee or permittee has been notified, shall be retained by the licensee or permittee until he is specifically authorized in writing by the Commission to destroy them: Provided, further, That logs incident to or involved in any claim or complaint of which the licensee or permittee has notice shall be retained by the licensee or permittee until such claim or complaint has been fully satisfied or until the same has been barred by statute limiting the time for the filing of suits upon such claims.

Section 73.116 sets forth the rules about making the logs and records available:

> The following shall be made available upon request by an authorized representative of the Commission:
>
> (a) Program, operating and maintenance logs.
>
> (b) Equipment performance measurements required by §73.47.
>
> (c) Copy of most recent antenna resistance or common-point impedance measurements submitted to the Commission.
>
> (d) Copy of most recent field intensity measurements to establish performance of directional antennas required by § 73.151.

SECRECY REQUIREMENTS

Most radio stations engaged in handling communications traffic are obliged to observe strict secrecy with regard to the

content of the messages they handle. For instance, stations in the shipboard maritime service are governed by Section 83.174 of the Rules, which provide:

> **The master or the person responsible, as well as all persons who may have knowledge of the text or even of the existence of the radio communications transmitted or received by a station on board ship or of any information whatever obtained by means of the radiocommunication service of such station, shall be under the obligation of observing and insuring the secrecy of communications to the extent required by the Communications Act and the International Radio Regulations.**

Section 501 of the Communications Act provides:

> **Any person who willfully and knowingly does or causes or suffers to be done any act, matter, or thing, in this Act prohibited or declared to be unlawful, or who willfully or knowingly omits or fails to do any act, matter, or thing in this Act required to be done, or willfully and knowingly causes or suffers such omission or failure, shall, upon conviction, thereof, be punished for such offense, for which no penalty (other than a forfeiture) is provided in this Act, by a fine of not more than $10,000 or by imprisonment for a term not exceeding one year, or both; except that any person, having been once convicted of an offense punishable under this section, who is subsequently convicted of violating any provision of this Act punishable under this section, shall be punished by a fine of not more than $10,000 or by imprisonment for a term not exceeding two years, or both.**

Section 502 of the Communications Act provides:

> **Any person who willfully and knowingly violates any rule, regulation, restriction, or condition made or imposed by the Commission under authority of this Act, or any rule, regulation, restriction, or condition made or imposed by an international radio or wire communications treaty or convention, or regulations annexed thereto, to which the United States is or may hereafter become a party, shall, in addition to any other penalties provided by law, be punished, upon conviction thereof, by a fine of not more than $500 for each and every day during which such offense occurs.**

Section 605 of the Communications Act provides:

> **No person receiving or assisting in receiving, or transmitting, or assisting in transmitting, any interstate or foreign communications by wire or radio shall divulge or publish the existence, contents, substance, purport, effect, or meaning thereof, except through authorized channels of transmission or reception, to any person other than the addressee, his agent, or attorney, or to a person employed or authorized to forward such communication to its destination, or to proper accounting or distributing officers of the various communicating centers over which the communication may be passed, or to the master of a ship under whom he is serving, or in response to a subpoena issued by a court of competent jurisdiction, or on demand of other lawful authority; and no person not being authorized by the sender shall intercept any communication and divulge or publish the existence, contents, substance, purport, effect, or meaning of such intercepted communication to any person; and no person not being entitled thereto shall receive or assist in receiving any interstate or foreign communication by wire or radio and use the same or any information therein contained for his own benefit or for the benefit of another not entitled thereto; and no person having received such intercepted communication or having become acquainted with the contents, substance, purport, effect, or meaning of the same or any part thereof, knowing that such information was so obtained, shall divulge or publish the existence, contents, substance, purport, effect, or meaning of**

the same or any part thereof, or use the same or any information therein contained for his own benefit or for the benefit or another not entitled thereto: Provided, That this section shall not apply to the receiving, divulging, publishing, or utilizing the contents of any radio communication broadcast, or transmitted by amateurs or others for the use of the general public, or relating to ships in distress.

ORDER OF PRIORITY

Messages handled in the communications services all have places in the order of priority. The details of this order are slightly different for the different services. However, the general order of priority can be seen from the regulations that apply to radiotelegraph communications in the maritime mobile service. This priority is set forth in Section 83.177(a):

(a) The order of priority of radiotelegraph communications in the maritime mobile service of any frequency used for this service shall be as follows:

(1) Distress calls (including the international distress signal for radiotelegraphy), the international radiotelegraph alarm signal, the international radiotelephone alarm signal, distress messages, and distress traffic.

(2) Communications preceded by the international radiotelegraph urgency signal.

(3) Communications preceded by the international radiotelegraph safety signal.

(4) Communications relative to radio direction-finding bearings.

(5) Communications relative to the navigation and safe movement of aircraft.

(6) Communications relative to the navigation, movements, and needs of ships; including weather observation messages destined for an official meteorological service.

(7) Government communications for which priority right has been claimed.

(8) Service communications relating to the working of the radiocommunication service or to communications previously transmitted.

(9) All other communications.

Distress, alarm, urgent, and safety signals are described as follows:

§83.234 Distress Signals.

(a) The international radiotelegraph distress signal consists of the group "three dots, three dashes, three dots" (. . . - - - . . .), symbolized herein by SOS, transmitted as a single signal in which the dashes are slightly prolonged so as to be distinguished clearly from the dots.

(b) The international radiotelephone distress signal consists of the word MAYDAY, pronounced as French expression "m'aider".

(c) These distress signals indicate that a mobile station is threatened by grave and imminent danger and requests immediate assistance.

§83.245 Radiotelegraph and radiotelephone alarm signals.

(a) The international radiotelegraph alarm signal consists of a series of twelve dashes sent in one minute, the duration of each dash being four seconds and the duration of the interval between consecutive dashes one second. The purposes of this special signal is the actuation of automatic devices giving the alarm to attract the attention of the operator when there is no listening watch on the distress frequency.

(b) The international radiotelephone alarm signal consists of two substantially sinusoidal audio frequency tones transmitted alternately. One tone shall have a frequency of 2200 cycles per second and the other a frequency of 1300 cycles per second, the duration of each tone being 250 milliseconds. When generated by automatic means, the radiotelephone alarm signal shall be transmitted continuously for a period of at least 30 seconds, but not exceeding one minute; when generated by other means, the signal shall be transmitted as continuously as practicable over a period of approximately one minute. The purpose of this special signal is to attract the attention of the person on watch or to actuate automatic devices giving the alarm.

§83.247 Urgency signals.

(a) The urgency signal indicates that the calling station has a very urgent message to transmit concerning the safety of a ship, aircraft, or other vehicle, or the safety of a person. The urgency signal shall be sent only on the authority of the master or person responsible for the mobile station.
(b) In radiotelegraphy, the urgency signal consists of three repetitions of the group XXX, sent with the individual letters of each group, and the successive groups clearly separated from each other. It shall be transmitted before the call.
(c) In radiotelephony, the urgency signal consists of the word PAN, spoken three times and transmitted before the call.
(d) The urgency signal shall have priority over all other communications, except distress. All mobile and land stations which hear it shall take care not to interfere with the transmission of the message which follows the urgency signal.

§83.249 Safety signals.

(a) The safety signal indicates that the station is about to transmit a message concerning the safety of navigation or giving important meteorological warnings.
(b) In radiotelegraphy, the safety signal consists of three repetitions of the group TTT, sent with the individual letters of each group, and the successive groups clearly separated from each other. It shall be sent before the call.
(c) In radiotelephony, the safety signal consists of the word SECURITY, spoken three times and transmitted before the call.
(d) The safety signal and call shall be sent on one of the international distress frequencies (500 kHz radiotelegraph; 2182 kHz radiotelephone), or on the national distress frequency (156.80 MHz radiotelephone). However, stations which cannot transmit on a distress frequency may use any other available frequency on which attention might be attracted.

INSPECTIONS

All stations licensed by the FCC are subject to station inspection. For instance, the Rules provide even with respect to Citizens Radio stations, in Section 95.103:

> All stations and records of stations in the Citizens Radio Service shall be made available for inspection upon the request of an authorized representative of the Commission made to the licensee or to his representative (see § 1.6 of this chapter). Unless otherwise stated in this part, all required station records shall be maintained for a period of at least 1 year.

Similar provisions apply to broadcast stations in Section 73.97:

> The licensee of any radio station shall make the station available for inspection by representatives of the Commission at any reasonable hour.

The possibility of an inspection makes it particularly important to keep both the log books and the station equipment in good shape at all times. Many points covered by the Rules but not mentioned in this brief text may be checked on a station inspection. For this reason, it is especially important to get a copy of the rules that apply to the particular service you are engaged in to make sure that the station is operated according to these rules at all times. For example, posting of operator and station licenses may seem like an incidental thing of little importance, but the Rules specifically provide in Section 73.92 that this shall be done.

(a) The station license and any other instrument of station authorization shall be posted in a conspicuous place and in such manner that all terms are visible, at the place the licensee considers to be the principal control point of the transmitter. At all other control points listed on the station authorization, a photocopy of the station license and other instruments of station authorization shall be posted.
(b) The original operator license, or FCC

Form 759, of each station operator shall be posted at the place where he is on duty as an operator.

It is also important for the operator requirements set out in Section 73.93 to be met at all times:

(a) One or more operators holding a radio operator license or permit of a grade specified in this section shall be in actual charge of the transmitting system, and shall be on duty either at the transmitter location or at the remote control point. If operation by remote control has not been authorized, the transmitter, required monitors and other required metering equipment shall be readily accessible, clearly visible, and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required instruments can be observed readily. If operation by remote control is authorized, the required controls and instruments shall be readily accessible, clearly visible, and located sufficiently close to the operator at the normal operating position that deviations from normal indications of required instruments can be observed readily.

(b) With the exception set forth in paragraph (f) of this section, adjustments of the transmitting system and inspection, maintenance, and required equipment performance measurements and required field strength measurements shall be performed only by a first class radiotelephone operator.

(c) A station using a non-directional antenna and with authorized power of 10 kilowatts or less shall have at least one first class radiotelephone operator, readily available at all times, either in full time employment, or, in the alternative, the licensee may contract in writing for the services on a part-time basis of one or more such operators. Signed contracts with part-time operators shall be kept in the files of the station and shall be made available for inspection upon request by an authorized representative of the Commission. A signed copy of contracts shall be forwarded to the Engineer in Charge of the radio district in which the station is located within three (3) days after the contract is signed.

(d) A station using a non-directional antenna, during periods of operation with authorized power in excess of 10 kilowatts, may employ first class radiotelephone operators, second class operators, or operators with the third class permit endorsed for broadcast station operation for routine operation of the transmitting system if the station has in full-time employment at least one first class radiotelephone operator and complies with the provisions of paragraphs (f) and (g) of this section.

(e) A station using a directional antenna system, which is required by the station authorization to maintain the ratios of the currents in the elements of the system within a tolerance which is less than 5 percent or the relative phases of those currents within a tolerance which is less than 3 degrees shall, without exception, employ first class radiotelephone operators who shall be on duty and in actual charge of the transmitting system as specified in paragraph (a) of this section during hours of operation with a directional radiation pattern. A station whose authorization does not specifically require therein the maintenance of phase and current relationships within closer tolerances than above specified shall employ first class radiotelephone operators for routine operation of the transmitting system during periods of directional operation, *Provided however*, That holders of second class licenses or third class permits endorsed for broadcast station operation, may be employed for routine operation of the transmitting system if the following conditions are met:

(1) The station must have in full-time employment at least one first class radiotelephone operator.

(2) The station shall be equipped with a type-approved phase (antenna) monitor fed by a sampling system installed and maintained pursuant to accepted standards of good engineering practice.

(3) At least once each day, 5 days each week, unless required more frequently by the terms of the station authorization, or rules governing operation by remote control (see Sections 73.571(a)(6) and 73.113(a)(4)) a

first class radiotelephone operator shall record the following observations in the station maintenance log for each directional radiation pattern used: (i) Common point current. (ii) Antenna base currents. (iii) Sample loop currents or remote antenna base currents and phase monitor indications. (iv) Antenna base current ratios, and remote antenna or sample loop current ratios, and the deviations in these ratios, in percent, from the licensed values. A station authorized to use the same directional radiation pattern during all hours of operation shall record these observations with successive readings not less than 12 hours apart.

(4) A partial proof of performance shall be made once each calendar year, with intervals between successive proofs not to exceed fourteen (14) months. The report of such proof measurements shall be prepared and filed as specified in paragraph (b) of Section 73.47.

(5) Field strength measurements shall be made at the monitoring points specified in the station authorization at least once each 30 days unless more frequent measurements are required by such authorization. The results of these measurements shall be entered in the station maintenance log. The licensee shall have readily available, and in proper working condition, field strength measuring equipment to perform these measurements.

(f) Subject to the conditions set forth in paragraphs (c), (d), and (e) of this section, the routine operation of the transmitting system may be performed by an operator holding a second class license or third class permit endorsed for broadcast station operation. Unless, however, performed under the immediate and personal supervision of an operator holding a first class radiotelephone license, an operator holding a second class license or third class permit endorsed for broadcast station operation, may make adjustments only of external controls as follows:

(1) Those necessary to turn the transmitter on and off;

(2) Those necessary to compensate for voltage fluctuations in the primary power supply;

(3) Those necessary to maintain modulation levels of the transmitter within prescribed limits;

(4) Those necessary to effect routine changes in operating power which are required by the station authorization;

(5) Those necessary to change between non-directional and directional or between differing radiation patterns, provided that such changes require only activation of switches and do not involve the manual tuning of the transmitter final amplifier or antenna phasor equipment. The switching equipment shall be so arranged that the failure of any relay in the directional antenna system to activate properly will cause the emissions of the station to terminate.

(g) It is the responsibility of the station licensee to insure that each operator is fully instructed in the performance of all the above adjustments, as well as in other required duties, such as reading meters and making log entries. Printed step-by-step instructions for those adjustments which the lesser grade operator is permitted to make, and a tabulation or chart of upper and lower limiting values of parameters required to be observed and logged, shall be posted at the operating position. The emissions of the station shall be terminated immediately whenever the transmitting system is observed operating beyond the posted parameters, or in any other manner inconsistent with the rules or the station authorization, and the above adjustments are ineffective in correcting the condition of improper operation, and a first class radiotelephone operator is not present.

(h) When lesser grade operators are used, in accordance with paragraphs (d) or (e) of this section, for any period of operation using authorized power in excess of 10 kilowatts, or using a directional radiation pattern, the station licensee shall designate one first class radiotelephone operator in full-time employment as the chief operator who, together with the licensee, shall be responsible for the technical operation of the station. The station licensee shall notify the Engineer in Charge of the radio district in which the station is located of the name and license number of the designated chief operator. Such notification shall be by

letter within three (3) days of such designation. A copy of the notification shall be posted with the chief operator's license.

(1) An operator designated as chief operator for one station may not be so designated concurrently at any other standard broadcast station.

(2) The station licensee shall vest such authority in, and afford such facilities to the chief operator as may be necessary to insure that the chief operator's primary responsibility for the proper technical operation of the station may be discharged efficiently.

(3) At such times as a regularly designated chief operator is unavailable or unable to act as chief operator (e.g., vacations, sickness), the station licensee shall designate another first class radiotelephone operator as acting chief operator on a temporary basis. Within three days of the date such action is taken, the Engineer in Charge of the radio district in which the station is located shall be notified by the licensee by letter of the name and license number of the acting chief operator, and shall be notified by letter, again within three days of the date when the regularly designated chief operator returns to duty.

(4) The designated chief operator may serve as a routine duty transmitter operator at any station only to the extent that it does not interfere with the efficient discharge of his responsibilities as listed below. (i) The inspection and maintenance of the transmitting system including the antenna system and required monitoring equipment. (ii) The accuracy and completeness of entries in the maintenance log. (iii) The supervison and instruction of all other station operators in the performance of their technical duties. (iv) A reveiw of completed operating logs to determine whether technical operation of the station has been in accordance with the rules and terms of the station authorization. After review, the chief operator shall sign the log and indicate the date of such review. If the review of the operating logs indicates technical operation of the station is in violation of the rules or the terms of the station authorization, he shall promptly initiate corrective action. The review of each day's operating log shall be made within 24 hours, except that, if the chief operator is not on duty during a given 24 hour period, the logs must be reviewed within two hours after his next appearance for duty. In any case, the time before review shall not exceed 72 hours.

(i) The operator on duty at the transmitter or remote control point, may, at the discretion of the licensee and the chief operator, if any, be employed for other duties or for the operation of another radio station or stations in accordance with the class of operator's license which he holds and the rules and regulations governing such other stations; *Provided, however*, That such other duties shall not interfere with the proper operation of the standard broadcast transmitting system and keeping of required logs.

(j) At all standard broadcast stations, a complete inspection of the transmitting system and required monitoring equipment in use, shall be made by an operator holding a first class radiotelephone license at least once each day, 5 days each week, with an interval of no less than 12 hours between successive inspections. This inspection shall include such tests, adjustments, and repairs as may be necessary to insure operation in conformance with the provisions of this subpart and the current station authorization.

VIOLATION NOTICES

Special provisions are made by the FCC for monitoring radio stations. These monitoring, or listening, posts can tell if a radio transmitter is operating properly.

If there is some defect in the operation of a radio station that violates the Rules and Regulations of the FCC, a note of the violation is sent to the holder of the station license. The provisions of Section 83.601 apply to stations on land in the maritime service. However, similar provisions apply to the other services as well:

> **Any person receiving official notice of a violation of the terms of the Communications Act, any legislative act, Executive order, treaty to which the United States is a party, terms of a station or operator license, or the rules and regulations of the Federal Communications Commission, shall, within 10 days from such receipt, send a written answer, in duplicate, to the office of the Commission originating the official notice. If an answer cannot be sent, or an acknowledgement made within such 10-day period by reason of illness or other unavoidable circumstances, acknowledgement and answer shall be made at the earliest practicable date with a satisfactory explanation of the delay. The answer to each notice shall be complete in itself and shall not be abbreviated by references to other communications or answers to other notices. The answer shall contain a full explanation of the incident involved and shall set forth the action taken to prevent a continuation or recurrence thereof. If the notice relates to lack of attention to, or improper operation of the station, or to log or watch discrepancies, the answer shall give the name and license number of the licensed operator on duty.**

Be sure you know the requirements for answering violation notices that apply to the particular service that you are in. Failure to respond properly to a notice of violation can result in license suspension.

LICENSE RENEWALS

Of course, the normal thing to do with either a station or an operator's license is to have it renewed when it expires. You should know the license renewal requirements for whatever license you hold. For example, the Novice amateur license is not renewable. Therefore, if you wish to continue operating after your Novice license expires, you must make provisions for obtaining a higher class of amateur license.

The fcllowing are the provisions that apply to the renewal and replacement requirements for commercial radio operators. You can get the corresponding requirements for other kinds of licenses by referring to the volume of the FCC Rules that covers that particular service.

Higher Class License. Section 13.26 describes the canceling of a license by the issuance of a higher class license, as follows:

> **If the holder of a license qualifies for a higher class in the same group, the license held will be canceled upon the issuance of the new license. Similarly, if the holder of a restricted operator permit qualifies for a first- or second-class operator license of the corresponding type, the permit held will be canceled upon issuance of the new license.**

Renewals. Rules regarding renewals are set forth in Section 13.28 as follows:

> **A restricted radiotelephone operator permit normally is issued for the lifetime of the holder and need not be renewed. A temporary limited radiotelegraph second-class operator license is not renewable. A license of any other class may be renewed without examination provided that the service record on the reverse side of the license (see §§ 13.91 to 13.94) shows at least two years of satisfactory service in the aggregate during the license term and while actually employed as a radio operator under that license. If this two-year renewal service requirement is not fulfilled, but the service record shows at least one year of satisfactory service in the aggregate during the last three years of the license term and while actually employed as a radio operator under that license, the license may be renewed upon the successful completion of a renewal examination, which may be taken at any time during the final year of the license term or during a one-year period of grace after the date of expiration of the license sought to be renewed. The renewal examination will consist of the highest numbered examination element normally required for a new license of the class southt to be renewed,**

plus the code test (if any) required for such new license. If the renewal examination is not successfully completed before expiration of the aforementioned one-year period of grace, the license will not be renewed on any basis.

NOTE: By order dated and effective April 4, 1951, the Commission temporarily waived the requirement of prior service as a radio operator or examination for renewal in the case of any applicant for renewal of his commercial radio operator license. This order is applicable to commercial radio operator licenses which expired after June 30, 1950 until further order of the Commission.

Duplicates. A license that has been lost or destroyed can be replaced as described in Section 13.71.

(a) An operator whose license or permit has been lost, mutilated, or destroyed shall immediately notify the Commission. If the authorization is of the diploma form, a properly executed application for duplicate should be submitted to the office of issue. If the authorization is of the card form (Restricted Radiotelephone Operator Permit), a properly executed application for replacement should be submitted to the Federal Communications Commission, Gettysburg, Pa., 17325. In either case the application shall embody a statement of the circumstances involved in the loss, mutilation, or destruction of the license or permit. If the authorization has been lost, the applicant must state that reasonable search has been made for it, and, further, that in the event it be found, either the original or the duplicate (or replacement) will be returned for cancellation. If the authorization is of the diploma form, the applicant should also submit documentary evidence of the service that has been obtained under the original authorization, or a statement embodying that information.

(b) The holder of any license or permit whose name is legally changed may make application for a replacement document to indicate the new legal name by submitting a properly executed application accompanied by the license or permit affected. If the authorization is of the diploma form, the application should be submitted to the office where it was issued. If the authorization is of the card form (Restricted Radiotelephone Operator Permit) it should be submitted to the Federal Communications Commission, Gettysburg, Pa., 17325.

Section 13.72 provides:

> When a duplicate or replacement operator license or permit has been requested, or request has been made for renewal upon service or for an endorsement or a verification card, the operator shall exhibit in lieu of the original document a signed copy of the application which has been submitted by him.

Verification Cards. A verification card may be obtained as set forth in Section 13.73:

> The holder of an operator license or permit of the diploma form (as distinguished from such document of the card form) may, by filing a properly executed application accompanied by his license or permit, obtain a verification card (Form 758-F). This card may be carried on the person of the operator in lieu of the original license or permit when operating any station at which posting of an operator license is not required: Provided, That the license is readily accessible within a reasonable time for inspection upon demand by an authorized Government representative.

Record of Service and Maintenance Duties. Section 13.75 provides the following:

> In every case where a station log or service and maintenance records are required to be kept, and where service or maintenance duties are performed which may affect the proper operation of a station, the responsible operator shall sign and date an entry in the log of the station concerned, or in the station maintenance records if no log is required, giving:
>
> (a) Pertinent details of all service and maintenance work performed by him or under his supervision;

(b) His name and address; and
(c) The class, serial number and expiration date of his license:
Provided, That the responsible operator shall not be subject to requirements of paragraphs (b) and (c) of this section in relation to a station, or stations of one licensee at a single location, at which he is regularly employed as an operator on a full time basis and at which his license is properly posted.

Service Record Endorsement. The following requirements are set forth in Sections 13.91 - 13.94 regarding the endorsement of the service record on an operator's license.

A station licensee, or his duly authorized agent, or the master of a vessel acting as the agent of a licensee, shall endorse the service record appearing on said operator license, showing the call letters and types of emission of the station operated, the nature and period of employment, and quality of performance of duty.

If the operator has operated more than three stations in the aviation service, the service may be shown by giving the name of the aviation chain or company in lieu of listing the call letters of the several stations.

Credit will be allowed only for satisfactory service obtained under conditions that required the employment of licensed operators, or when obtained at United States Government stations.

The holder of a radiotelegraph first- or second-class operator license, or a temporary limited radiotelegraph second-class operator license desiring an endorsement to be placed thereon attesting to an aggregate of at least 6 months' satisfactory service as a qualified operator on a vessel of the United States or an applicant for a temporary limited radiotelegraph second-class operator license under §13.5(d)(3) may, in the event documentary evidence cannot be produced, submit to any office of the Commission a statement under oath accompanied by the license to be endorsed, embodying the following:

(a) Names of ships at which employed;
(b) Call letters of stations;
(c) Types of emission used;
(d) Type of service performed as follows:
(1) Manual radiotelegraph operation only; and
(2) Transmitter control only; or
(3) Combination of (1) and (2) running concurrently;
(e) Whether service was satisfactory or unsatisfactory;
(f) Period of employment;
(g) Name of master, employer, licensee, or his duly authorized agent.

SUMMARY

This text gives you a general idea of the kind of material found in the Rules and Regulations. You should become thoroughly familiar with those that apply to your particular service.

The Rules and Regulations contain most of the information you will need to know about the licensing and operating requirements for radio stations and operators. These Rules and Regulations are made to put into effect the provisions of the Federal Communications Act, as amended. Therefore, both the Rules and the Communications Act often contain provisions that relate to the same subject. Consequently, it is useful to have a copy of this Act of Congress as well as the Rules that apply to your particular service. The Act has been printed separately, and can also be ordered from the Superintendent of Documents, Government Printing Office, Washington, D. C., 20402.

TYPE OF MODULATION OF MAIN CARRIER	TYPE OF TRANSMISSION	SYMBOL
Amplitude	With no modulation	A0
	Telegraphy without the use of a modulating audio frequency (by on-off keying)	A1
	Telegraphy by the on-off keying of an amplitude modulating audio frequency, or audio frequencies, or by the on-off keying of the modulated emission (special case: an unkeyed emission amplitude modulated).	A2
	Telephony	
	Double sideband	A3
	Single sideband, reduced carrier	A3A
	Single sideband, suppressed carrier	A3J
	Two independent sidebands	A3B
	Facsimile (with modulation of main carrier either directly or by a frequency modulated subcarrier).	A4
	Facsimile - single sideband, reduced carrier	A4A
	Television - vestigial sideband	A5C
	Multichannel voice-frequency telegraphy - single sideband, reduced carrier	A7A
	Cases not covered by the above, e.g., a combination of telephony and telegraphy - two independent sidebands	A9B
Frequency (or Phase)	Telegraphy by frequency shift keying without the use of a modulating audio frequency: one of two frequencies being emitted at any instant	F1
	Telegraphy by the on-off keying of a frequency modulating audio frequency or by the on-off keying of a frequency modulated emission (special case: an unkeyed emission, frequency modulated)	F2
	Telephony	F3
	Facsimile by direct frequency modulation of the carrier	F4
	Television	F5
	Four-frequency diplex telegraphy	F6
	Cases not covered by the above, in which the main carrier is frequency modulated.	F9

TYPE OF MODULATION OF MAIN CARRIER	TYPE OF TRANSMISSION	SYMBOL
Pulsed	A pulsed carrier without any modulation intended to carry information (e.g., radar)	P0
	Telegraphy by the on-off keying of a pulsed carrier without the use of a modulating audio frequency	P1D
	Telegraphy by the on-off keying of a modulating audio frequency or audio frequencies, or by the on-off keying of a modulated pulse carrier (special case: an unkeyed modulated pulsed carrier).	
	Audio frequency or audio frequencies modulating the amplitude of the pulses.	P2D
	Audio frequency or audio frequencies modulating the width (or duration) of the pulses.	P2E
	Audio frequency or audio frequencies modulating the phase (or position) of the pulses.	P2F
	Telephony	
	Amplitude modulated pulses	P3D
	Width (or duration) modulated pulses	P3E
	Phase (or position) modulated pulses	P3F
	Code modulated pulses (after sampling and quantization)	P3G
	Cases not covered by the above in which the main carrier is pulse modulated	P9

Table III. Classification of Typical Emissions.

GOOD RESOLUTIONS

When you make a good resolution, put it into effect at once. To postpone it is deadly. Anything that can be done next month or next year can be done *now* -- or at least a start can be made toward it.

Millions of people dream about doing fine, worthwhile things. But only a few hundred people ever get around to actually doing these things.

The few hundred may not be as smart as the others -- may not be as talented, as capable, or as well educated. But they *act* and achieve concrete results while the plans and good resolutions of the millions fade into nothing.

Remember this when you make plans -- when you make good resolutions. Put your plans and resolutions into effect at once. Get started!

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RADIO • TELEVISION COMMUNICATIONS

MAIL PROBLEMS

XMX

NATIONAL RADIO INSTITUTE • WASHINGTON, D. C.

MATH PROBLEMS

CXMX

STUDY SCHEDULE NO. CXMX

CPC1M768 **1968 EDITION** Printed in U. S. A.

This is the final lesson in your NRI course. No new concepts are introduced here. Instead, it is intended as a convenient review covering all types of questions you are likely to encounter in taking the FCC exam, which involve the use of mathematics. Using the various required formulas will not only serve to refresh your memory on certain points, but should serve as an excellent indicator to you of how thoroughly you have learned the material covered in preceding lessons.

This lesson also has another purpose; that is, as preparation for the examinations you will be required to take when applying for employment with many manufacturing and service organizations. This is often the first step in determining whether or not they can make use of your particular skills. If you fail the examination, there is little hope for employment with that concern.

These industry examinations also serve to point out exactly what we have told you throughout your training: Just to know the answer to a given question is not enough and is not an indication of skill. You must know the "hows" and "whys" of electronics to last long on any job. You may fool yourself by hurrying through lessons and learning just enough to answer the examination questions, but you won't fool an employer.

You have progressed too far now to permit any small difficulty to stand in your way. You can be justifiably proud of your accomplishments - a relatively small percentage of men have neither the ambition nor the courage to follow through to the end in a course of instruction such as you have completed.

Make this effort count. Don't hurry now, when success is so near. Remember, you can always study in haste and repent in leisure.

The lesson is divided into two parts. In the first part you will find 117 examination-type questions, generally arranged in an order of progressive difficulty.

When you have finished a problem, the correctness of your work can be verified by turning to the corresponding number in the second section of the lesson entitled "Answers."

It must be emphasized that this review is in no way intended as a "cram" device. Your training has been thorough and such practices are entirely unnecessary and undesirable. Although you may be able to pass a given exam by "cram" methods, and even obtain a job as a result of holding an FCC license, lack of real understanding becomes readily apparent to an employer and you would find yourself back where you started.

With this in mind, if you have difficulty with any problem, and if your understanding of the problem is still not perfectly clear after studying the answer, go back to the lesson text in which the material is covered and make a thorough review. For example, if you do not completely understand how a given formula is transposed, go back to the math book where the process is explained in detail. If you do not understand any part of the non-mathematical associated discussion, again go back to the original lesson text and review. The importance of this procedure cannot be over-emphasized.

When you have completed this lesson in the manner recommended and have sent your final exam to NRI for grading, make a final review of the rules and regulations contained in the Lessons 11CX and 12CX. If you do as we recommend, you will have no difficulty with the FCC exam.

Problems

1. State the three ordinary mathematical forms of Ohm's Law.

2. What is the resistance of a circuit if I = 5 amps and E = 30 volts?

3. If two resistors of 10 and 5 ohms are connected in series, what is the total resistance?

4. If two resistors of 10 and 15 ohms, respectively, are connected in parallel, what is their effective resistance?

5. A battery having an emf of 6 volts is connected in series with a 300-ohm resistor. What is the circuit current?

6. In a series dc circuit the current, as measured by an ammeter, is 0.05 ampere, and the resistance, as measured by an ohmmeter is 100 ohms. What is the applied emf?

7. Three resistors of 5, 10, and 20 ohms, are connected in parallel. What is their total effective resistance?

8. A 6-volt battery is to be charged at a 3-amp rate from a 115-volt line. What value of resistance should be connected in series with the battery?

9. The filament of a vacuum tube is rated at 250 ma and 5 volts. It is to be operated from a 6-volt battery. What is the value of the required series resistor?

10. The coil resistance of a relay is 600 ohms. The relay is designed to operate when 0.3 amp current passes through the coil. If operation is to be made from a 220-volt dc line, what value of resistance is needed in series with the coil?

11. Give the three basic formulas for calculating power in dc circuits.

12. What will be the heat dissipation, in watts, of a resistor of 50 ohms having a current of 0.2 amp passing through it?

13. What is the maximum rated current-carrying capacity of a resistor marked "5000 ohms 200 watts?"

14. If two 5-watt, 300-ohm resistors are connected in parallel, what are the power dissipation capabilities of the combination?

15. The input power to a transmitter is 500 watts. The radiated power from the antenna is 300 watts. What is the efficiency of the transmitter?

16. State the formula for determining (1) the quantity or charge of a capacitor; (2) the energy stored in a capacitor.

17. What is the formula used to determine the total capacitance of a group of capacitors connected in parallel?

18. What is the formula used to determine the total capacitance of a group of capacitors connected in series?

19. If capacitors of 5, 3, and 7 μf are connected in series, what is the total capacitance?

20. If capacitors of 10, 20, and 30 μf are connected in parallel, what is the total capacitance?

21. Given two identical mica capacitors of 0.2 μf capacitance each. One is charged to a potential of 116 volts and disconnected from the charging circuit. The charged capacitor is then connected in parallel with the uncharged capacitor. What voltage will appear across the two capacitors connected in parallel?

22. State the mathematical formula for the energy stored in the magnetic field surrounding an inductance carrying an electric current.

23. What is the formula for determining wavelength when the fre-

quency in kilocycles is known?

24. If the period of one complete cycle of a radio wave is 0.000001 second, what is the wavelength?

25. What is the effective value of a sine wave in relation to its peak value?

26. What is the seventh harmonic of 360 kc?

27. What factors must be known in order to determine the power factor of an alternating current circuit?

28. In a circuit consisting of an inductance having a reactance of 100 ohms and a resistance of 100 ohms, what will be the phase angle of the current with respect to the voltage?

29. State Ohm's Law for ac circuits.

30. Neglecting distributed capacitance, what is the reactance of a 6 millihenry choke coil at a frequency of 500 kc?

31. What is the reactance value of a capacitor of 0.02 μf at a frequency of 20 kc?

32. Given a series circuit consisting of a resistance of 4 ohms, an inductive reactance of 4 ohms, and a capacitive reactance of 1 ohm. The applied circuit alternating emf is 50 volts. What is the voltage drop across the inductance?

33. What is the impedance of a solenoid, if its resistance is 5 ohms and 0.3 amp flows through the winding when 110 volts at 60 cycles is applied to the solenoid?

34. State the formula for determining the resonant frequency of a circuit where the inductance and capacitance are known.

35. Given a series-resonant circuit consisting of a resistance of 6.5 ohms, and equal inductive and capacitive reactances of 175 ohms. What is the voltage drop across the inductance when the applied potential is 260 volts?

36. Given a series-resonant circuit consisting of a resistance of 6.5 ohms, and equal inductive and capacitive reactances of 175 ohms. What is the voltage drop across the resistance, assuming the applied circuit potential is 260 volts?

37. Explain how you would determine the value of cathode bias resistance necessary to provide correct grid bias for any particular amplifier.

38. Given the following vacuum tube constants, E_p = 1000 volts, I_p = 150 ma, I_g = 10 ma, and grid leak = 5000 ohms, what would be the value of dc grid-bias voltage?

39. What is the percentage regulation of a power supply with a no-load voltage output of 126.5 volts and a full-load voltage output of 115 volts?

40. If a 1500-kc radio wave is modulated by a 2000-cycle sine-wave tone, what frequencies are contained in the output wave?

41. State the formula for determining the percentage modulation in an AM system.

42. If a ship telephone station is assigned the frequency of 2738 kc and the maximum tolerance is 0.04 percent, what are the highest and lowest frequencies within the tolerance limits?

43. Define the term "decibel."

44. A ship radiotelephone transmitter operates on 2738 kc. At a certain point distant from the transmitter the 2738-kc signal has a measured field of 147 mv per meter. The second harmonic field at the same point is measured as 405 μv per meter. To the nearest whole unit in decibels, how much has the harmonic emission been attenuated below the 2738-kc fundamental?

45. If a superheterodyne receiver is tuned to a desired signal at 1000 kc, and its conversion oscillator is operating at 1300 kc, what would be

the frequency of an incoming signal which would possibly cause "image" reception?

46. How much energy is consumed in 20 hours by a radio receiver rated at 60 watts?

47. A 6-volt storage battery has an internal resistance of 0.01 ohm. What current will flow when a 3-watt, 6-volt lamp is connected?

48. What determines the synchronous speed of a synchronous motor?

49. A milliammeter with a full-scale deflection of 1 ma and a resistance of 25 ohms was used to measure an unknown current by shunting the meter with a four-ohm resistor. It then read 0.4 ma. What was the unknown current value?

50. If a 0-1 dc milliammeter is to be converted into a voltmeter with full-scale calibration 100 volts, what value of series resistance must be connected in series with the milliammeter?

51. If a heterodyne frequency meter, having a calibrated range of 1000 to 5000 kc, is used to measure the frequency of a transmitter operating on approximately 500 kc by measurement of the second harmonic of the transmitter, and the indicated measurement was 1008 kc, what is the actual frequency of the transmitter output?

52. If a frequency meter having an over-all error proportional to the frequency, is accurate to 10 cycles when set at 600 kc, what is its error in cycles when set at 1110 kc?

53. What is the total reactance of two inductors, connected in series, with zero mutual inductance?

54. If the mutual inductance between two coils is 0.1 henry, and the coils have inductances of 0.2 and 0.8 henry, respectively, what is the coefficient of coupling?

55. When two coils of equal inductance are connected in series with unity coefficient of coupling and their fields in phase, what is the total inductance of the two coils?

56. A potential of 110 volts is applied to a series circuit containing an inductive reactance of 25 ohms, a capacitive reactance of 10 ohms, and a resistance of 15 ohms. What is the phase relationship between the applied voltage and the current flowing in the circuit?

57. What is the reactance of a capacitor at the frequency of 1000 kc if the reactance is 600 ohms at 800 kc?

58. If an alternating current of 5 amp flows in a series circuit composed of 12 ohms resistance, 15 ohms inductive reactance, and 40 ohms capacitive reactance, what is the voltage drop across the circuit?

59. If a lamp, rated at 100 watts and 115 volts, is connected in series with an inductive reactance of 355 ohms and a capacitive reactance of 130 ohms across a voltage of 220 volts, what is the current value through the lamp?

60. If an ac series circuit has a resistance of 12 ohms, an inductive reactance of 7 ohms, and a capacitive reactance of 7 ohms, at the resonant frequency, what will be the total impedance at twice the resonant frequency?

61. A series circuit contains reactance, inductive reactance, and capacitive reactance. The resistance is 7 ohms, the inductive reactance is 8 ohms, and the capacitive reactance is unknown. What value of reactance must the capacitor have in order for the total circuit impedance to be 13 ohms?

62. If, in a given ac series circuit, the resistance, inductive reactance, and capacitive reactance are of equal magnitude of 11 ohms, and the frequency is reduced to 0.411 of its value of resonance, what is the re-

sultant impedance of the circuit at the new frequency?

63. If an alternating voltage of 115 volts is connected across a parallel circuit made up of a resistance of 30 ohms, an inductive reactance of 17 ohms, and a capacitive reactance of 19 ohms, what is the total current drain from the source?

64. A parallel circuit is made up of five branches, three of the branches being pure resistances of 7, 11, and 14 ohms, respectively. The fourth branch has an inductive reactance value of 500 ohms. The fifth branch has a capacitive reactance of 900 ohms. What is the total impedance of this network? If a voltage is impressed across this parallel network, which branch will dissipate the greatest amount of heat?

65. In a parallel circuit composed of an inductance of 150 microhenries and a capacitance of 160 micromicrofarads, what is the resonant frequency?

66. What value of capacitance must be shunted across a coil having an inductance of 56 microhenries in order that the circuit resonates at 5000 kc?

67. What is the stage amplification obtained with a single triode operating with the following constants: Plate voltage 250, plate current 20 milliamperes, plate impedance 5000 ohms, load impedance 10,000 ohms, grid bias 4.5 volts, and amplification factor 24?

68. If a preamplifier, having a 600 ohm output, is connected to a microphone so that the power output is -40 db, and assuming the mixer system to have a loss of 10 db, what must be the voltage amplification necessary in the line amplifier in order to feed 10 db into the transmitter line?

69. If a certain audio frequency amplifier has an over-all gain of 40 db, and the output is 6 watts, what is the input?

70. What is the power output of an audio amplifier if the voltage across the load resistance of 500 ohms is 40 volts?

71. If a transformer, having a turns ratio of 1:10, working into a load impedance of 2000 ohms, and out of a circuit having an impedance of 15 ohms, what value of resistance may be connected across the load to effect an impedance match?

72. What is the formula for determining the db loss or gain.

73. What unit has been adopted by leading program transmission organizations as a volume unit and to what power is this unit equivalent?

74. If a frequency doubler stage has an input frequency of 1000-kc, and the plate inductance is 60 microhenries, what value of capacitance is necessary for resonance, neglecting stray capacitances?

75. The dc input power to the final amplifier stage is exactly 1500 volts and 700 milliamperes. The antenna resistance is 8.2 ohms and the antenna current is 9 amperes. What is the plate efficiency of the final amplifier?

76. How is the inverse peak voltage to which the tubes of a full-wave rectifier will be subject, determined from the known secondary voltages of the power transformer? Explain.

77. If a power transformer has a primary voltage of 4400 volts, a secondary voltage of 220 volts, and an efficiency of 98%, when delivering 23 amperes of secondary current, what is the value of primary current?

78. Three single phase transformers, each with a ratio of 220 to 2200 volts, are connected across a 220-volt, three phase line, primaries in delta. If the secondaries are connected in Y, what is the sec-

ondary line voltage?

79. What is the predominant ripple frequency in the output of the single phase fullwave rectifier when the primary source of power is 110 volts at 60 cycles?

80. If a power supply has a regulation of 11% when the output voltage at full-load is 240 volts, what is the output voltage at no load?

81. If a power supply has an output voltage of 140 volts at no load, and the regulation at full load is 15%, what is the output voltage at full load?

82. A rectifier filter power supply is designed to furnish 500 volts at 60 milliamperes to one circuit, and 400 volts at 40 milliamperes to another circuit. The bleeder current in the voltage divider is to be 15 milliampere. What value of resistance should be placed between the 500 and 400-volt taps of the voltage divider?

83. A 600-kc X-cut crystal, calibrated at 50° C, and having a temperature coefficient of -20 parts per million per degree, will oscillate at what frequency when its temperature is 60°C?

84. A certain transmitter has an output of 100 watts. The efficiency to the final, modulated amplifier stage is 50%. Assuming that the modulator has an efficiency of 66%, what plate input to the modulator is necessary for 100% modulation of this transmitter? Assume that the modulator output is sinusoidal.

85. If you decrease the percentage of modulation from 100% to 50% by what percentage have you decreased the power in the side-bands?

86. If the power output of a modulator is decreased from 1000 watts to 10 watts, how is the power expressed in db?

87. Given a Class C amplifier with a plate voltage of 1000 volts, and a plate current of 150 milliamperes which is to be modulated by a Class A amplifier with a plate voltage of 2000 volts, plate current of 200 milliamperes and a plate impedance of 15,000 ohms. What is the proper turns ratio for the coupling (modulation) transformer?

88. If the transmission line current of an FM broadcast transmitter is 8.5 ampere without modulation, what is the transmission line current when the percentage of modulation is 90%?

89. If the conductors in a two-wire radio frequency transmission line are replaced by larger conductors, how is the surge impedance affected, assuming no charge in the center to center spacing of the conductor?

90. The power input to a 72-ohm concentric transmission line is 5000 watts. What is the RMS voltage between the inner conductor and sheath?

91. The power input to a 72-ohm concentric line is 5000 watts. What is the current flowing in it?

92. An antenna is being fed by a properly terminated two-wire transmission line. The current in the line at the input end is 3 amperes. The surge impedance of the line is 500 ohms. How much power is being supplied to the line?

93. A long transmission line delivers 10kw into an antenna; at the transmitter end, the line current is 5 amperes and at the coupling house, it is 4.8 amperes. Assuming the line to be properly terminated, and the losses in the coupling system negligible, what is the power loss in the line?

94. A 50kw transmitter employs six tubes in push-pull parallel in the final Class B linear stage, operating with a 50kw output and an efficiency of 33%. Assuming that all the heat radiation is transferred to the water cooling system, what amount of

power must be dissipated from each tube?

95. If the daytime transmission line current of a 10-kw transmitter is 12 amperes, and the transmitter is required to reduce to 5-kw at sunset, what is the new value of transmission line current?

96. If the power output of a broadcast station is quadrupled what effect will this have upon the field intensity at a given point?

97. What is the frequency swing of an FM broadcast transmitter when modulated 60%?

98. If an FM transmitter employs one doubler, one tripler, and one quadrupler, what is the carrier frequency swing when the oscillator frequency swing is 2-kc?

99. An FM broadcast transmitter operating on 98.1 megacycles has a reactance tube modulated oscillator operating on a frequency of 4905-kc. What is the oscillator frequency swing when the transmitter is modulated 100% by a 2000-cycle tone?

100. An FM broadcast transmitter is modulated 50% by a 7000-cycle test tone. When the frequency of the test tone is changed to 5000 cycles and the percentage of modulation is unchanged, what is the transmitter frequency swing?

101. An FM broadcast transmitter is modulated 40% by a 5000-cycle test tone. When the percentage of modulation is doubled, what is the frequency swing of the transmitter?

102. What is the approximate speed of a 220-volt, 60-cycle, 4-pole, 3-phase induction motor?

103. What is the ohms per-volt of a voltmeter constructed of a zero-1 dc milliammeter and a suitable resistor which makes the full-scale reading of the meter 500 volts?

104. A current squared meter has a scale divided into 50 equal divisions. When 45 milliamperes flows through the meter, the deflection is 45 divisions. What is the current flowing through the meter when the scale deflection is 25 divisions?

105. If a heterodyne frequency meter, having a straight line relation between frequency and dial reading, has a dial reading of 31.7 for a frequency of 1390-kc, and a dial reading of 44.5 for a frequency of 1400-kc, what is the frequency of the ninth harmonic of the frequency corresponding to a scale reading of 41.2?

106. If a broadcast station receives a frequency measurement report indicating that the station frequency was 45 cycles low at a certain time, and the transmitter log for the same time, shows the measured frequency to be 5 cycles high, what is the error of the station frequency monitor?

107. If the two towers of a 950-kc directional antenna are separated by 120 electrical degrees, what is the tower separation in feet?

108. What must be the height of a vertical radiator one-half wavelength high if the operating frequency is 1100-kc?

109. If the vertical antenna is 405 feet high and is operated at 1250-kc, what is the physical height, expressed in wavelength?

110. If the field intensity of 25 millivolts per-meter develops 2.7 volts in a certain antenna, what is its effective height?

111. If the power output of a broadcast station has been increased so that the field intensity at a given point is doubled, what increase has taken place in antenna current?

112. If the day input power to a certain broadcast station antenna having a resistance of 20 ohms is 2000 watts, what would be the night input power if the antenna current were cut in half?

113. If the antenna current of a

station is 9.7 amperes for 5 kilowatts, what is the current necessary for a power of 1-kilowatt?

114. What is the antenna current when a transmitter is delivering 900 watts into an antenna having a resistance of 16 ohms?

115. The ammeter connected at the base of a Marconi Antenna has a certain reading. If this reading is increased 2.77 times, what is the increase in output power?

116. An FM broadcast transmitter has 370 watts plate power input to the last radio frequency stage and an antenna field gain of 1.3. The efficiency of the last radio frequency stage is 65% and the efficiency of the antenna transmission line is 75%. What is the effective radiated power?

117. What is the effective radiated power of a television broadcast station if the output of the transmitter is 1000 watts, the antenna transmission line loss is 50 watts and the antenna power gain is 3?

Answers

1. $E = IR$, $R = \frac{E}{I}$ and $I = \frac{E}{R}$

2. Using Ohm's Law, $R = \frac{E}{I}$, by substitution,

$$R = \frac{30}{5} = 6 \text{ ohms.}$$

3. Resistors in series add. Thus, $R_t = R_1 + R_2 + \text{etc.}$ Substituting the values given, $R_t = 10 + 5 = 15$ ohms (R_t = total resistance).

4. For two resistors connected in parallel, the total effective resistance can be determined by using the formula

$$R_t = \frac{R_1 R_2}{R_1 + R_2}$$

where R_t is the total effective resistance and R_1 and R_2 represent the individual resistors. Substituting the values given,

$$R_t = \frac{10 \times 15}{10 + 15} = \frac{150}{25} = 6 \text{ ohms}$$

5. $I = \frac{E}{R} = \frac{6}{300} = 0.02 \text{ amp} = 20 \text{ ma.}$

6. $E = IR = 0.05 \times 100 = 5$ volts.

7. When more than two resistors are connected in parallel, the following formula is used to determine the total effective resistance.

$$R_t = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \text{etc.}}$$

Substituting the values given,

$$R_t = \frac{1}{\frac{1}{5} + \frac{1}{10} + \frac{1}{20}}$$

$$= \frac{1}{0.2 + 0.1 + 0.05}$$

$$= \frac{1}{0.35}$$

$$= 2.86 \text{ ohms}$$

This problem could also be solved by finding a lowest common denominator in the fractional denominator in the first step, Thus,

$$R_t = \frac{1}{\frac{1}{5} + \frac{1}{10} + \frac{1}{20}}$$

$$= \frac{1}{\frac{4}{20} + \frac{2}{20} + \frac{1}{20}}$$

$$= \frac{1}{\frac{7}{20}}$$

Then, inverting and multiplying,

$$R_t = \frac{1 \times 20}{7} = \frac{26}{7} = 2.86 \text{ ohms}$$

8. Because the battery is the 6-volt type, the resistor must "drop" the remaining 109 volts available from the line. (115-6) From Ohm's Law we have the simple relation that

$$R = \frac{E}{I}$$

By substituting the values from our problem in this formula, we obtain

$$R = \frac{109}{3}$$

$$= 36.3 \text{ ohms}$$

9. This problem is very similar to No. 8. The supply voltage is 6 volts and we need 5 volts. The resistor must, therefore, drop 1 volt. By Ohm's Law,

$$R = \frac{E}{I}$$

$$= \frac{1}{0.25}$$

$$= 4 \text{ ohms}$$

10. During normal operation, the voltage drop across the coil is

$$E = IR = 0.3 \times 600 = 180 \text{ volts}$$

Thus, the series resistor must drop 220 - 180 = 40 volts. Again, by simple Ohm's Law,

$$R = \frac{E}{I}$$

$$= \frac{40}{0.3}$$

$$= 133.3 \text{ ohms}$$

11. $P = EI \quad P = I^2R \quad P = \frac{E^2}{R}$

12. In this problem we are given I and R. Thus, we use the formula

$$P = I^2R$$
$$= (0.2)^2 \times 50$$
$$= 0.04 \times 50$$
$$= 2 \text{ watts}$$

13. Returning to the basic formula $P = I^2R$, in this problem we know P and R. The job is to find the value of I.

If we divide both sides of the basic formula by R, we obtain,

$$\frac{P}{R} = I^2$$

Then, to find I, we must eliminate the square. We can do this by taking the square root of both sides of the equation. When this is done,

$$I = \sqrt{\frac{P}{R}}$$

since the square root of a square is the quantity itself. Substituting the values originally given,

$$I = \sqrt{\frac{200}{5000}}$$

$$= 0.04$$

$$= 0.2 \text{ ampere}$$

14. Each resistor is able to handle five watts without overheating. This dissipation capability is unaffected by the method of connection. The two resistors, either in series or parallel, can, therefore, dissipate a total of 10 watts.

15. The efficiency of any device is equal to the useful output power divided by the input power. The trans-

mitter efficiency in this problem is therefore,

$$\frac{300}{500} = 0.6, \text{ or } 60\%$$

16. (1) The quantity of electricity is given by the formula

$$Q = CE$$

where Q is in coulombs, C is in farads, and E is in volts. (2) The energy stored in a capacitor is expressed by the formula

$$W = \frac{1}{2}E^2C$$

where W is expressed in joules. One joule is defined as the energy expended in one second by an electric current of one ampere through a resistance of one ohm.

17. $C_t = C_1 + C_2 + C_3$, etc.

18. $$C_t = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \text{etc.}}$$

19. $$C_t = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$$

By substitution,

$$C_t = \frac{1}{\frac{1}{5} + \frac{1}{3} + \frac{1}{7}}$$

The LCD (lowest common denominator) for 5, 3, and 7 is 105. Thus,

$$C_t = \frac{1}{\frac{21}{105} + \frac{35}{105} + \frac{15}{105}}$$

$$= \frac{1}{\frac{71}{105}}$$

$$= \frac{105}{71}$$

$$= 1.48 \ \mu f$$

20. $C_t = 10 + 20 + 30$
$= 60 \ \mu f$

21. The formula $Q = CE$ can be transposed to

$$E = \frac{Q}{C}$$

We can then see that when C is doubled, by the parallel connection, E is halved. The voltage across the two capacitors in parallel is, therefore, 58 volts.

22. $$W = \frac{1}{2}LI^2$$

where L = inductance in henries
I = current in amperes
W = energy in joules

23. $$\lambda = \frac{300{,}000}{f} \text{ (kc)}$$

where λ = wavelength in meters (Greek letter Lambda)

f = frequency

24. We must first determine frequency in cycles per second. The frequency is equal to the reciprocal of the period of one complete cycle. Thus,

$$f \text{ (cps)} = \frac{1}{0.000001} = 1{,}000{,}000 \text{ cps}$$

Then, because 1,000,000 cps equals 1000 kc, we can use the formula previously given to find wavelength, that is,

$$\lambda = \frac{300{,}000}{1000} = 300 \text{ meters}$$

A more direct solution of the prob-

lem is to recall that electromagnetic waves travel 300,000,000 meters per second. In 0.000001 second, the wave must, therefore, travel

$300{,}000{,}000 \times 0.000001 = 300$ meters

25. The effective (RMS) value of a sine wave is equal to 0.707 times the peak value. If the RMS value is applied to a resistance, it produces the same heating effect as an equal dc value.

26. A harmonic is defined as a multiple of the fundamental frequency, in this case, 360 kc. The 7th harmonic is, therefore, the 7th multiple of 360 kc,

$$7 \times 360 = 2520 \text{ kc}$$

27. The power factor can be determined when we know any of the following:

a. The ratio of true power (as measured by a wattmeter) to apparent power, as measured by a voltmeter and ammeter.

$$\text{pf} = \frac{P}{EI}$$

b. The ratio of resistance to impedance

$$\text{pf} = \frac{R}{Z}$$

c. The phase angle, Θ (pf = cos Θ)

d. The values of resistance and reactance. We then use these values to determine Z and then find the pf as in b.

28. When the reactance and resistance of a circuit are equal, the phase angle is 45°. If the reactance is greater than the resistance, the phase angle is some value between 45° and 90°. If the reactance is less than the resistance, the phase angle is some value between 0° and 45°.

29. $I = \frac{E}{Z}$ $Z = \frac{E}{I}$ $E = IZ$

where Z = circuit impedance in ohms.

30. The formula for determining inductive reactance X_L in ohms is

$$X_L = 2\pi fL$$

where 2π = a constant equal to approximately 6.28.

f = frequency in cycles per second

L = inductance in henries

Substituting the values given,

$$X_L = 6.28 \times 5 \times 10^5 \times 6 \times 10^{-3}$$
$$= 188.4 \times 10^2$$
$$= 18{,}840 \text{ ohms}$$

31. The formula for finding capacitive reactance is

$$X_C = \frac{1}{2\pi fC}$$

where X_C = capacitive resistance in ohms

2π = a constant equal to approximately 6.28

f = frequency in cycles per second

C = capacitance in farads

Substituting the values,

$$X_C = \frac{1}{6.28 \times 2 \times 10^{-8} \times 2 \times 10^4}$$

$$= \frac{1}{25.12 \times 10^{-4}}$$

$$= 398 \text{ ohms, approximately}$$

32. The formula for determining

the voltage drop across the inductance is

$$E_L = IX_L$$

where E_L = voltage drop across inductance L

I = current in amperes through L
X_L = inductive reactance of L in ohms.

To use this formula, we must first determine circuit current. Because this is a series ac circuit the same current exists in all parts of the circuit and is equal to the ratio E ÷ Z. Impedance Z, in turn, is equal to

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$
$$= \sqrt{4^2 + (4 - 1)^2}$$
$$= \sqrt{4^2 + 3^2}$$
$$= \sqrt{16 + 9}$$
$$= \sqrt{25}$$
$$= 5 \text{ ohms}$$

Then, I = E ÷ Z = 50 ÷ 5 = 10 amperes. Finally, we go back to the original formula given:

$$E_L = IX_L$$
$$= 10 \times 4$$
$$= 40 \text{ volts}$$

33. In this case, Z is given by the basic relation Z = E ÷ I. Substituting given values in this equation:

$$Z = \frac{110}{0.3} = 367 \text{ ohms, approximately.}$$

34. $$f = \frac{1}{2\pi\sqrt{LC}}$$

where f = frequency in cycles per second
L = inductance in henries
C = capacitance in farads

35. The basic formula for impedance is $Z = \sqrt{R^2 + X^2}$. Obviously, if $X^2 = 0$, then Z = R, because the square root of a value squared is equal to the value itself. Thus, in the problem being considered, Z = 6.5 ohms, and by basic Ohm's Law, I = E ÷ Z = 260 ÷ 6.5 = 40 amperes. Then $E_L = IX_L = 40 \times 175 = 7000$ volts.

36. Because X_L and X_C are equal, the voltage drops developed across them cancel. Also, because we are dealing with a simple series circuit in which the sum of the voltage drops around the circuit is equal to the applied voltage, the entire 260 volts of applied emf must be dropped across the resistor.

37. The value of grid bias voltage is equal to

$$E_{CC} = IR_K$$

and,

$$R_K = E_{CC} \div I$$

where E_{CC} = desired grid bias voltage in volts
I = total current passing through cathode bias resistor in amps. R_K = resistance of cathode bias resistor in ohms.
Note: "I" may include plate and screen grid currents.

38. In this problem, notice that E_p and I_p are of no concern. The dc grid-bias voltage is determined entirely by grid current I_g and the value of the grid leak. Thus,

$$E_{CC} = I_g R_g$$
$$= 0.01 \times 5000$$
$$= 50 \text{ volts}$$

39. The voltage regulation of a device is defined as the change in

voltage between full load and no load divided by the full-load voltage. To express regulation as a percentage regulation, as determined above, it is multiplied by 100. Thus, in our problem,

Percentage Regulation

$$= \left(\frac{126.5 - 115}{115}\right) 100$$

$$= \left(\frac{11.5}{115}\right) 100$$

$$= 0.1 \times 100$$

$$= 10\%$$

40. Assuming amplitude modulation is used, there will be the carrier frequency of 1500 kc and two sidebands, one 2 kc below the carrier and the other, 2 kc above the carrier. If FM is used, additional sidebands spaced at 2 kc intervals are also present. The number of such sidebands that need be considered depends on the modulation index.

41. Percentage modulation

$$= \left(\frac{E_{max} - E_{min}}{E_{max} + E_{min}}\right) 100$$

where E_{max} and E_{min} are the maximum and minimum values of the modulation envelope.

42. The first step is to determine the maximum permissible deviation from the assigned frequency,

$$0.0004 \times 2738 = 1.0952 \text{ kc}$$

Notice here that 0.04 percent is written as 0.0004 because percent means "by the hundred". Thus 0.04 means four hundredth parts of a quantity or number. The word "percent" or the symbol % thus does the job of two decimal places. The upper frequency limit is then

$$2738 + 1.0952 = 2739.0952 \text{ kc}$$

and the lower frequency limit is

$$2738 - 1.0952 = 2736.9048 \text{ kc}$$

43. The decibel is a unit used to express the ratio between two sound or electric power levels. The formula for calculating decibels (db) is

$$db = 10 \log_{10} \frac{P_1}{P_2}$$

where P_1 is generally the larger power. If amplification is involved, db becomes a plus (+) value, that is, simply db. If attenuation is involved, db is preceded by the negative (-) sign. Decibels can also be used to express the ratio between two voltages or two currents as follows:

$$db = 20 \log_{10} \frac{E_1}{E_2}$$

and

$$db = 20 \log_{10} \frac{I_1}{I_2}$$

In both of the above forms of the db equation, the two voltages or two currents involved must be measured at points of equal impedance.

In working with db in power problems, the following relations are useful to remember: an increase of 10 db increases power 10 times; an increase of 3db doubles the power, and a decrease of 3 db (-3 db) cuts power in half.

When working with voltages or currents, double the number of db involved to retain the same relationship. For example, an increase of 20 db increases E and I 10 times; an increase of 6 db doubles E and I; etc.

44. To have both the fundamental and harmonic field strength stated in the same units, we will first convert the signal strength, given in mv per meter, to μv per meter. This is accomplished simply by moving the decimal point three places to the right, so that 147 mv becomes 147,000 μv per meter. We now use the correct db formula using two voltages. Thus,

$$db = 20 \log_{10} \frac{147{,}000}{405}$$

$$= 20 \log_{10} 363$$

Because there are three places to the left of the decimal point, the characteristic for 363 is 2. From a table of logs we find the mantissa is 0.5599. Thus, the log of 363 is 2.5599, and

$$db = 20\ (2.5599)$$
$$= 51.2 \text{ approximately}$$

If no log tables are available, we can estimate the answer from the relationships previously given. Multiplying 405 μv/m by 10 represents an increase of 20 db, and gives a value of 4050 μv/m. Multiplying again by ten gives us 40,500 μv/m and represents 40 db. If we double this value, it becomes 81,000 μv/m and represents 40 + 6 = 46 db. Doubling the voltage again gives a value of 162,000 μv/m and represents 46 + 6 = 52 db. This is somewhat higher than the 147,000 μv/m in our problem, but provides us with a reasonable estimate.

45. An image frequency lies as far above the oscillator frequency as the signal frequency does below the oscillator frequency. The difference between the desired signal and the oscillator frequency is called the "intermediate frequency." This intermediate frequency is equal to the difference between the image and oscillator frequencies. The image frequency is equal to the signal frequency plus twice the intermediate frequency.

In this problem, the i-f frequency is equal to 1300 - 1000 = 300 kc. The image frequency is then equal to 2(300) + 1000 = 1600 kc.

46. The watt hour is the unit used to measure work done in an electrical circuit. It is equal to the product of the circuit power in watts and time in hours. Thus, in this problem;

$$60 \times 20 = 1200 \text{ watt hours.}$$

This answer may also be expressed as 1.2 kilowatt hours.

47. By Ohm's Law, I = E ÷ R, where R is equal to the internal resistance of the battery plus the resistance of the light bulb. The resistance of the bulb is found by using the formula

$$R = \frac{E^2}{P}$$

$$= \frac{6^2}{3}$$

$$= 12 \text{ ohms}$$

The total resistance then is 12 + 0.01 = 12.01 ohms, and the circuit current is,

$$I = E \div R$$
$$= 6 \div 12.01$$
$$= 0.4996 \text{ ampere or,}$$

for practical purposes 0.5 ampere.

48. The number of poles and the frequency of the supply voltage. The speed in revolutions per minute is equal to 60 times the frequency di-

vided by the number of pairs of poles, that is

$$rpm = 60 \times f \div N$$

where N is the number of pairs of poles.

49. By Ohm's Law, the voltage drop is equal to IR. Thus,

$$E = IR = 0.0004 \times 25 = 0.01 \text{ volt}$$

Because the same voltage exists across all branches of a parallel circuit, the same 0.01 volt must act across the shunt so that the current through the shunt is,

$$I = E \div R = 0.01 \div 4 = 2.5 \text{ ma}$$

The unknown current value must, then, be the sum of the currents through the meter and through the shunt, that is,

$$0.4 + 2.5 = 2.9 \text{ ma}$$

50. The added value of resistance must be such that when 100 volts is applied across the meter, no more than 1 ma current passes through the meter. Thus,

$$R = E \div I = 100 \div 0.001 = 100{,}000 \text{ ohms.}$$

51. The second harmonic is 1008 kc, the fundamental must be $1008 \div 2 = 504$ kc.

52. To find the error, which is proportional to frequency, we set up the following proportion:

$$\frac{10}{X} = \frac{600}{1110}$$

and by cross multiplication

$$600X = 11{,}110$$
$$X = 18.5 \text{ cps}$$

53. The basic formula that applies in this case is

$$L_t = L_1 + L_2 \pm 2M$$

where M is the mutual inductance, and L_1 and L_2 are the inductance of the two inductors. The formula indicates that if M = O, then L_t is simply the sum of $L_1 + L_2$.

If the lines of force from one coil link the turns of the other, M is no longer zero, but assumes a definite value and must be considered in problems such as the above. If the fields aid each other, we use + 2M, and if the fields oppose each other, -2M.

54. The coefficient of coupling, designated k, is a measure of the degree of coupling between two circuits, and has a value ranging from 0 to 1. The two extremes indicate no coupling and maximum possible coupling, respectively. The formula for k is,

$$k = \frac{M}{\sqrt{L_1 L_2}}$$

when M is the mutual inductance in henries, L_1 and L_2 are the inductances of two coils in henries, and k is the coefficient of coupling, expressed as a pure number (dimensionless). Substituting the values given,

$$k = \frac{0.1}{\sqrt{0.2 \times 0.8}}$$
$$= \frac{0.1}{\sqrt{.16}}$$
$$= .1 \div .4$$
$$= 0.25$$

55. The mutual inductance between the two coils is found by simply transposing the formula given for k. This is accomplished by multiplying both sides of the equation by the square root of $L_1 L_2$. Thus,

$$M = k\sqrt{L_1 L_2}$$

Because k is given as unity (1), and L_1 is given as equal to L_2, the mutual inductance M is equal to the value of either L_1 or L_2. Thus, the total inductance is equal to four times the inductance of either coil. This can be seen in the equation

$$L_t = L_1 + L_2 + 2M$$

when M = L. Thus,

$$L_t = L_1 + L_2 + 2L$$
$$= 4L$$

56. The phase angle is equal to the angle whose tangent is equal to X + R. In the above problem the total reactance is 25 - 10 = 15. Then the ratio X + R = 15 + 15 = 1. From a set of trigonometric tables, the angle is found to be 45°. Just remember, in any circuit where X = R, the phase angle is 45°. If the reactance is predominantly inductive, as in this problem, the 45° phase angle is said to be a "leading" phase angle. If capacitive reactance predominates, voltage lags current and the 45° phase angle is then "lagging". In either case, notice that "lead" or "lag" refers to the voltage in the circuit.

57. The reactance of a capacitor varies inversely with frequency; as frequency increases X_C decreases, and as frequency decreases, X_C increases. Thus, we can write,

$$\frac{600}{X} = \frac{1000}{800}$$

where $X = X_C$ at 1000 kc. Cross-multiplying,

$$1000 \times = (600 \times 800)$$
$$1000 \times = 480{,}000$$
$$\times = 480 \text{ ohms}$$

58. The formula used in this solution of problems of this type is very similar to the formula for determining the impedance of an ac circuit. Mathematically,

$$E = E_R^2 + E_X^2$$

where E_X^2 is the algebraic sum of the voltages across the reactances. The voltage developed across the various elements are:

$$E_R = IR = 5 \times 12 = 60 \text{ volts}$$

$$E_L = IX_L = 5 \times 15 = 75 \text{ volts}$$

$$E_C = IX_C = 5 \times 40 = 200 \text{ volts}$$

Substituting these values in the previously given formula,

$$E = (60)^2 + (200 - 75)^2$$

$$= (60)^2 + (125)^2$$

$$= 19{,}225$$

$$= 138.6 \text{ volts}$$

59. Circuit current can only be determined after the lamp resistance and circuit impedance are known. The formula used for resistance is

$$R = \frac{E^2}{P} = \frac{(115)^2}{100} = 132.2 \text{ ohms}$$

This value is then used in the standard formula for impedance,

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$= \sqrt{(132.2)^2 + (355 - 130)^2}$$

$$= \sqrt{(132.2)^2 + (225)^2}$$

$$= \sqrt{17477 + 50625}$$

$$= \sqrt{68102}$$

$$= 261 \text{ ohms}$$

As a final step,

$$I = \frac{E}{Z} = \frac{220}{261} = 0.843 \text{ ampere}$$

60. Inductive reactance is directly proportional to frequency and capacitive reactance is inversely proportional to frequency. Therefore, X_L is doubled, and X_C is halved when the frequency is doubled. Under these conditions,

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$= \sqrt{(12)^2 + (14 - 3.5)^2}$$

$$= \sqrt{144 + 110.25}$$

$$= \sqrt{254.25}$$

$$= 15.9 \text{ ohms}$$

61. The standard formula for impedance is

$$Z = \sqrt{R^2 + X^2}$$

To find X, we first square both sides of the equation

$$Z^2 = R^2 + X^2$$

then subtract R^2 from both sides

$$Z^2 - R^2 = X^2$$

and finally take the square root of both sides

$$X = \sqrt{Z^2 - R^2}$$

where X = total circuit reactance.

Substituting the values given,

$$X = \sqrt{(13)^2 - (7)^2}$$

$$= \sqrt{169 - 49}$$

$$= \sqrt{120}$$

$$= 10.96 \text{ ohms}$$

The value of 10.96 ohms can represent either an inductive reactance (+) or a capacitive reactance (-), but we know we are looking for X_C so X is negative. Then, because

$$X = X_L - X_C = 10.96$$

$$= 8 - X_C$$

and

$$X_C = 18.96 \text{ ohms}$$

62. As noted before, X_L is directly proportional to frequency and X_C is inversely proportional to frequency. When the frequency (f) is reduced to 0.411 its value at resonance, therefore, is

$$X_L = 0.411 \times 11 = 4.52 \text{ ohms}$$

$$X_C = 11 + 0.411 = 26.7 \text{ ohms}$$

and $$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$= \sqrt{(11)^2 + (26.7 - 4.52)^2}$$

$$= \sqrt{(11)^2 + (22.2)^2}$$

$$= \sqrt{121 + 493}$$

$$= \sqrt{614}$$

$$= 24.8 \text{ ohms}$$

63. Because the same voltage acts across all branches of a parallel circuit

$I_R = E \div R = 115 \div 30 = 3.83A$

$I_L = E \div X_L = 115 \div 17 = 6.76A$

$I_C = E \div X_C = 115 \div 19 = 6.05A$

The total current drain is then equal to the vector sum of the branch currents, that is,

$$I_{total} = \sqrt{I_R^2 + (I_L - I_C)^2}$$
$$= \sqrt{(3.83)^2 + (6.76 - 6.05)^2}$$
$$= \sqrt{15.27}$$
$$= 3.91 \text{ amperes}$$

64. If we assume an applied voltage of 100 volts,

$I_1 = E \div R_1 = 100 \div 7 = 14.28$ amps

$I_2 = E \div R_2 = 100 \div 11 = 9.09$ amps

$I_3 = E \div R_3 = 100 \div 14 = 7.14$ amps

$I_4 = E \div X_L = 100 \div 500 = 0.2$ amps

$I_5 = E \div X_C = 100 \div 900 = 0.111$ amp

The currents through the three resistors are in phase and can be added directly. Thus,

$I_R = I_1 + I_2 + I_3$

$= 14.28 + 9.09 + 7.14 = 30.5$ amps

Then, because $I_4 = I_L$ and $I_5 = I_C$,

$$I_{total} = \sqrt{I_R^2 + (I_L - I_C)^2}$$
$$= \sqrt{(30.5)^2 + (0.2 - 0.111)^2}$$
$$= \sqrt{(30.5)^2 + (0.09)^2}$$
$$= \sqrt{930 + .0081}$$
$$= \sqrt{930}$$
$$= 30.5 \text{ amperes}$$

Knowing E and I, we can write

$$Z = E \div I$$
$$= 100 \div 30.5$$
$$= 3.28 \text{ ohms}$$

Ideally, a capacitor or inductor dissipate no heat. The greatest heat is, therefore, dissipated in one of the resistive branches and is proportional to the power consumed, or to the product of EI. Because E is the same for all branches of a parallel circuit, I is the only value we need consider. The greatest current is in the 7-ohm resistor, and this branch must dissipate the most heat.

65. The resonant frequency of an LC circuit is found by using the formula

$$f = \frac{1}{2\pi\sqrt{LC}}$$

where 2π = constant, approximately 6.28. Thus, in the given problem,

$$f = \frac{1}{6.28\sqrt{1.5 \times 10^{-4} \times 1.6 \times 10^{-10}}}$$
$$= \frac{1}{6.28\sqrt{2.4 \times 10^{-14}}}$$
$$= \frac{1}{6.28 \times 1.55 \times 10^{-7}}$$
$$= \frac{1 \times 10^7}{9.73}$$
$$= 1028 \text{ kc}$$

66. To find the value of C, the formula used in problem 65 is transposed as follows:

First, squaring both sides to remove the radial sign,

$$f^2 = \frac{1}{(2\pi)^2 LC}$$

Then, multiplying both sides of the equation by C and dividing both sides by f^2,

$$C = \frac{1}{4\pi^2 Lf^2}$$

Substituting values given in the problem

$$C = \frac{1}{4(3.14)^2 \times 56 \times 10^{-6} \times (5 \times 10^6)^2}$$

$$= 18.1\ \mu\mu f$$

67. Stage amplification of a single triode is determined by using the formula

$$A = \frac{\mu R_L}{r_p + R_L}$$

where A = stage gain

μ = amplification factor of triode

r_p = dynamic plate resistance of triode

R_L = plate load resistor

By substitution then,

$$A = \frac{2.4 \times 10^1 \times 1 \times 10^4}{5000 + 10{,}000}$$

$$= \frac{2.4 \times 10^5}{15{,}000}$$

$$= \frac{2.4 \times 10^5}{1.5 \times 10^4}$$

$$= \frac{2.4 \times 10^1}{1.5}$$

$$= 16$$

68. The total loss in db is

$$-40 + (-10) = -50 \text{ db}$$

Then, we can write

$$-50 + X = 10$$

$$X = 60$$

where X = required gain in db.

Using the basic formula for gain A,

$$db = 20 \log A$$

and substituting

$$60 = 20 \log A$$

$$\log A = \frac{60}{20}$$

$$\log A = 3$$

$$A = \text{antilog } 3$$

$$= 1000$$

69. The formula to use here is

$$db = 10 \log \frac{P_1}{P_2}$$

The output is, obviously P_1 and is, therefore, 6 watts. Thus, in our problem here we can write

$$40 = 10 \log \frac{6}{P_2}$$

$$\log \frac{6}{P_2} = \frac{40}{10}$$

$$\frac{6}{P_2} = \text{antilog } 4$$

$$\frac{6}{P_2} = 10{,}000$$

$$P_2 = \frac{6}{10{,}000}$$

$$= 0.0006 \text{ watts}$$

$$= 600\ \mu \text{ watts}$$

70. This problem is readily solved by using the formula

$$P = \frac{E^2}{R}$$

$$= \frac{40^2}{500}$$

$$= \frac{1600}{500}$$

$$= 3.2 \text{ watts}$$

71. A 15-ohm impedance is connected across the transformer primary. Using the formula

$$Z_S = Z_p \text{ (turns ratio)}^2$$

or

$$Z_S = Z_p \left(\frac{N_S}{N_p}\right)^2$$

where Z_S and Z_p = secondary and primary impedances, respectively, and N_p and N_S = number of primary and secondary turns, respectively, we first find the reflected impedance into the secondary.

$$Z_S = 15 \left(\frac{10}{1}\right)^2$$

$$= 15 \times 10^2$$

$$= 1500 \text{ ohms}$$

For a correct impedance match it is, therefore, necessary that $Z_S = 1500$ instead of 2000 ohms as given in the problem. Now we know that when two impedances are connected in parallel, the effective resistance R_E is equal to

$$R_E = \frac{R_1 R_2}{R_1 + R_2}$$

We already know R_E (1500 ohms) and R_1 (2000 ohms), so the problem is to find R_2. First, multiply both sides of the equation by $(R_1 + R_2)$,

$$R_E (R_1 + R_2) = R_1 R_2$$

Performing the indicated multiplication in the left side of the equation,

$$R_E R_1 + R_E R_2 = R_1 R_2$$

The quantity R_2 now appears on both sides of the equation, but we want it to appear only on one side, by itself, as the unknown. Thus, we must eliminate one of the R_2's. To do this, first subtract $R_E R_2$ from both sides of the equation so that

$$R_E R_1 = R_1 R_2 - R_E R_2$$

Next, factor R_2 in the right side of the equation,

$$R_E R_1 = R_2 (R_1 - R_E)$$

Then divide both sides by $R_1 - R_E$,

$$\frac{R_E R_1}{R_1 - R_E} = R_2$$

Substituting our known values

$$R_2 = \frac{1500 \quad (2000)}{2000 - 1500}$$

$$= \frac{(1.5 \times 10^3)(2 \times 10^3)}{500}$$

$$= \frac{3 \times 10^6}{5 \times 10^2}$$

$$= \frac{3 \times 10^4}{5}$$

$$= 0.6 \times 10^4$$

$$= 6000 \text{ ohms}$$

72. Power gain or loss

$$= 10 \log \frac{P_1}{P_2} \text{ db}$$

When voltages and currents are used in the equation, they must be measured at points of equal impedance and the numerical multiplier is 20 instead of 10.

Thus, voltage gain or loss

$$= 20 \log \frac{E_1}{E_2} \text{ db}$$

and, current gain or loss

$$= 20 \log \frac{I_1}{I_2} \text{ db}$$

73. The volume unit designated VU. The reference level, OVU, is 1 milliwatt in 600 ohms.

74. The formula for finding the resonant frequency f_r is,

$$f_r = \frac{1}{2\pi \sqrt{LC}}$$

and by transposition,

$$C = \frac{1}{4\pi^2 f_r^2 L}$$

Substituting given values,

$$C = \frac{1}{4 \times (3.14)^2 \times (2 \times 10^6)^2 \times 6 \times 10^{-5}}$$

$$= \frac{1}{4 \times 9.86 \times 4 \times 10^{12} \times 6 \times 10^{-5}}$$

$$= \frac{1}{946.56 \times 10^7}$$

$$= \frac{1 \times 10^{-7}}{947}$$

$$= 106 \ \mu\mu f$$

75. Plate efficiency expressed as a percentage

$$\left(\frac{P_o}{P_i}\right) 100$$

where P_o and P_i = output and input power, respectively.

In turn, $P_o = I^2 R$

$$= 9^2 \times 8.2$$

$$= 664 \text{ watts}$$

and $P_i = EI$

$$= 1.5 \times 10^3 \times 7 \times 10^{-1}$$

$$= 10.5 \times 10^2$$

$$= 1050 \text{ watts}$$

Then, plate efficiency $= \frac{664}{1050} \times 100$

$= 63.2$ percent

76. The inverse peak voltage across the nonconducting tube is the rms value (peak-to-peak ac voltage) of the entire secondary winding times 1.414, less the drop in the conducting tube.

If the drop across the tube is not specified in a problem, the answer is found by simply multiplying the rms voltage value by 1.414.

77. With 98 percent efficiency, the power output of the secondary is

$$P_o = \frac{220 \times 23}{0.98}$$

$$= 5163 \text{ watts}$$

The same power must be delivered to the primary. Knowing the values of P and E,

$$I = P \div E$$
$$= 5163 \div 4400$$
$$= 1.173 \text{ amperes}$$

78. The secondary line voltage of a delta-Y connected three-phase system is determined by using the formula

$$E_s = E_p \times \text{turns ratio} \times 1.732$$

The turns ratio is the same as the voltage ratio, that is, 10:1, or simply 10. By substitution

$$E_S = 220 \times 10 \times 1.732$$
$$= 3810 \text{ volts}$$

In a Y connection, the output voltage is obviously greater than the voltage across a single line because two windings are in series between any two of the three windings. However, the voltages induced between any of the two windings are not entirely in phase, and this is why we use the factor 1.732 as a multiplier in the above equation, rather than 2.

79. In a single-phase, full-wave rectifier, the lowest and most predominant ripple frequency in the output is twice the applied frequency. Thus, the predominant ripple frequency is $2 \times 60 = 120$ cycles.

80. The output voltage at no load is equal to the full-load voltage, plus 11 percent of the full-load voltage. Thus,

$$0.11 \times 240 = 26.4 \text{ volts}$$

and no load voltage

$$= 240 + 26.4$$
$$= 266.4 \text{ volts}$$

81. The no-load output voltage E_{NL} is 15 percent greater than the full-load output voltage E_{FL}. Thus, the no-load voltage is equal to 115 percent of the full-load voltage, or

$$E_{NL} = \frac{140}{1.15}$$

$$= 121.7 \text{ volts}$$

In finding E_{NL}, we can also use the formula

$$\text{Regulation } (R) = \frac{E_{NL} - E_{FL}}{E_{FL}}$$

By transposition

$$R\,E_{FL} = E_{NL} - E_{FL}$$

$$R\,E_{FL} + E_{FL} = E_{NL}$$

$$E_{FL}\,(R + 1) = E_{NL}$$

and

$$E_{FL} = \frac{E_{NL}}{R + 1}$$

By substitution

$$E_{FL} = \frac{140}{0.15 + 1}$$

$$= \frac{140}{1.15}$$

$$= 121.7 \text{ volts}$$

82. Two currents are present in the resistor section of this question, the 15-ma bleeder current, and the 40-ma taken by the 400-volt circuit. Total current through the resistor is, therefore,

$$40 + 15 = 55 \text{ ma}$$

The voltage drop across the same resistor is

$$500 - 400 = 100 \text{ volts}$$

By Ohm's Law,

$$R = E \div I$$
$$= 100 \div .055$$
$$= 1{,}818 \text{ ohms}$$

83. The crystal frequency decreases 20 cycles for every megacycle-operating frequency and for every 1° C temperature increase. In this problem the operating frequency is 0.6 mc and temperature increases

10°C. The total decrease in crystal frequency is

$$-20 \times 0.6 \times 10 = -120 \text{ cycles}$$

The new operating frequency is

$$600{,}000 - 120 = 599{,}880 \text{ cycles}$$
$$= 599.88 \text{ kc}$$

The characteristics of the crystal in this case are sometimes written as $-20 + 10^{6} + {}^{\circ}$C.

84. It is stated that the efficiency of the final stage is 50 percent. The dc power input to the stage must, therefore, be two times the output, that is, 100 + 0.5 = 200 watts. Under conditions of 100 percent modulation, the modulator must supply power equal to 50 percent of the dc power input to the final, that is, 200 + 2 = 100 watts. Then, because the efficiency of the modulator is only 66 percent, its input power must be 100 + 0.66 = 151.5 watts.

85. Assuming sinusoidal modulation, the power in the sidebands varies as the ratio of sideband power at 100 percent modulation squared to sideband power at the reduced percentage of modulation squared. Taking the values given, the new sideband power is in the ratio of

$$\frac{(100)^2}{(50)^2} = \frac{10{,}000}{2500} = \frac{4}{1}$$

This means P_{SB} is now one quarter (25 percent) of its value at 100 percent modulation.

86. For this problem we use the formula

$$\text{db power loss} = 10 \log_{10} \frac{P_1}{P_2}$$

where $P_1 = 1000$ watts

and $P_2 = 10$ watts

$$\text{db} = 10 \log_{10} \frac{1000}{10}$$

$$= 10 \log_{10} 100$$

$$= 10 \times 2$$

$$= 20 \text{ db}$$

87. When a triode of moderate μ is used as a Class A amplifier, the load impedance should be about twice the dynamic plate resistance of the tube for reasonable power output and acceptable distortion (about 5 percent).

Assuming this condition is satisfied, the load impedance in our problem should be $2 \times 15{,}000 = 30{,}000$ ohms. The load on the modulator tube is equal to the dc plate impedance of the Class C modulated rf amplifier, in this problem,

$$\text{load on modulator} = \frac{E_b}{I_b} = \frac{1000}{0.15}$$

$$= 6667 \text{ ohms}$$

We now have two widely different impedances of 30,000 and 6667 ohms, which must be matched by the modulation transformer.

To obtain this match, the turns ratio of the matching transformer should be equal to the square root of the ratio of the Class C stage impedance to the Class A stage impedance. Thus, the correct turns ratio (T.R.) is,

$$\text{T.R.} = \frac{30{,}000}{6667}$$

$$= 4.5$$

$$= 2.12 : 1$$

that is, 2.12 to 1.

88. The power output of an FM transmitter remains constant with or without modulation. Thus, the transmission line current remains at 8.5 amperes.

89. The formula for computing surge impedance Z_o is

$$Z_o = 276 \log_{10} \frac{2D}{d}$$

where D is the center-to-center spacing of the conductors and d is the diameter of the conductors.

Examination of the formula indicates that if d is increased while D remains unchanged, Z_o must decrease.

90. Assuming the line is nonresonant, we take the formula

$$P = \frac{E^2}{R}$$

and transpose to

$$E_{rms} = \sqrt{PR}$$

Then, by substitution,

$$E_{rms} = \sqrt{72 \times 5000}$$
$$= \sqrt{360{,}000}$$
$$= 600 \text{ volts}$$

If we wanted the peak voltage, we would multiply this rms value by 1.414.

91. Taking the basic formula

$$P = I^2R$$

and

$$I = \sqrt{P \div R}$$

Substituting given values,

$$I = \sqrt{\frac{5000}{72}}$$
$$= \sqrt{69.5}$$
$$= 8.34 \text{ amperes}$$

92. Here we use the basic formula $P = I^2R$

$$P = 3^2 \times 500$$
$$= 9 \times 500$$
$$= 4500 \text{ watts}$$

93. We must first determine line impedance, which is equal to the input antenna impedance, assuming proper line termination. We do this by transposing the basic formula $P = I^2R$, so that

$$R = \frac{P}{I^2}$$

Substituting given values,

$$R = \frac{10{,}000}{(4.8)^2} = 434 \text{ ohms}$$

Knowing the value of R, the input power is

$$P_i = I^2R$$
$$= 5^2 \times 434$$
$$= 25 \times 434$$
$$= 10{,}840 \text{ watts}$$

Then the line power loss is equal to $P_i - P_o$, that is,

$$\text{line power loss} = 10{,}840 - 10{,}000$$
$$= 840 \text{ watts}$$

94. We must first find the total power input which is equal to the power output divided by efficiency. Thus,

$$P_i = \frac{50{,}000}{0.33}$$

$$= 151{,}515 \text{ watts}$$

The total power dissipation for all six tubes is equal to

$$P_i - P_o = 151{,}515 - 50{,}000 = 101{,}515$$

Finally, the power dissipated by a single tube is equal to the total power dissipation divided by 6, that is, 101,515 ÷ 6 = 16,919 watts.

95. The power is proportional to the square of the current as shown in the basic formula $P = I^2R$. Thus we can write

$$\frac{P_1}{P_2} = \frac{I_1^2}{I_2^2}$$

and by transposition

$$I_2 = I_1\sqrt{\frac{P_2}{P_1}}$$

Substituting given values,

$$I_2 = 12\sqrt{\frac{5}{10}}$$

$$= 12\sqrt{0.5}$$

$$= 12 \times 0.707$$

$$= 8.48 \text{ amperes}$$

96. The field intensity varies as the square root of radiated power. If power is increased four times, then field intensity doubles because $\sqrt{4} = 2$.

97. By definition, 100 percent modulation of an FM transmitter occurs when the frequency swing is ± 75 kc. At 60 percent modulation, the frequency swing then becomes

$$0.6 \times \pm 75 = \pm 45 \text{ kc}$$

98. Using a doubler, tripler, and quadrupler, the oscillator swing is multiplied

$$2 \times 3 \times 4 = 24 \text{ times}$$

Thus, the carrier frequency swing is

$$2 \text{ kc} \times 24 = 48 \text{ kc}$$

99. If the oscillator frequency is 4905 kc and the operating frequency is 98.1 mc, the multiplication between the oscillator and the final rf stage is

$$\frac{98.1}{4.905} = 20$$

At 100 percent modulator the output frequency swing is ±75 kc. This means the oscillator frequency swing at 100 percent modulation must be

$$\frac{1}{20} \times 75 \text{ kc} = \pm 3.75 \text{ kc}$$

100. The frequency of the test tone is of no importance in this problem. Since, at 100 percent modulation the frequency swing is ±75 kc, at 50 percent modulation it becomes

$$\frac{75 \text{ kc}}{2} = \pm 37.5 \text{ kc}$$

101. The new frequency swing is 80 percent of that which occurs at 100 percent modulation, that is,

$$0.8 \times 75 \text{ kc} = \pm 60 \text{ kc}$$

102. The voltage and number of phases need not be considered in this problem. The synchronous speed is equal to,

synchronous speed

$$= \frac{\text{line frequency} \times 60}{\text{No. pairs of poles}}$$

and by substitution,

synchronous speed

$$= \frac{60 \times 60}{2} = 1800 \text{ rpm}$$

In a synchronous motor, the emf generated by the rotor must be exactly the correct amount to produce a current that, in turn, produces a torque equal to the combined resisting torque of the load and rotor losses. This characteristic requires that the running speed be somewhat less, about 2 to 3 percent in the motor described, than the synchronous speed. This difference in speed is called "slip." Thus, the running speed of the motor in this problem would be

$$1800 \times 0.98 = 1764 \text{ rpm}$$

for 2 percent slip and

$$1800 \times 0.97 = 1746 \text{ rpm}$$

for 3 percent slip.

103. Regardless of the full-scale meter reading, the ohms per volt of a meter is equal to the reciprocal of full-scale current. Thus, in this problem,

$$\text{ohms per volt} = \frac{1}{0.001}$$

$$= 1000$$

104. The needle deflection is proportional to the square of measured current even though the scale is linear (has equal division). This permits us to set up the proportion

$$\frac{D_1}{D_2} = \frac{I_1^2}{I_2^2}$$

where D_1 = deflection of 25 divisions
D_2 = deflection of 45 divisions
I_2 = current for deflection D_2
I_1 = unknown current

By substitution

$$\frac{25}{45} = \frac{I_1^2}{(45)^2}$$

$$I_1^2 = \frac{25 \times (45)^2}{45}$$

$$I_1^2 = 25 \times 45$$

and $$I_1 = \sqrt{25 \times 45}$$

$$I_1 = \sqrt{1125}$$
$$= 33.5 \text{ ma}$$

105. When the frequency is changed 10 kc, from 1390 to 1400 kc, the dial reading changes 44.5 - 31.7 = 12.8 divisions. When the scale reading is 41.2 it is 9.5 divisions higher than the reading at 1390 kc, (41.2 - 31.7 = 9.5). Because 12.8 divisions represents 10 kc,

$$\frac{9.5}{12.8} \times 10 = 7.421 \text{ kc}$$

and the frequency at a dial reading of 41.2 is

$$1390 + 7.421 = 1397.421 \text{ kc}$$

The ninth harmonic of this frequency is

$$9 \times 1397.421 = 12576.789 \text{ kc}$$

106. The error in the monitor is the sum of the low reading report and the high reading recorded in the log, that is, 45 + 5 = 50 cps.

107. If 360° represents one wave-

length, the towers are separated by 1/3 wavelength (360/120). Converting the frequency in kc to wavelengths in meters

$$\lambda = \frac{300{,}000}{950}$$

$$= 316 \text{ meters}$$

The tower separation in meters is then

$$\frac{316}{3} = 105.3$$

To convert meters to feet, we multiply by 3.28. Thus, the tower separation in feet is

$$3.28 \times 105.3 = 345.4 \text{ feet}$$

108. The wavelength in meters is

$$= \frac{300{,}000}{1100}$$

$$= 272.7 \text{ meters}$$

One half wavelength at 1100 kc is, therefore,

$$\frac{272.7}{2} = 136.35 \text{ meters}$$

Multiplying by 3.28 we obtain the height of the half-wave vertical radiator in feet

$$3.28 \times 136.35 = 447 \text{ feet}$$

109. Changing height in feet to meters, we obtain

$$\frac{405}{3.28} = 123.44 \text{ meters}$$

Then, changing frequency in kc to meters,

$$= \frac{300{,}000}{1250}$$

$$= 240 \text{ meters}$$

Finally the ratio of the two measurements in meters is

$$\frac{123.44}{240} = 0.514 \text{ wavelengths}$$

110. The effective height is equal to the ratio of the total voltage developed, to the voltage developed per meter, that is,

$$\frac{2.7}{0.025} = 108 \text{ meters}$$

Converting to feet,

$$108 \times 3.28 = 354 \text{ feet}$$

111. Field intensity is directly proportional to antenna current and is a measure of voltage. When field density doubles, so does antenna current.

112. We know that $P = I^2R$. Inspecting this formula, it is apparent that when R is constant, if we cut I in half, P is reduced to $\frac{1}{4}$ its former value. Thus, the right input power is

$$\frac{1}{4} \times 2000 = 500 \text{ watts}$$

113. Power is proportional to the square of current, so we can write

$$\frac{P_1}{P_2} = \frac{I_1^2}{I_2^2}$$

By substitution

$$\frac{1}{5} = \frac{I_1^2}{(9.7)^2}$$

and transposing

$$I_1 = \frac{9.7}{\sqrt{5}}$$

$$= 4.33 \text{ amperes}$$

114. Here, we use the formula

$$I^2 = P/R \quad \text{and} \quad I = \sqrt{P/R}$$

substituting

$$I = \sqrt{\frac{900}{16}} = \frac{30}{4} = 7.5 \text{ amperes}$$

115. Output power is proportional to the square of the current. In this problem the increase in current is 2.77 times. Output power is, therefore,

$$(2.77)^2 = 7.67$$

times as great as its previous value.

116. The power output of the last rf stage is 370 × 0.65 = 241 watts. The power reaching the antenna is 241 × 0.75 = 180.4 watts. (Twenty-five percent is dissipated on line).

The antenna power gain is equal to the square of the antenna field gain, that is, $(1.3)^2 = 1.69$. Then, the effective radiated power is

$$1.69 \times 180.4 = 305 \text{ watts}$$

117. The power reaching the antenna is

$$1000 - 50 = 950 \text{ watts}$$

With an antenna power gain of 3, the effective radiated power is

$$3 \times 950 = 2850 \text{ watts}$$

SHOULD YOU DEPEND ON LUCK?

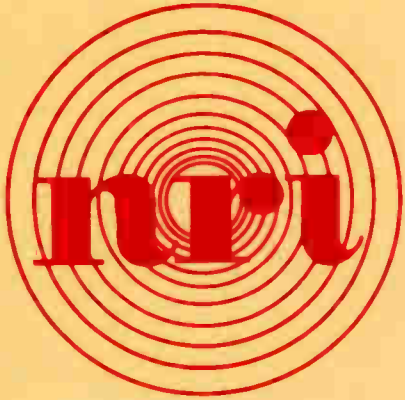
Accident--chance--luck--have very little bearing upon the production of any great result or true success in life. Of course, there have been many discoveries and accomplishments which may seem to be the result of "luck."

For instance: Newton "discovered" the law of gravity by watching an apple fall from a tree. Galileo "invented" the telescope after hearing of a toy constructed by a spectacle-maker. Brown "invented" the suspension bridge after watching a spider throw its web.

But these discoveries and inventions were made by men trained to take advantage of what they observed. Thousands of untrained men had seen the same things and paid no attention.

The new discoveries in radio--television--electronics will be made by men trained to take advantage of what they observe.

J. M. Smith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ACHIEVEMENT THROUGH ELECTRONICS

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FCC RULES AND REGULATIONS

REFERENCE TEXT C112X

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FCC RULES AND REGULATIONS

C112X

STUDY SCHEDULE

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FCC Rules and Regulations

Although your final goal is a first-class radiotelephone license, the job is made somewhat easier by first acquiring a third-class radiotelephone permit. To do this, you must pass Elements I and II, which are essentially non-technical and made up largely of laws and regulations. To qualify for broadcast station operation Element IX must be passed. Once you have this permit, you will not have to be re-examined on Elements I and II when you take the examination for a first-class license.

The minimum passing grade on any Element is 75%.

The examination for Element I consists of 20 multiple-choice type questions.

The examination for Element II also consists of 20 multiple-choice type questions. This examination covers practices and procedures generally followed or required in radiocommunications. Two separate tests are offered. One is general and is intended for all persons seeking work in non-marine stations. This includes land, mobile, and aircraft stations. The general questions and answers are from 2.1 to 2.54. Marine questions are preceded by the letter "M".

The third part of this lesson contains "Rules and Regulations" type questions such as might be encountered in Elements III and IV. The examination for Element III consists of 100 questions and for Element IV, 50 questions. It is recommended that you study these questions after completing the material in the regular lesson dealing with television. Certain of these questions provide necessary information about transmitter frequency tolerances, permissible operating powers, methods of measurement acceptable by the FCC, etc. This material is not given in the regular lesson. Just remember, it costs you one to five points to miss a question on any examination, whether it is of a technical nature or related to Rules and Regulations.

A companion book on Rules and Regulations, C111X, should be consulted for more detailed information on many of the questions asked. We recognize that reading material of this type can be extremely tiresome, but it is an important part of your training and a job that must be done if you are to pass your FCC exam. It might be a good idea to underline or otherwise mark information which you will want to study again.

Lesson C111X also contains information related to amateur and citizen's band communications. It is not a required part of your study, but should be looked over at least partially whenever you have the opportunity. It may be that you will be employed by an organization that does a great deal of maintenance work on such equipment and this knowledge will then prove useful.

When you have completed the final examination in your course and, just before you go to take the FCC exam, it is suggested that you restudy the Rules and Regulations information contained both in this lesson and in Lesson C111X. This type of material is the most likely to be forgotten and can often cause the most trouble in passing the exam. More than one man has "sat" for his ticket with good preparation on technical material

only to find that he failed due to a lack of knowledge about Rules and Regulations. Just remember, they all count and you cannot afford to give any points away.

It should be apparent by now why we think it is best to get your third class permit first, even though this means an extra trip to the FCC office and may cause you considerable inconvenience.

Basic Law - - Element I

1.1 Where and how is an operator license or permit obtained?

Ans. Licenses and permits are issued by the Federal Communications Commission to those citizens of the United States who have been found qualified to receive them. Applicants for a license or permit must appear before an FCC field engineer at a designated examining point and successfully complete a written examination and show other qualifications as required for the type of license or permit desired.

1.2 Who may apply for an FCC license?

Ans. Generally any citizen or other national of the United States. (The FCC may waive nationality requirements provided the alien holds an aircraft pilot certificate issued by the FAA and public interest is served.)

1.3 What is the usual license term for radio operators?

Ans. Five years from date of issuance.

1.4 When a licensee qualifies for a higher grade of FCC license or permit, what happens to the lesser grade license?

Ans. It will be cancelled upon issuance of the new license.

1.5 When may a license be renewed?

Ans. Any time during the final year of the license term or during a 1-year period of grace after expiration date of the license to be renewed.

1.6 Must a person designated to operate a radiotelephone station post his operator's license or permit, and if so, where?

Ans. Yes. The original license of each station operator must be posted at the place where he is on duty, or kept in his possession in the manner specified in the rules governing the particular class of station concerned.

1.7 If a licensee is notified that he has violated an FCC rule or provision of Communications Act of 1934, what must he do?

Ans. He must send a written reply within 10 days to the office of the Commission originating the official notice. If unavoidable circumstances make it impossible within that time, the reply must be made at the earliest practicable date and a satisfactory explanation given of the delay. The answer must be complete in itself and not abbreviated by reference to other correspondence or answers to other notices. It must contain a statement of action taken to correct the

condition or omission. If the notice relates to violations due to physical or electrical characteristics of the transmitting apparatus, the reply shall state what steps, if any, have been taken to prevent future violations. If any new equipment is to be installed, the date of order, the name of the manufacturer, and the promised delivery date must be stated. If this installation requires a construction permit, the application file number or other identification must be given to help locate the application. If the notice relates to lack of attention to, or improper operation of, the transmitter, the name and license number of the operator in charge must be given.

1.8 What are the grounds for suspension of operator licenses?

Ans. Upon proof sufficient to satisfy the Commission that the licensee has: (1) violated any provision of any act, treaty, or convention binding on the United States, which the FCC is authorized to administer, or any regulation made by the FCC under any such act, treaty, or convention; (2) failed to carry out a lawful order of the master or person lawfully in charge of the ship or aircraft on which he is employed; (3) wilfully damaged, or permitted to be damaged, radio apparatus or installation; (4) transmitted superfluous radiocommunications or communications containing profane and/or obscene language or meaning; (5) transmitted false or deceptive signals, or call letters, not assigned by proper authority; (6) wilfully or maliciously interfered with any other radiocommunications or signals; or (7) obtained or attempted to obtain, or helped another person obtain, or attempt to obtain, an operator's license by fraudulent means.

1.9 If a licensee receives a notice of suspension of his license, what must he do?

Ans. Within 15 days of receipt of notice, or as soon as possible thereafter with a satisfactory explanation of the delay he must send an application for hearing to the FCC. The suspension order is held in abeyance until the hearing is concluded. At that time the FCC will affirm, modify, or revoke the order of suspension.

1.10 What must a person do whose operator license or permit has been lost, mutilated, or destroyed?

Ans. Immediately notify the Commission. A properly prepared and sworn application for a duplicate should then be submitted to the office of issue. This application should include a statement of the circumstances involved in the loss of the original license. It must also include a statement that a reasonable search has been made for the lost license, and if it is later found, it will be returned for cancellation. Documentary evidence of service obtained under the original license, or a statement under oath or affirmation embodying that information, must also be submitted.

1.11 Is it permissible to operate pending receipt of a duplicate operator license or permit after application has been made for reissue?

Ans. Yes. The operator should post a signed copy of the application for duplicate or renewal in place of the original document.

1.12 Is the holder of a radiotelephone third-class permit authorized to make technical adjustments to the transmitter he operates?

Ans. Only under the immediate super-

vision of a person holding the proper class of license required for the equipment involved. The licensed man is responsible for the proper functioning of the station equipment.

1.13 Should a radio station that is required to be operated by a licensed radio operator be a licensed radio station?

Ans. Yes. Any such station should be licensed.

1.14 Are communications bearing upon distress situations subject to the secrecy provisions of law?

Ans. No. Distress communications are exempt from these provisions.

1.15 When may an operator divulge the contents of an intercepted message?

Ans. Whenever the contents of any radiocommunication broadcast, transmitted by amateurs or others, is for the use of the general public, or relating to ships in distress.

1.16 What are the penalties for violating a provision of the Communications Act of 1934?

Ans. Any person upon conviction shall be punished for such offense for which no penalty (other than a forfeiture) is provided in this Act by a fine of not more than $10,000 or by imprisonment for a term not exceeding one year or both. Subsequent convictions provide the same penalty except for imprisonment term of two years.

1.17 What are the penalties for violating a provision of the Rules and Regulations of the FCC?

Ans. Any person upon conviction shall, in addition to any other penalties provided by law be punished by a fine of not more than $500 for each and every day during which such offense occurs.

1.18 Does the government have authority to impose fines for failure to comply with the Rules and Regulations governing the use of radio on compulsorily equipped ships?

Ans. Yes. Any person who knowingly violates any international radio treaty or convention to which the United States is a party may, upon conviction, be fined not more than $500 for each and every day during which such violation occurs. International treaties and conventions require certain ships to be compulsorily equipped with radio, and regulate the requirements and use of this equipment.

1.19 What government agency inspects radio stations in the U. S.?

Ans. The Federal Communications Commission has authority to inspect all radio stations required to be licensed, to ascertain if station construction, installation, and operation meet the requirements of the Commission Rules and Regulations.

1.20 Who keeps the station logs?

Ans. The station employee (or contract operator) competent to do so and having knowledge of facts required.

1.21 Who corrects errors in the station logs?

Ans. The operator on duty or other person who made the error. All corrections must be approved by the person responsible for keeping the log.

1.22 How may errors in the station logs be corrected?

Ans. By striking out the erroneous portion, or by making a corrective explanation on the log or attachment to it.

1.23 Is it prohibited by law to transmit false or fraudulent signals of distress?

Ans. Yes. International convention and the Communications Act of 1934 forbid false distress signals.

1.24 Under what conditions may messages be rebroadcasted?

Ans. Only when authority is obtained from the originating station.

1.25 What messages and signals may not be transmitted?

Ans. Unnecessary, unidentified, superfluous, obscene, indecent, profane, false or deceptive messages and signals. Unassigned call letters or signals may not be transmitted.

1.26 May an operator deliberately interfere with any radiocommunication or signal?

Ans. No.

1.27 What is meant by "harmful interference"?

Ans. Any emission, radiation or induction which endangers the functioning of a radionavigation service or of other safety services, or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service.

1.28 What type of communication has top priority in the mobile service?

Ans. All distress communications including alarm signals and distress traffic.

Basic Operating Practice Element II

2.1 If a radiotelephone operator desires to make a brief test of a transmitter, what would be a good choice of words to use in the test?

Ans. The official call sign of the testing station, then the word "testing" followed by the count "1, 2, 3, 4 . . ." or by test phrases or sentences not in conflict with normal operating signals. The test signals shall have a duration not exceeding 10 seconds.

2.2 Why is it important to avoid unnecessary calls by radiocommunications?

Ans. To help prevent interference, to allow others the opportunity to use the air waves, and to improve station operating efficiency.

2.3 Is it required that a person listen in on a channel before transmitting?

Ans. Yes. Failure to listen in on a channel before transmitting can cause serious interference and should be avoided.

2.4 Why is it desirable to listen in on a channel before transmitting?

Ans. To make sure that interference will not be caused in communications already in progress.

2.5 Why should a trial of the radiotelephone installation be made every day?

Ans. To insure that it is in proper operating condition, not only for normal use, but also for emergency use.

2.6 How can a radiotelephone installation be tested?

Ans. See Question 2.1. In testing a radiotelephone transmitter, the operator should clearly indicate that he is testing,

and station identification must be given. Tests should be made as brief as possible.

2.7 Before placing the transmitter apparatus of a radio station in operation for a test, what precautions must be taken?

Ans. The radio operator shall ascertain by careful listening that the test emissions will not be likely to interfere with any other communications.

2.8 What is the correct form for transmitting a distress call by radiotelephone?

Ans. The correct form for transmitting a distress call by radiotelephone is: (1) announce the distress signal Mayday three times, and (2) the words, "this is," followed by the identification of the mobile station in distress, the whole repeated three times. This distress call, when sent by radiotelephony, is generally preceded by the signal ... - - - ... (SOS) produced by a whistle or other suitable means.

2.9 Why is it a good policy to be brief in radiotelephone conversation?

Ans. To aid in preventing interference and give others an opportunity to use the airwaves.

2.10 What may happen to the received signal when an operator has shouted into a microphone?

Ans. Shouting into the microphone overloads the audio amplifier and overmodulates the transmitter. This causes so much distortion the signals may become unintelligible at the receiving end. Also, the width of the radiated band is increased, possibly causing interference with other services. The operator should make every effort to train his voice for most effective radiocommunication. His voice should be loud enough to be distinctly heard by the receiving operator, but not so loud as to become distorted and difficult to understand. Normally the microphone is held 2 to 6 inches from the operator's lips.

2.11 How should a microphone be treated when used in noisy locations?

Ans. The operator cups his hands over the microphone to exclude extraneous noise.

2.12 Why should the operator use well-known words and phrases?

Ans. To insure accuracy and save time from undue repetition of words.

2.13 What is the operator's responsibility upon hearing the word "SECURITY" repeated three times?

Ans. The word "SECURITY" is the safety signal. Upon hearing it three times the operator must continue to listen on the frequency on which it is being transmitted until he is satisfied that the message is of no interest to him. In addition, he must not make any transmission likely to interfere with the message.

2.14 What must the operator do if he is told that he is interfering with a distress call?

Ans. He must discontinue the cause of interference at once. The distress call has absolute priority over all other transmissions. All stations that hear it must immediately cease any transmission capable of interfering with the distress traffic and must listen on the frequency used for the emission of the distress call.

2.15 What are the meanings of these words: clear, out, over, roger, words twice, repeat, and break?

Ans. "Clear" means the sending station has completed all messages for the receiving station and is ending its transmission. "Out" means "This conversation

is ended and no response is expected." "Over" means "My transmission is ended, and I expect a response from you." "Roger" means "I have received all of your last transmission." "Words twice" means "Give every phrase twice." "Say again" means "Repeat." "Break" means a separation between portions of a message.

2.16 Can a radio operator always consider his conversation completely confidential and not heard by other persons?

Ans. No. Radio signals normally travel outward from the transmitter in all directions, and can easily be intercepted by unauthorized persons.

2.17 In calling a station, how many times does the calling station generally repeat the call sign or name of the called station in each calling transmission?

Ans. Generally, not more than three times, followed by the letters of the calling station not more than three times.

2.18 Would you listen on a shared channel before transmitting? Why?

Ans. Yes, to make sure that you do not interfere with communications in progress.

2.19 Under normal conditions would a transmission on a calling frequency be proper if the receiver for that frequency were inoperative?

Ans. No. Calls other than emergency calls should not be made until the receiver is repaired.

2.20 What is the difference between calling and working frequencies?

Ans. Calling frequencies are those used for initial contact of another station, or stations, for some particular purpose. Once initial contact is made, all stations concerned shift to another designated frequency, known as the working frequency, for completion of further communications. For example, in the ship service, an initial call may be made on 500 kc. After contact is made, operation may be shifted to 410 kc.

2.21 Why is the station's call sign transmitted?

Ans. To avoid unnecessary repetition of call letters or names, and to enable monitoring stations to clearly identify all calls.

2.22 Should a test of the transmitting equipment be made each day?

Ans. Yes. Regular tests may reveal defects which, if corrected immediately, may prevent delays when communications are necessary. If, however, the equipment is used during the day for regular communications purposes, its general operating condition is known, and special tests are unnecessary.

2.23 What precautions should be observed in testing a station on the air?

Ans. The operator should clearly indicate that he is testing. Tests should be as brief as possible. He should be certain that the test message will not interfere with other communications in progress at the same time.

2.24 Should messages bearing upon safety, including weather information, be given priority over business messages?

Ans. Yes. Communications preceded by the safety signal have priority over all communications except those related to distress and preceded by the urgency signal.

2.25 If a station is required by law to listen in on a calling of distress frequency, when may the listening be discontinued?

Ans. The listening may be discontinued whenever the station is being used for transmission on that channel, or for communication on other radio channels.

In the event a distress, urgent, or safety call is heard, the operator must continue to listen until it is evident that the distress, urgency, or safety message does not concern his station.

2.26 Why should radio transmitters be "off" when signals are not being transmitted?

Ans. The operator of a radiotelephone station should not press the push-to-talk button except when he intends to speak into the microphone. Radiation from a transmitter may cause interference even when voice is not transmitted.

2.27 Why is it beneficial for the transmitter radio station to be in constant readiness for making a call?

Ans. So that it is available as needed, either for routine or emergency use.

2.28 If a station is required to maintain effective listening on a distress frequency, why is it desirable for the equipment to return automatically to reception on the distress frequency immediately after completing use of the equipment on another frequency?

Ans. To eliminate the possibility of the operator forgetting to switch back to the distress frequency channel.

2.29 Why is rapid frequency change of the transmitter and receiver desirable?

Ans. To permit the operator to quickly shift from a calling to a working frequency.

2.30 What would you do if you were told that your voice was distorting?

Ans. Lower my voice to see if the distortion is eliminated. If not, check the transmitter for improper operation.

2.31 Under what conditions may a station employ a calling frequency as contrasted to a working frequency?

Ans. When separate calling and working frequencies have been designated by the FCC, or by international convention, for the particular service involved.

2.32 Should a calling station repeat the call sign or name of the called station in each calling transmission more than three times?

Ans. No. Repetition of the call sign or name more than three times during any one calling is prohibited. The call may be repeated, however, after a one minute delay, if no response is obtained to the first call.

2.33 Why should stations using a shared frequency have an interval between calls?

Ans. To allow other stations sharing the frequency an opportunity to make calls.

2.34 Under what conditions may it be desirable to repeat important words?

Ans. When conditions of reception are such that words are not clearly intelligible, or when requested by the receiving operator.

2.35 What is the operator's responsibility upon hearing a distress call in a mobile service?

Ans. Cease all transmissions and continue to listen until he is certain the distress message in no way concerns his station.

2.36 Is it good practice to listen on the working frequency to be later used before making an initial call on the calling frequency?

Ans. Yes, to make sure that the desired communication can be handled on the working frequency. Unnecessary interference to other parties wishing to use the calling frequency is thereby avoided.

2.37 Why is it important to avoid unnecessary calls?

Ans. Unnecessary calls are forbidden by international law because they may cause interference with other stations wishing to use the air lanes.

2.38 State why station identification should be clearly made by a radio station.

Ans. To avoid unnecessary repetition of call letters or names, and to enable monitoring stations to identify all calls.

2.39 When routine radiocommunications are unreliable due to static or fading, should the operator continue transmitting or wait for more favorable conditions?

Ans. When radiocommunications at a station are unreliable or are disrupted due to static or fading, the operator should wait for more favorable conditions. Continued calling can cause severe interference with other stations.

2.40 What is the order of priority for communications?

Ans. (1) Distress calls, distress messages, and distress traffic; (2) communications preceded by an urgent signal; (3) communications preceded by the safety signal; (4) communications related to radio direction finding bearing; (5) communications related to the navigation and safe movement of aircraft; (6) communications related to the navigation, movements, and need of ships for an official meteorological service; (7) government communications for which priority rights have been claimed; (8) service communications related to the working of the radiocommunications service, or to communications previously transmitted; and (9) all other communications.

2.41 What is the priority of the urgency signal?

Ans. The urgency signal is second in the order of priority. Distress signals are first and safety signals third.

2.42 What are the distress, urgency, and safety signals?

Ans. The distress signal is the word MAYDAY. The urgency signal is the word PAN. The safety signal is the word SECURITY. All are repeated three times before the call.

2.43 In radiocommunications what does the transmission of the "distress," "urgency," and "safety" signals signify, respectively?

Ans. "MAYDAY" indicates that the ship, aircraft, or other vehicle sending the distress signals is threatened by serious and imminent danger, and requests immediate assistance. "PAN" indicates the calling station has an urgent message to transmit concerning the safety of a ship, aircraft, or other vehicle, or person on board or within sight. "SECURITY" indicates the station is about to transmit a message concerning the safety of navigation or important meterological warnings.

2.44 What information must be contained in a distress message?

Ans. (1) The distress call, (2) the name of the ship, aircraft, or vehicle in distress, (3) position of the latter, (4) the nature of the distress, (5) assistance, and (6) any other information which might facilitate matters.

2.45 Under what conditions may a mobile radio station send a distress message for another mobile station in distress?

Ans. (1) When the station in distress cannot itself transmit the message, (2) the master or person responsible for the ship, aircraft, or other vehicle carrying the station which intervenes believes addi-

tional help is needed, and (3) when directed to do so by the station in charge of distress traffic.

2.46 In the case of a mobile radio station in distress, what station is responsible for the control of distress message traffic?

Ans. The mobile station in distress, or the mobile station which, under the provision of the Commission Rules and Regulations, sends the distress call. These stations may, however, delegate the control of distress traffic to another station.

2.47 What does the distress call consist of?

Ans. The word MAYDAY repeated three times, and the words "this is," followed by the call of the mobile station in distress, repeated three times. The distress call may be preceded by the Morse Code signal ... --- ... (SOS) produced by a whistle or some other means.

2.48 What should an operator do when he leaves a transmitter unattended?

Ans. The transmitter should be left inoperable or inaccessible to unauthorized persons. The operator continues to bear responsibility for proper operation of the station.

2.49 Where does an operator find specifications for obstruction marking and lighting (where required) for the antenna towers of a particular radio station?

Ans. Part 17 of the Rules and Regulations of the FCC. If he wishes to determine the specifications for a particular station he should examine the station authorization issued by FCC.

2.50 What should an operator do if he hears profanity being used at his station?

Ans. He should discontinue broadcast immediately. Warn the offender. Take such other action as necessary to prevent recurrence. Prepare explanation in event suspension notice is received.

2.51 How does the licensed operator of a station normally exhibit his authority to operate the station?

Ans. By posting a valid operator license or permit at the transmitter control point.

2.52 When may an operator use his station without regard to certain provisions of his station license?

Ans. During a period of emergency in which normal communications facilities are disrupted as a result of hurricane, flood, earthquake or similar disaster.

2.53 Who bears the responsibility if an operator permits an unlicensed person to speak over his station?

Ans. The operator bears the responsibility for proper operation at all times.

2.54 What is meant by a "phonetic" alphabet in radiotelephone communications?

Ans. It is an alphabet or word list used to identify letters or words that may sound like other letters or words of different meaning. For example "group" may sound like "scoop," or "bridge" may sound like "ridge." It consists of 26 words, each word representing a letter of the alphabet. If the letters "GROUP" are represented in a phonetic alphabet as George, Roger, Oboe, Uncle and Peter, the word "group" is transmitted as "GROUP," G as in George, R as in Roger, O as in Oboe, U as in Uncle, P as in Peter.

MARITIME QUESTIONS AND ANSWERS

2.1M In making a ship-to-ship contact, except in an emergency involving safety,

how long may a ship station continue calling in each instance?

Ans. Calling a particular station, either by voice or by automatic means, shall not continue for a period of more than 30 seconds.

2.2M Except in an emergency involving safety, if a ship radiotelephone station does not receive a reply after calling, how long must it wait before calling again?

Ans. At least two minutes.

2.3M What types of communications may be transmitted by ship stations on the ship-to-ship frequencies between 2000 and 3000 kc?

Ans. Frequencies between 2000 and 3000 kc can be used for distress, safety, or urgent signals, initial calls and answers, and normal radio traffic on working frequencies.

2.4M In regions of heavy traffic, how long may the ship-to-ship radiotelephone frequencies between 2000 and 3000 kc be used for any one exchange of communication (other than distress or emergency)?

Ans. Any one exchange shall not exceed three minutes in duration.

2.5M How is a ship radiotelephone station required to be identified in connection with its operation?

Ans. All radiotelephone emissions from a ship station shall be clearly identified by transmitting in the English language the official call sign assigned to that station by the Commission. If no call sign has been assigned the complete name of the ship and name of licensee shall be sent. The required station identification shall be made: (1) at the beginning and upon the completion of each transmission made for any other purpose, (2) at intervals not exceeding fifteen minutes whenever transmission is sustained for a period exceeding fifteen minutes.

2.6M Do public coast stations normally charge for forwarding messages reporting dangers to navigation?

Ans. No public coast station shall charge for the transmission, receipt, or reply of information concerning dangers to navigation originating on a ship of the United States or a foreign country.

2.7M How does the licensed operator of a ship radiotelephone station exhibit his authority to operate the station?

Ans. The operator must post his original license in a conspicuous place at the principal location on board ship at which the station is operated. If, however, the station is portable, or is a marine utility station, the operator can keep the required license, or a duly issued verification card attesting to the existence of the license, on his person.

2.8M If a radiotelephone installation is provided on board ship for safety purposes, in accordance with a treaty, and it becomes defective, what action must the licensed operator take?

Ans. The ship master must be notified promptly. If the ship is being navigated outside of port, the licensed operator shall make every effort to return the equipment to normal operating conditions as quickly as possible. If operating on the Great Lakes, and the equipment cannot be repaired sooner, it must be placed in operating condition at the next port of arrival. In addition, the master of the vessel must send a written report to the Federal Communications Commission in Washington, D. C., giving full particulars of the matter. The report must include the date the master became

aware of the deficiency, a description of the steps taken to correct it, and a statement to the effect that the equipment has been, or will be, placed in operation before the ship again leaves port.

2.9M Who signs the radio log of a ship radiotelephone station certifying the entries made therein?

Ans. The licensed operator who is responsible for the operation of radiotelephone apparatus. The use of initials or signs in lieu of the operator's signature is not authorized.

2.10M What are the requirements for keeping watch on 2182 kc? If a radio operator is required to "stand watch" on international distress frequency, when may he stop listening?

Ans. Ship stations shall during its hours of service maintain an efficient watch for the reception of A3 and A3H emissions on 2182 kc frequency whenever such station is not being used for transmission on that frequency or for communication on other frequencies.

The watch period on an international distress frequency, when the ship station is in Region 1 or 3 shall be, insofar as possible, maintained at least twice each hour for 3 minutes commencing at X h.00 and X h.30, GMT.

2.11M Who may operate the radiotelephone set aboard the vessel?

Ans. Operation of all transmitting apparatus in any radio station in the maritime mobile service of the United States must normally be carried on only by a person holding an operator's license of the required class. However, at a ship station, the licensee or master may permit an unlicensed person to speak into the microphone.

2.12M Is it necessary for all vessels having knowledge of distress traffic to follow the traffic even if they do not take any part in it?

Ans. Any station of the mobile service having knowledge of distress traffic must follow such traffic, even if it does not take part in it. While following such distress traffic, however, if the mobile station is able to continue its normal service, it may do so, provided the distress traffic is well established, and provided it does not transmit on frequencies used for the distress traffic, and does not interfere with the distress traffic.

2.13M What is the proper form to use in acknowledging a distress message?

Ans. To acknowledge receipt of a distress message, use the following form: (1) call sign of the mobile station in distress repeated three times; (2) the letters DE in Morse Code or the words "This is," followed by (3) call sign of the station repeated three times; (4) the three-lettered group RRR in Morse Code, or the spoken word "received" repeated three times; and (5) distress signal.

2.14M What information is required to be sent following acknowledgement of a distress message?

Ans. The following information, in the order shown, must be transmitted as soon as possible by the mobile station acknowledging receipt: (1) its name, (2) its position, (3) the speed at which it is proceeding toward the ship, aircraft, or other vehicle in distress. Before sending the message, the station must insure that it will not interfere with the emissions of other stations better situated to render immediate assistance to the station in distress.

2.15M Is it necessary that the authori-

ty of the master or person responsible for the vessel be obtained prior to sending information required following acknowledgement of a distress call?

Ans. Yes. The information can only be sent on the order of the master or person responsible for the ship, aircraft, or other vehicle.

2.16M Is it desirable that care be taken to insure that an acknowledgment to a distress message will not interfere with other acknowledgments from vessels that are better able to assist?

Ans. Yes. Mobile stations that receive a distress message from another mobile station which, beyond any possible doubt, is not in their vicinity, must allow a short interval of time before acknowledging receipt of the message, to permit stations nearer the station in distress to answer and acknowledge receipt without interference.

2.17M Is a vessel which hears a distress message, but is not in a position to assist, required to take all steps to attract the attention of stations which might be in a position to assist?

Ans. Yes. Any mobile station not in a position to assist, after hearing a distress message which has not been properly acknowledged, must take all possible steps to attract the attention of mobile stations which are in a position to render assistance. For this purpose, with the approval of the person lawfully responsible for the station, the distress message may be repeated. All necessary steps are also taken to notify authorities who may be able to help.

2.18M Is it necessary to make a trial of the ship radiotelephone installation every day?

Ans. Yes, unless normal daily use of the equipment demonstrates that it is in proper operating condition for an emergency.

2.19M How can the radiotelephone installation be tested each day?

Ans. By making a test communication to demonstrate that the equipment is in proper operating condition for an emergency.

2.20M Does the Geneva 1959 Treaty give other countries the authority to inspect U. S. vessels?

Ans. Yes. The license must be produced for examination upon request of the government of the country being visited by the mobile station. The operator of the mobile station will cooperate in this examination.

2.21M What is the difference between calling and working frequencies?

Ans. Calling frequency is transmission from a station solely for getting the attention of another station(s) for a particular purpose. Working frequency is for all radiocommunications except calling.

2.22M How would you contact another vessel prior to communicating with it for routine communication purposes?

Ans. Example: Suppose Station KENT wishes to contact Station WASH. KENT would call as follows: "WASH, WASH, WASH, this is KENT, KENT, KENT, over." The repetition of the call station and the calling station as shown is not absolutely required and should never be repeated more than three times.

2.23M Why are call signs sent? Why should they be sent clearly and distinctly?

Ans. To enable other stations to identify calls easily.

2.24M In the mobile service, why

should messages be as brief as possible?

Ans. To allow other stations on the same frequency to make calls.

2.25M What procedure would you use in contacting the U. S. Coast Guard?

Ans. Example: "Baltimore Lifeboat Station, this is KENT, over."

2.26M Is it permissible to use 2182 kc for establishing contact prior to communicating on an appropriate public correspondence channel?

Ans. Yes; 2182 kc is the international radiotelephone calling frequency for the maritime mobile service.

2.27M Is it the general practice for a ship to use 2182 kc for establishing contact prior to communicating with a coast station on an appropriate public correspondence channel?

Ans. Yes.

2.28M Is it permissible to communicate with coast stations or any other stations on 2182 kc except for safety purposes?

Ans. Yes. See Question 2.26M.

2.29M Give a typical procedure you might use to call a vessel when its identity is not known.

Ans. In this case, the inquiry symbol CQ is used in place of the call sign of the station called. Example: "CQ, CQ, CQ, this is KENT, KENT, KENT, calling tanker at position 35 degrees north, 81 degrees west, over."

2.30M What do distress, safety and urgency signals indicate?

Ans. (1) Distress signal indicates that a mobile station is threatened by grave and imminent danger and requests immediate assistance. (2) Safety signal indicates that the station is about to transmit a message concerning the safety of navigation or giving meteorological warnings. (3) Urgency signal indicates that the calling station has a very urgent message to transmit concerning the safety of a ship, aircraft or other vehicle or the safety of a person.

2.31M What are the international urgency, safety and distress signals?

Ans. (1) Urgency signal is PAN. (2) Safety signal is SECURITY. (3) Distress signal is MAYDAY.

2.32M In the case of a mobile radio station in distress, what station is responsible for the control of distress message traffic?

Ans. It is the responsibility of the mobile station in distress or the station which had sent the message. These stations may delegate control to another station.

2.33M What daily attention should be given to the antenna tower lights at a radio station?

Ans. A daily check of the tower lights must be made not later than one hour after sunset. Inspection may be made either by visually observing the tower lights or by observing an automatic indicator, to insure that all tower lights are functioning properly as required.

2.34M What should be done in case of failure of the antenna tower lights at a radio station?

Ans. Report immediately by telephone or telegraph to the nearest airways communications station or office of the Federal Aviation Agency any observed failure of any code or rotating beacon light if such failure is not corrected within thirty minutes after observation thereof. Further, notify the above station or office immediately upon resumption of the required illumination. Data concerning the failure of tower lights must

also be recorded in the station log. Include in the log entry the nature of the failure, the date and time the failure was observed, and the date, time, and nature of the adjustments, repairs, or replacements made. In the event of failure of rotating or beacon lights, the time of notifying the Federal Aviation Agency must also be entered.

2.35M How should a radio identification be made at a coast station using radiotelephony?

Ans. All radiotelephone emissions of a public coast station shall be clearly identified by voice transmission in the English language, either by the official call sign assigned to that station by the Commission or by the approximate geographic location of the station as approved in such case by the Commission. Alternatively, the official call sign may be clearly transmitted by tone-modulated telegraphy in the Morse Code, either by a duly licensed radiotelegraph operator or by means of an automatic device approved by the Commission.

2.36M If a licensed operator at the controls of a coast station observes or hears obscene language being transmitted through the facilities of a station, what action should be taken?

Ans. The station should immediately be removed from the air or steps taken to insure against further transmission of the obscene language. Details of the unlawful transmission must be entered in the station log, and a report sent to the FCC.

2.37M If a coast station hears a distress call from a mobile station, what action, if any, should the operator on duty take?

Ans. The operator must immediately cease any transmission capable of interfering with the distress traffic and listen on the frequency used for the emission of the distress call. After the distress message is sent, receipt should be acknowledged.

2.38M Under what circumstances should a public coast station employing radiotelephony use a calling frequency in establishing a communications circuit with a ship or aircraft?

Ans. (1) For distress signals and traffic, (2) urgency signals, and very urgent messages concerning safety of a ship, aircraft, or other vehicle, or safety of a person on board or within sight of such vehicles, (3) safety messages, (4) occasional messages of general interest to ship mobile stations, (5) normal calls, replies, and brief operating signals, (6) brief test signals, to determine if the station transmitting equipment is in good operating condition.

2.39M When may a coast station NOT charge for messages it is requested to handle?

Ans. Whenever tariffs for the requested service are not on file with the Commission. No charge will be made (1) for transmission of distress messages and replies thereto, involving safety of life and property at sea; (2) for transmission, receipt or relay of information about dangers to navigation, and (3) any services related to preparation for national defense.

2.40M In regions of heavy traffic why should an interval be left between radiotelephone calls? Why should a radio operator listen before transmitting on a shared channel?

Ans. Each authorized channel is available for use on a shared rather than an exclusive basis. Cooperation on use of

assigned frequency reduces interference. Listen first, and if interference is likely, then wait until existing communication is ended. Intervals between calls permit calls to be made by another station using the same frequency.

2.41M How long may a radio operator in the mobile service continue attempting to contact a station which does not answer?

Ans. An interval of 2 minutes must elapse before calling a station again. After three attempts without response the interval will be 15 minutes. Should harmful interference to other communications not be indicated then the calls may be made as before, with a pause of 3 instead of 15 minutes. In all cases calling may continue for no longer than 30 seconds. These provisions do not apply to emergency calls involving safety.

2.42M What is meant by "safety communication" in the maritime service?

Ans. Safety communication is the transmission or reception of distress, alarm, urgent, or safety signals, or any form of radiocommunication which, if delayed in transmission or reception, may adversely affect the safety of life or property; an occasional test transmission or reception is necessary for determining if the radio equipment is in good working condition for purposes of safety.

2.43M Describe completely what actions should be taken by a radio operator who hears a safety message?

Ans. All stations hearing the safety signal shall listen to the safety message until they are satisfied that the message is of no concern to them. They shall not make any transmission likely to interfere with the message.

2.44M What are the requirements with respect to log-keeping at a coast station using radiotelephony?

Ans. Public coast stations using telephony shall maintain an accurate log during their hours of service. Each log sheet shall be numbered in sequence, be dated, and shall include the official call sign of the station and the signature of the licensed operator on duty. The entry "on duty," followed by his signature, shall be made by the operator at the beginning of a duty period. The entry "off duty," followed by his signature, shall be made by the operator ending a duty period. All log entries shall be currently completed and, unless otherwise stated, shall be made by the licensed operator on duty. The use of initials in lieu of any operator's signature is not authorized. The time of each entry shall be shown opposite the entry and, except for the following, shall be expressed in Greenwich Mean Time (GMT). (1) In the Great Lakes region, the time shall be expressed in Eastern Standard Time counted from 00:00 to 24:00 o'clock, beginning at midnight. (2) For public coast stations which communicate exclusively with vessels on inland waters of the United States, the time shall be expressed in local standard time. The first entry in each hour shall consist of four figures; additional entries in the same hour may be expressed in two figures by omitting the hour designation. The abbreviation GMT (or other kind used) shall be marked at the head of the column in which the time is entered.

2.45M What is the importance of the frequency 2182 kc?

Ans. This is the international distress frequency. It shall be used for this purpose by ship, aircraft and survival craft

stations using frequencies in the authorized bands between 1605 and 4000 kc when requesting assistance from the maritime services.

2.46M What information must be contained in distress messages? What procedures should be followed by a radio operator in sending a distress message? What is a good choice of words to be used in sending a distress message?

Ans. The distress message consists of: (1) the distress signal MAYDAY; (2) name of mobile station in distress; (3) its position; (4) nature of distress; (5) kind of assistance desired; (6) any other information which might facilitate rescue.

The distress procedure consists of: (1) alarm signal (when possible); (2) distress call; (3) distress message. Transmissions shall be made slowly and distinctly with each word clearly pronounced to ease receipt of message. After sending the distress message, the mobile station may be requested to send suitable signs followed by its call sign or name to permit direction-finding stations to determine its position. As necessary, this request may be repeated at frequent intervals. The alarm signal, when possible, distress call and distress message shall be repeated at intervals until an answer is received. If no answer is received on the distress frequency, any other frequency may be used to attract attention.

2.47M Describe completely what actions should be taken by a radio operator who hears a distress message.

Ans. When a distress message is received from a mobile station which is, beyond any possible doubt, in his vicinity, he shall immediately acknowledge receipt. If reliable communication with one or more coast stations is practicable, ship stations may defer acknowledgment for a short interval so that a coast station may acknowledge receipt. When the distressed mobile station is, without doubt, not in the vicinity, then a short interval will be allowed to elapse before acknowledging receipt of message, in order to permit stations nearer the mobile station in distress to acknowledge receipt without interference.

Acknowledgment of receipt of a distress message takes this form: (1) Call sign or other identification of the station sending the distress message, spoken three times; (2) the words THIS IS; (3) call sign or other identification of the station acknowledging receipt, spoken three times; (4) the word RECEIVED; the distress signal MAYDAY.

Every mobile station which acknowledges receipt of a distress message shall, on the order of the master or person responsible for the ship, aircraft or other vehicle carrying such mobile station, transmit as soon as possible the following information in the order shown: (1) Its name; (2) its position; (3) the speed at which it is proceeding towards, and approximate time it will take to reach, the mobile station in distress.

Before acknowledging, the station shall ensure that it will not interfere with the emissions of other stations better situated to render immediate assistance to the station in distress.

2.48M Under what conditions may a coast station intervene in a distress situation?

Ans. Any station or mobile service, which is not in a position itself to render assistance, but which has heard a distress message that has not been acknowledged, must take all possible steps to attract the

attention of stations which are in a position to render service. With the approval of the person lawfully in charge of the station, the distress call or the distress message may be repeated, using full power, on the distress frequency or on another frequency which may be used in case of distress.

2.49M To what extent may a coast station using radiotelephony communicate with stations other than ship stations?

Ans. Coast stations may communicate with other land stations to facilitate the transmission or reception of safety communications to and from a ship or aircraft station. They may also communicate with marine fixed stations on a frequency below 4000 kc, provided no harmful interference or intolerable delay is caused in communication with mobile stations as a result of such communication.

2.50M What is indicated by the use of the word "break" in a radiotelephone conversation?

Ans. The word "break" indicates a separation between portions of a message.

2.51M What is indicated by the use of the word "Roger" as a reply to a radiotelephone communication?

Ans. "Roger" means "I have received all of your last transmission."

2.52M What is indicated by the expression "words twice" when transmitted by radiotelephone?

Ans. "Words twice" is used to ask a station to send every phrase twice, or to inform a station every word will be sent twice.

2.53M What is indicated by the use of the words "read back" when transmitted by radiotelephone?

Ans. The words "read back" are used to request that the message be read back to the sending operator for verification.

2.54M Why are test transmissions sent? How often should they be sent? What is the proper way to send a test message? How often should the station's call sign be sent?

Ans. Tests may reveal defects or faults which, if corrected immediately, may prevent delays when communications are necessary. Before testing, listen to make sure there will be no interference with transmissions in progress. The call sign of the testing station, followed by the word "test" shall be announced on the radio channel being used for the test, as a warning that test emissions are about to be made on that frequency. The test must be delayed if there is interference or when "wait" is heard.

The operator announces the word "Testing" followed by "1, 2, 3, 4 ..." or by test phrases, sentences or test signals not in conflict with normal operating signals. The signals shall not last longer than 10 seconds. At the end of the test, announcement is made of the call sign, name of ship and its general location at time of test. One minute should elapse before retest on 2182 kc in heavy traffic, 5 minutes is waiting period. The call sign is sent at the beginning and end of test.

2.55M For what purpose is the frequency 121.5 megacycles authorized to be used by an aircraft radio station?

Ans. This is a universal simplex emergency and distress frequency for air-ground communications.

2.56M In lieu of using a call sign, how may a private aircraft telephone station be identified in the course of operation?

Ans. By use of the official aircraft registration number. The full number

must be given for the initial call of a continuous series of communications or, name of owner of aircraft followed by last two characters of registration; type of aircraft may be substituted for name or owner, provided practice is initiated by ground station operator.

2.57M What types of communications or messages is an aircraft radiotelephone station authorized to transmit?

Ans. Communications limited to those necessary for safe aircraft operations.

2.58M When must an aircraft radio station and maintenance record be made available for inspection?

Ans. Upon request of an authorized representative of the FCC made to the licensee or his representative.

2.59M How is the communications range of an aircraft radio station at a very high frequency dependent upon the altitude of the aircraft?

Ans. The higher the aircraft, the greater the communications range, because very high frequency radiations travel in essentially straight lines, which limits reception to the line-of-sight distance. The higher the aircraft radio station, the greater the distance to the horizon and the greater the communications range.

2.60M Why should an aircraft station avoid making unnecessary "on the air" tests?

Ans. To avoid interference with communications in progress and to permit other stations with necessary business to use the airways.

2.61M What is the normal calling procedure of a private aircraft for contacting a control tower?

Ans. Example: "Washington control tower, this is Beechcraft N123456, Over."

2.62M How should an air carrier aircraft radiotelephone station normally be identified in operation in lieu of using the call sign?

Ans. The official aircraft registration number or company flight identification may be used, provided proper records are kept to permit ready identification of a given aircraft.

2.63M What is meant by a phonetic alphabet in radiotelephone communications?

Ans. A phonetic alphabet is a word list with each letter represented by an easily understood word. This alphabet is used to make sure a message is received correctly. For example, the word "robe" may be transmitted as Roger (r), oboe (o), baker (b), easy (e). The possibility of the word then being misunderstood is minimized.

2.64M What radio channel or channels are used by ships for communicating by radiotelephone with the U. S. Coast Guard?

Ans. Normally 2182 kc. In the Great Lakes, distress calls may be made on 2670 kc.

2.65M How often should station identification be made at a base or land radiotelephone station?

Ans. At the end of each transmission or exchange of transmissions, or once every 30 minutes of the operating period, as the licensee may prefer.

2.66M What entries must be made in the logs or records of radio stations required to have antenna tower lights?

Ans. The time each day the lights are turned on and off if manually controlled, the time a daily check for proper operation is made if an automatic alarm

system is not provided, and results of periodic inspections required at least once every three months. This includes general condition of the system and any adjustments, replacements, or repairs made and the date.

If the tower lights fail, the log must show the nature of the failure, the time observed, the date, time, and nature of repairs, and the time the FAA was notified (for failures not corrected within 30 minutes). The results of the periodic inspection required every three months must be entered in the log, showing the date of the inspection and the condition of all tower lights and associated equipment. Any adjustments, replacements, or repairs to insure compliance with the lighting requirements must also be shown.

2.67M What attention should be given periodically to the antenna tower lights and associated apparatus at a radio station?

Ans. The lights must be checked at least once every 24 hours, either by direct observation or through a properly operating indicator system that will indicate any failure. Inspection must also be made at least once every three months to insure that all automatic or mechanical control devices, indicators, and alarm systems associated with the tower lighting is in proper operating order.

2.68M What precaution should be taken in a radio station which is left unattended in a public place?

Ans. The station should be locked up and other necessary precautions taken to prevent unauthorized use of the equipment. This may include temporary disablement of the equipment by tube removal, crystal removal, etc.

Basic and Advanced Radiotelephone for Elements III and IV

3.1 What is the frequency range associated with the following general subdivisions?

ULF	Below 30 kc	VHF	30-300 mc
LF	30-300 kc	UHF	300-3000 mc
MF	300-3000 kc	SHF	3-30 gc
HF	3-30 mc	EHF	30-300 gc

3.2 What is meant by the following emission designations? (Answer combined with question).

Symbol	Modulation	Type of transmission	Other characteristics
A3	Amplitude	Telephony	Double sideband
A3A	Amplitude	Telephony	Single sideband, reduced carrier
A5C	Amplitude	Television	Vestigial sideband
F3	Frequency or phase	Telephony	———
F5	Frequency or phase	Television	———
P3D	Pulse	Telephony	Amplitude modulated

3.3 What is the basic difference between type approval and type acceptance of transmitting equipment?

Ans. Type approval is based on tests made by FCC. Type acceptance is based on test data submitted by manufacturer or licensee and accepted by FCC.

3.4 May stations in the Public Safety Radio Services be operated for short periods of time without a station authorization issued by FCC?

Ans. No. Even in emergencies involving safety of life or property, authorization must be obtained.

3.5 What notification must be forwarded to the Engineer in Charge of the FCC district office prior to testing a new radio transmitter in the Public Safety Radio Service which has been obtained under a construction permit issued by FCC?

Ans. At least two days before test date, send written notice giving name of permittee, station location, call sign and frequencies to be used in testing.

3.6 Where may standard forms applicable to the Public Safety Radio Services be obtained?

Ans. From any engineering field office or FCC, Washington, D. C. 20554.

3.7 In general, what type of changes in authorized stations must be approved by FCC? What type does not require FCC approval?

Ans. Approval is necessary whenever any operation would be inconsistent with terms of authorization. Proposed changes which are consistent do not require approval.

3.8 The carrier frequency of a transmitter in the Public Safety Radio Service must be maintained within what percentage of the licensed value? Assume the station is operating at 160 mc with a licensed power of 50 watts.

Ans. .0005 per cent.

3.9 What is the authorized bandwidth and frequency deviation of Public Safety stations operating at about 30 mc? At about 160 mc?

Ans. At either 30 mc or 160 mc, authorized bandwidth is 20 kc with 5 kc frequency deviation.

3.10 What is the maximum percentage modulation allowed by FCC rules for stations in the Public Safety Radio Services which utilize amplitude modulation?

Ans. Not more than 100% on negative peaks.

3.11 Outline the transmitter measurements required by FCC rules for stations in the Public Safety Radio Service.

Ans. Each transmitter operating with a plate input power to the final radio

frequency stage in excess of 3 watts must be measured at stated intervals. Objectives are to assure that (1) carrier frequency is maintained within prescribed tolerance, (2) maximum voltage specified in the station authorization is not exceeded, and (3) that modulation does not exceed specified limits.

3.12 What are the general requirements for transmitting the identification announcements for stations in the Public Safety Radio Service?

Ans. The assigned signal at each transmission, or each 30 minutes, as licensee prefers. Mobile units operating above 30 mc may use another identifier plus name of government unit.

3.13 When a radio operator makes transmitter measurements required by FCC rules for a station in the Public Safety Radio Service, what information should be transcribed into the station's records?

Ans. Results and dates of required measurements and name of person making measurements.

3.14 What are FCC general requirements regarding the records which are required to be kept by stations in the Public Safety Radio Service?

Ans. Kept in an orderly manner and in detail so that required facts are readily available. Key letters and abbreviations may be used provided meaning is set forth in the record. Each entry shall be signed by a qualified person who has actual knowledge of the recorded facts. No entries shall be erased, obliterated or destroyed within the retention period. Correction may be made by person originating the entry who shall strike out the erroneous portion, initial correction made and show date of correction. Records will be retained by licensee for at least one year.

3.15 If a standard broadcast station is licensed to operate at a frequency of 1260 kc, what are the minimum and maximum frequencies at which it may operate and still be within the proper limits established by the FCC rules?

Ans. The operating frequencies shall be maintained within 20 cycles. Therefore, 1259.98 kc and 1260.02 kc are frequency limits.

3.16 What is an STL system?

Ans. It is a fixed station using telephony for transmission of aural program material between the studio and the transmitter of a broadcasting station, other than an international broadcasting station, for simultaneous or delayed broadcast.

3.17 What is a proof-of-performance? How does a proof-of-performance differ from annual equipment performance measurements required by FCC rules? What must be included in the annual equipment performance measurements?

Ans. Proof-of-performance is a set schedule of tests made throughout the year for purposes of locating trouble areas, making measurements and keeping station at top efficiency. It is more inclusive and frequent than the annual measurements required by FCC. Required annual measurements are: (1) data and curves showing over-all audio frequency response from 30 to 7500 cps for approximately 25, 50, 85, and 100 (if obtainable) percent modulation; (2) data and curves showing audio frequency for harmonic content for 25, 50, 85, and 100 per cent modulation for fundamental frequencies of 50, 100, 400, 1000, 5000, and 7500 cps; (3) data showing per-

centage carrier shift for 25, 50, 85, and 100 per cent modulation with 400 cps tone; (4) carrier hum and extraneous noise generated within the equipment and measured as the level below 100 per cent modulation throughout the audio spectrum or by bands; and (5) measurements or evidence that spurious radiations including radio frequency harmonics are suppressed or are not causing objectionable interference.

3.18 What are the specifications of a plate current meter in the last radio stage of a transmitter?

Ans. Length of scale not less than 2.3 inches; accuracy at least 2% of full-scale reading; maximum rating shall not read off-scale during modulation; scale must have at least 40 divisions; full scale reading shall not be greater than five times the minimum normal indication.

3.19 Under what conditions may remote reading antenna ammeters be used to indicate antenna current?

Ans. When the transmission line current meter is used at transmitter.

3.20 (a) What is the maximum temperature variation at the normal operating temperature when using X or Y cut crystals? (b) When using low temperature coefficient crystals?

Ans. (a) Not greater than ± 0.1°C; (b) ± 1.0°C.

3.21 Who keeps the keys to the fence which surrounds the antenna base at a standard broadcast station? Where are the keys usually kept?

Ans. In possession of the operator on duty at the transmitter.

3.22 Changes to the broadcast transmitter of what general nature require FCC approval? What types of changes or alterations do not require approval?

Ans. No change in the last radio stage, the number of vacuum tubes, nor change to vacuum tubes of different power rating or class of operation, nor change in system or modulation without authority of the FCC. Other changes which do not affect the maximum power rating or operating power of the transmitter or the operation or precision of the frequency control equipment may be made at any time without authority of the FCC.

3.23 What is the FCC requirement regarding maintenance of operating power?

Ans. As practicable, but not above 5% nor below 10% of licensed power.

3.24 What is frequency tolerance at standard broadcast stations?

Ans. ± 20 cycles of assigned frequency.

3.25 What are the FCC requirements concerning stations which operate their transmitters by remote control?

Ans. Operation by remote control shall be subject to the following conditions: (1) the equipment at the operating and transmitting positions shall be so installed and protected that it is not accessible to or capable of operation by persons other than those duly authorized by the licensee; (2) the control circuits from the operating positions to the transmitter shall provide positive on and off control and shall be such that open circuits, short circuits, grounds or other line faults will not actuate the transmitter and any fault causing loss of such control will automatically place the transmitter in an inoperative position; (3) a malfunction of any part of the remote control equipment and associated line circuits resulting in improper control or inaccurate meter readings shall be cause for the immediate

cessation of operation by remote control; (4) control and monitoring equipment shall be installed so as to allow the licensed operator at the remote control point to perform all the functions in a manner required by the FCC's rules; (5) the indications at the remote control point of the antenna current meter or, for directional antennas, the common point current meter and remote base current meters shall be read and entered in the operating log each half hour; (6) the indications at the transmitter, if a directional antenna station, of the common point current, base currents, phase monitor sample loop currents and phase indications shall be read and entered in the operating log once each day for each pattern. These readings must be made within two hours after the commencement of operation for each pattern.

All stations, whether operating by remote control or direct control, shall be equipped so as to be able to follow the prescribed procedure for Emergency Broadcast Service in event of national emergency.

3.26 At what place must the station license be posted? Where must the licenses of the operator be posted?

Ans. Station license: In a conspicuous place at the principal control point of the transmitter; a photocopy at each other control point is also required. Operator license: Original license or FCC Form 759 of each operator at his place of duty.

3.27 What are the operator requirements for AM broadcast stations?

Ans. Third Class permit with Broadcast Endorsement, provided that a First Class licensed operator is on call, except in the case of certain stations employing directional antennas, in which case a First Class operator must be on duty at all times during directional operation.

3.28 During what period of time preceding the date of filing for a renewal of the station license should such measurements be made?

Ans. During a four-month period before filing renewal applications.

3.29 (a) Explain how operating power is computed using direct measurement; (b) Using indirect measurement; (c) Under what conditions at a standard broadcast station may the indirect method be used?

Ans. (a) Resistance is determined by taking measurements at 5, 10, 15 and 20 kc on each side of operating frequency. These readings are plotted and a smooth curve developed. Where the operating frequency cuts the curve is the antenna resistance. Operating power is the square of the antenna current times the resistance. (b) Computed from the plate input power of the last radio stage and is the product of $E_p \times I_p \times F$. F is a factor based on method of modulation, maximum rated carrier power and class of amplifier. (c) Emergency, where antenna system has been damaged; pending completion of changes in antenna system or any change affecting antenna system.

3.30 What is the FCC requirement as to maintenance of percentage of modulation?

Ans. As high as possible along with good quality of transmission and broadcast practice. It must not exceed 100% on negative peaks of frequent recurrence, nor should it be less than 85% on peaks of frequent recurrence except as neces-

sary to avoid objectionable loudness.

3.31 (a) What should be done if the station's modulation monitor becomes defective? (b) If the frequency monitor becomes defective?

Ans. (a) The station may be operated up to 60 days without FCC authority, pending repair or replacement. During this time modulation will be monitored with cathode ray oscilloscope, or other means. Engineer in Charge will be notified immediately of defect and whenever additional time is needed to correct. Entries in maintenance log showing date and time, when removed and restored to service; (b) same requirements as in (a) except frequency of station shall be measured by an external source at least each 7 days and results entered in maintenance log.

3.32 Under what conditions may a standard broadcast station use its facilities for communications directly with individuals or other stations? What notice shall be given when a station is operating during a local emergency?

Ans. When there is a severe emergency and communications are to dispatch aid, assist in rescue, promote safety of life and property, and reduce hardship. Notify the FCC in Washington, D. C., Engineer in Charge of District, of use to which station is being put, at the start and end of operations.

3.33 How many times and when must the station's operating log be signed by an operator who goes on duty at 10 a.m. and off duty at 6 p.m.?

Ans. Usually twice; upon going on and coming off duty.

3.34 (a) What entries shall be made in the operating log? (b) In the station's maintenance log?

Ans. (a) All readings pertaining to transmitting apparatus. (b) All readings, tests, and results of equipment installation and grounds inspections.

3.35 How long must the station's logs be kept?

Ans. Two years. However, logs with entries about a disaster, investigation by the FCC, will be kept until the FCC authorizes their destruction. Logs involving claims or complaints shall be kept until settled or when statute time limit runs out.

3.36 What information (logs and records) must be made available to an authorized FCC employee?

Ans. All logs, equipment performance records, copy of most recent antenna resistance or common-point impedance measurements submitted to the FCC and copy of most recent field intensity measurements to establish performance of directional antennas.

3.37 What specific equipment performance measurements must be made at all FM broadcast stations on an annual basis?

Ans. Audio frequency response, audio frequency harmonic distortion, output noise level (frequency modulation), and output noise level (amplitude modulation).

3.38 During what time period may an FM broadcast station transmit signals for testing and maintenance purposes?

Ans. Between 1:00 a.m. and 6:00 a.m.

3.39 What are the operator license requirements for FM broadcast stations?

Ans. One or more operators holding a Third Class permit, endorsed for broadcast operation (Element IX). However, a First Class licensed operator must be on call.

3.40 By what methods may operating power at FM broadcast stations be computed?

Ans. By direct or indirect method.

3.41 What is the allowable frequency tolerance at FM broadcast stations?

Ans. The center frequency shall be maintained within 2000 cycles of the assigned frequency.

3.42 What is SCA? What are some possible uses of SCA?

Ans. SCA means Subsidiary Communications Authorization. It permits limited types of secondary services on a multiplex basis. Possible uses are: (1) Transmissions of interest to segments of public wishing to subscribe thereto, and (2) transmissions of signals directly related to operation of FM broadcast stations.

3.43 What items must be included in an SCA operating log?

Ans. The times subcarrier generator is turned on and off; and times modulation is applied to, and removed from subcarrier. Daily entries are made excluding subcarrier interruptions of 5 minutes or less.

3.44 What are the transmission standards of subsidiary communications multiplex operations?

Ans. FM of SCA subcarriers shall be used; instantaneous frequency shall be within 20 to 75 kc -- range for stereophonic broadcast is 53 to 75 kc; sum of modulation of main carrier by SCA subcarriers shall not exceed 30% -- 10% for stereophonic broadcast; FM of main carrier caused by SCA subcarrier shall, in frequency range 50 to 15,000 cycles, be at least 60 db below 100% modulation.

3.45 What are the licensed operator requirements for a TV broadcast station? An FM broadcast station? A 5-kilowatt, nighttime directional standard broadcast station?

Ans. For a TV broadcast station, one or more licensed radiotelephone First Class operators must be on duty where the transmitting equipment is located, and in actual charge thereof when the equipment is in operation.

At an FM broadcast station, one or more operators holding a Third Class permit, endorsed for broadcast operation, must be on duty, provided that a First Class licensed operator is on call.

Adjustment of transmitting equipment by lower-class operators, except when under the immediate supervision of a radiotelephone First Class operator, shall be limited to the following; (1) putting the transmitter on and off the air in a routine manner; (2) making external adjustments required as a result of variations of primary power supply; (3) making external adjustments required to insure proper modulation.

Should the transmitting equipment be observed to be operating improperly, an operator holding a license other than First Class must shut down the equipment and call a radiotelephone First Class operator to make the necessary repairs and adjustments. Every FM station with power over 25 kw must have at least one

First Class licensed operator in full-time employment, whose primary duties are to insure proper equipment operation.

For an AM broadcast using a highly critical or unstable directional antenna, a First Class licensed operator is required on duty during directional operation. In less critical installations, a Third Class operator may be employed, but only if a First Class operator is on call.

3.46 What is the frequency tolerance for television stations?

Ans. (a) The carrier frequency of the visual transmitter shall be maintained within ± 1000 cycles of the authorized carrier frequency. (b) The center frequency of the aural transmitter shall be maintained 4.5 megacycles ± 1000 cycles, above the visual carrier frequency.

3.47 What items must be included in a television station's operating log? What items must be included in a television station's maintenance log?

Ans. The following entries shall be made in the operating log by the properly licensed operator in actual charge of the transmitting apparatus only: (a) An entry of the time the station begins to supply power to the antenna and the time it stops. (b) An entry of each interruption of the carrier wave, where restoration is not automatic, its cause and duration followed by the signature of the person restoring operation (if licensed operator other than the licensed operator on duty). (c) An entry, at the beginning of operation and at intervals not exceeding one-half hour, of the following (actual readings observed prior to making any adjustments to the equipment) and, when appropriate, an indication of corrections made to restore parameters to normal operating values: (1) Operating constants of last radio stage of aural transmitter (total plate voltage and plate current). (2) Transmission line meter readings for both transmitters. (d) Any other entries required by the instrument of authorization or the provisions of this part. (e) The entries required for tower light inspections.

The following entries shall be made in the maintenance log: (a) An entry each week of the time and result of test of auxiliary transmitters. (b) A notation each week of the calibration check of automatic recording devices. (c) An entry describing the method used and the results obtained in determining the operating frequency of the transmitter: (1) Whenever the required frequency check is made. (2) Whenever the required frequency measurement is made. (d) An entry of the date and time of removal from and restoration to service of any of the following equipment in the event it becomes defective: (1) Visual modulation monitoring equipment or aural modulation monitor. (2) Final stage plate voltmeters of aural and visual transmitters. (3) Final stage plate ammeters of aural and visual transmitters. (4) Visual and aural transmitter transmission line radio frequency voltage, current, or power meter. (e) Record of tower light inspections. (f) Entries shall be made so as to describe fully any operation for testing and maintenance purposes.

3.48 (a) How is operating power determined for the visual transmitter at a television broadcast station? (b) For the aural transmitter?

Ans. (a) Average power output shall be measured while operating into a dummy load of substantially zero reactance and a resistance equal to the

transmission line characteristic impedance. During this measurement the transmitter shall be modulated only by a standard synchronizing signal with blanking level set at 75 per cent of peak amplitude as observed in an output monitor, and with this blanking level amplitude maintained throughout the time interval between synchronizing pulses. The peak power output shall be the power so measured in the dummy load multiplied by the factor 1.68. During this measurement the direct plate voltage and current of the last radio stage and the transmission line meter shall be read and compared with similar readings taken with the dummy load replaced by the antenna. These readings shall be in substantial agreement. (b) Determined by either the direct or indirect method: (1) Using the direct method, the power shall be measured at the output terminals of the transmitter while operating into a dummy load of substantially zero reactance and a resistance equal to the transmission line characteristic impedance. The transmitter shall be unmodulated during this measurement. During this measurement the direct plate voltage and current of the last radio stage and the transmission line meter shall be read and compared with similar readings taken with the dummy load replaced by the antenna. These readings shall be in substantial agreement. (2) Using the indirect method, the operating power is the product of the plate voltage (E_p) and the plate current (I_p) of the last radio stage, and an efficiency factor, F, as follows:

$$\text{Operating power} = E_p \times I_p \times F$$

3.49 Describe the Emergency Action Notification Attention Signal.

Ans. It consists of two 5-second carrier breaks and 15 seconds of 1000 cps tone. It is followed by the warning or other message.

3.50 Under normal conditions all standard FM and TV broadcast stations must make what provisions for receiving Emergency Action Notifications and Terminations?

Ans. Licensees are required to install, maintain, and operate radio receiving equipment for such messages.

3.51 What type of station identification shall be given during an Emergency Action Condition?

Ans. No broadcast of call letters; only State and Operational Area identifications will be given.

3.52 Must stations operate in accordance with Section 73.57 (about maintenance of operating power) of the FCC Rules during an Emergency Action Condition?

Ans. No, not while operating under NDEA.

3.53 How often and at what times must EBS tests be sent?

Ans. Once each week on an unscheduled basis between 8:30 a.m. and local sunset.

SPECIAL BROADCAST SERVICES

3.54 What is the uppermost power limitation imposed on remote pickup broadcast stations? STL (studio transmitter link) stations? Intercity relay broadcast stations?

Ans. Not more than 5% above the maximum authorized power for all these stations.

3.55 What records of operation must be maintained for each licensed remote pickup broadcast station?

Ans. Hours of operation; program transmitted; frequency check; remarks about transmission; entry giving points of program origination and receiver location; where an antenna structure(s) is required to be illuminated.

3.56 What is the basic difference between STL and Intercity Relay broadcast stations?

Ans. STL stations can transmit program material only between the studio and transmitter location of a broadcast station; the Intercity Relay station is authorized to transmit between broadcast stations.

3.57 What type of antenna must be used with STL and Intercity Relay broadcast stations?

Ans. Directional.

3.58 What is the frequency tolerance provided by FCC Rules for an STL (studio transmitter link) and Intercity Relay broadcast station?

Ans. ± 0.005 per cent of the assigned frequency.

ANTENNAS

3.59 Under what two general conditions must antenna structures be painted and lighted?

Ans. When higher than 200 feet above ground or when aeronautical study is required.

3.60 What color(s) should antenna structures be painted? Where can paint samples be obtained?

Ans. With alternate bands of aviation surface orange and white. Specifications for paint can be obtained from General Services Administration, Washington, D.C. 20407.

3.61 If a tower is required to be lighted and the lights are controlled by a light-sensitive device and the device malfunctions, when should the tower lights be on?

Ans. Sunset to sunrise.

3.62 As a general rule, a light-sensitive device used to control tower lights should face which direction?

Ans. North.

3.63 If the operation of a station's tower lights are not continuously monitored by an alarm device, how often should the lights be visually checked?

Ans. At least once each 24 hours.

3.64 How often should automatic control devices and alarm circuits associated with antenna tower lights be checked for proper operation?

Ans. Not less than once every three months.

3.65 What items regarding the operation of antenna tower lighting should be included in the station's maintenance log?

Ans. The licensee of any radio station which has an antenna structure requiring illumination shall make the following entries in the station record of the inspections: (a) The time the tower lights are turned on and off each day if manually controlled. (b) The time the daily check of proper operation of the tower lights was made, if automatic alarm system is not provided. (c) In the event of any observed or otherwise known extinguishment or improper functioning of a tower light: (1) Nature of such extinguishment or improper functioning. (2) Date and time the extinguishment or improper functioning was observed, or otherwise noted. (3) Date, time, and nature of the adjustments, repairs or replacements made. (4) Identification of Flight Service Station (Federal Aviation Administra-

tion) notified of the extinguishment of improper functioning of any code or rotating beacon light or top light not corrected within 30 minutes, and the date and time such notice was given. (5) Date and time notice was given to the Flight Service Station (Federal Aviation Administration) that the required illumination was resumed. (d) Upon completion of the periodic inspection required at least once each 3 months: (1) The date of the inspection and the condition of all tower lights and associated tower lighting control devices, indicators and alarm systems. (2) Any adjustments, replacements, or repairs made to insure compliance with the lighting requirements and the date such adjustments, replacements or repairs were made.

3.66 Generally speaking, how often should the antenna tower be painted?

Ans. As necessary to maintain good visibility.

3.67 Is it necessary to have replacement lamps for the station's antenna tower lights?

Ans. A sufficient supply of spare lamps shall be maintained for immediate replacement at all times.

3.68 Generally speaking, how soon, after a defect in the antenna tower lights is noted, should the defect be corrected?

Ans. As soon as possible.

3.69 What action should be taken if the tower lights at a station malfunction and cannot be repaired immediately?

Ans. Report immediately by telephone or telegraph to the nearest airways communications station or office of the Federal Aviation Agency any observed failure of any code or rotating beacon light if such failure is not corrected within thirty minutes after observation thereof. Further, notify the above station or office immediately upon resumption of the required illumination. Data concerning the failure of tower lights must also be recorded in the station log. Include in the log entry the nature of the failure, the date and time the failure was observed, and the date, time, and nature of the adjustments, repairs, or replacements made. In the event of failure of rotating or beacon lights, the time of notifying the Federal Aviation Agency must also be entered.

Glossary - - FCC Words and Phrases

CONTENTS

HOW TO USE THIS GLOSSARY

When the Service is shown separately, use the section first. Whenever the word or phrase is not shown, use Section I - General Definitions next.

These groupings by Service are arranged for your convenient reference when studying for the exam. Necessarily, all definitions are not shown because some of them are very simple or familiar.

An asterisk (*) with a word means an often asked definition in examination. Know these words very well.

I General Definitions

Active satellite. An earth satellite carrying a station intended to transmit or retransmit radiocommunication signals.

Alaska Communication System or ACS. The telecommunication system within Alaska and between Alaska and other areas which is operated by the United States Army Signal Corps.

Alaska-public fixed station. A fixed station in Alaska, which is open to public correspondence and is licensed by the Commission for radiocommunication between specified fixed points in Alaska exclusively.

Antenna power gain. The square of the ratio of the root-mean-square free space field intensity produced at one mile in the horizontal plane, in millivolts per meter for one kilowatt antenna input power to 137.6 mv/m. This ratio should be expressed in decibels (db). (If specified for a particular direction, antenna power gain is based on the field strength in that direction only.)

Antenna power input. The radio frequency peak or RMS power, as the case may be, supplied to the antenna from the antenna transmission line and its associated impedance matching network.

Antenna structures. The term "antenna structure" includes the radiating system, its supporting structures, and any surmounting appurtenances.

Assigned frequency. The frequency coinciding with the center of an authorized bandwidth of emission shall be specified as the assigned frequency.

Aural broadcast intercity relay station. A fixed station utilizing telephony for the transmission of aural program material between broadcasting stations other than international broadcasting stations, for simultaneous or delayed broadcast.

Aural broadcast STL (studio transmitter link) station. A fixed station utilizing telephony for the transmission of aural program material between a studio and the transmitter of a broadcasting station other than an international broadcasting station, for simultaneous or delayed broadcast.

*Authorized bandwidth. The authorized bandwidth is the occupied bandwidth authorized to be used by a station.

Authorized carrier frequency. A specific carrier frequency authorized for use by a station, from which the actual or suppressed carrier frequency is permitted to deviate, solely because of frequency instability, by an amount not to exceed the frequency tolerance.

Authorized frequency. The frequency assigned to a station by the Commission and specified in the instrument of authorization.

Authorized power. The power assigned to a radio station by the Commission and specified in the instrument of authorization. The authorized power does not necessarily correspond to the power used by the Commission for purposes of its Master Frequency Record (MFR) and notification to the International Telecommunication Union.

***Bandwidth occupied by an emission.** The width of the frequency band (normally specified in kilocycles) containing those frequencies upon which a total of 99 percent of the radiated power appears, extended to include any discrete frequency upon which the power is at least 0.25 percent of the total radiated power.

Baseband. In the process of modulation, the baseband is the frequency band occupied by the aggregate of the modulating signals when first used to modulate a carrier.

***Base station.** A land station in the land mobile service carrying on a service with land mobile stations.

Broadcasting service. A radiocommunication service in which the transmissions are intended for direct reception by the general public. This service may include sound transmissions, television transmissions or other types of transmissions.

Broadcasting station. A station in the broadcasting service.

***Carrier.** In a frequency stabilized system, the sinusoidal component of a modulated wave whose frequency is independent of the modulating wave; or the output of a transmitter when the modulating wave is made zero; or a wave generated at a point in the transmitting system and subsequently modulated by the signal; or a wave generated locally at the receiving terminal which, when combined with the side bands in a suitable detector, produces the modulating wave.

***Carrier frequency.** The frequency of the carrier.

Carrier power. The average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle under conditions of no modulation. This definition does not apply to pulse modulated emissions.

Citizens radio service. A radiocommunication service of fixed, land, and mobile stations intended for personal or business radiocommunications, radio signalling, control of remote objects or devices by means of radio, and other purposes not specifically prohibited.

***Coast station.** A land station in the maritime mobile service.

"Common carrier" or "carrier". "Common carrier" or "carrier" means any person engaged as a common carrier for hire, in interstate or foreign communication by wire or radio or in interstate or foreign radio transmission of energy, except where reference is made to common carriers not subject to the Communications Act of 1934, as amended; but a person engaged in radio broadcasting shall not, insofar as such person is so engaged, be deemed a common carrier.

Common carrier fixed station. A fixed station open to public correspondence.

Common carrier land station. A land station open to public correspondence.

Common carrier mobile station. A mobile station open to public correspondence.

Communication common carrier. Any person engaged in rendering communication service for hire to the public.

Communication-satellite earth station. An earth station in the communication-satellite service.

Communication-satellite service. A space service: (a) between earth stations, when using active or passive satellites for the exchange of communications of the fixed or mobile service, or (b) between an earth station and stations on active satellites for the exchange of communications of the mobile service, with a view to their re-transmission to or from stations in the mobile service.

Communication-satellite space station. A space station in the communication-satellite service, on an earth satellite.

Community antenna relay service. A fixed service, the stations of which are used for the transmission of television and related audio signals, and signals of standard and FM broadcasting stations, to a terminal point from which the signals are distributed to the public by cable.

Community antenna relay station. A fixed station in the community antenna relay service.

Control point. A control point is an operating position which is under the control and supervision of the licensee, at which a person immediately responsible for the proper operation of the transmitter is stationed, and at which adequate means are available to aurally monitor all transmissions and to render the transmitter inoperative.

Control station. A fixed station whose transmissions are used to control automatically the emissions or operations of another radio station at a specified location, or to transmit automatically to an alarm center telemetering information relative to the operation of such station.

Deep space. Space at distances from the earth equal to or greater than the distance between the earth and the moon.

Developmental broadcast station. A station licensed experimentally to carry on development and research primarily in radiotelephony for the advancement of the broadcast services.

Disaster communications service. A service of fixed, land, and mobile stations licensed or authorized to provide essential communications incident to or in connection with disaster or other incidents which involve loss of communications facilities normally available or which require the temporary establishment of communications facilities beyond those normally available.

Dispatch point. A dispatch point is any position from which messages may be transmitted under the supervision of the person at a control point.

Domestic fixed public service. A fixed service, the stations of which are open to public correspondence, for radiocommunications originating and terminating solely at points all of which lie within: (a) the State of Alaska, or (b) the State of Hawaii, or (c) the contiguous 48 states and the District of Columbia, or (d) a single possession of the United States. Generally, in cases where service is afforded on frequencies above 72 mc/s, radiocommunications between the contiguous 48 States (including the District of Columbia) and Canada or Mexico, or radiocommunications between the State of Alaska and Canada, are deemed to be in the domestic fixed public service.

Domestic fixed public station. A fixed station in the domestic fixed public service.

Domestic public radiocommunication services. The land mobile and domestic fixed public services the stations of which are open to public correspondence.

Duplex operation. Operating method in which transmission is possible simultaneously in both directions.

***Earth station.** A station in the space service located either on the earth's surface, including on board a ship, or on board an aircraft.

Environmental communications. Communications in the maritime mobile service for the broadcast of information pertaining to the environmental conditions, in which vessels operate, i.e., weather, sea conditions, time signals of a grade adequate for practical navigation, notices to mariners and hazards to navigation.

Experimental station. A station utilizing radio waves in experiments with a view to the development of science or technique. This definition does not include amateur stations.

Experimental television broadcast station. A station licensed for experimental transmission of transient visual images of moving or fixed objects for simultaneous reception and reproduction by the general public.

Facsimile. A system of telecommunication for the transmission of fixed images, with or without halftones, with a view to their reproduction in a permanent form.

Facsimile broadcasting station. A station licensed to transmit images of still objects for record reception by the general public.

Fixed earth station. An earth station intended to be used at a specified fixed point.

Fixed public control service. A fixed service carried on for the purpose of transmitting intelligence between transmitting or receiving stations in the public radiocommunication services and the message centers or control points associated therewith.

Fixed relay station. An operational fixed station established for the automatic retransmission of radiocommunications received from either one or more fixed stations or from a combination of fixed and mobile stations and directed to a specified location.

Fixed service. A service of radiocommunication between specified fixed points.

***Fixed station.** A station in the fixed service.

FM broadcasting station. A broadcasting station utilizing telephony by means of frequency modulation, and when authorized under a Subsidiary Communications Authorization (SCA), utilizing F9 emissions.

Frequency modulation (FM). A system of modulation where the instantaneous

radio frequency varies in proportion to the instantaneous amplitude of the modulating signal (amplitude of modulating signal to be measured after pre-emphasis, if used) and the instantaneous radio frequency is independent of the frequency of the modulating signal.

Frequency tolerance. The extent to which an actual or suppressed carrier frequency is permitted to depart, solely because of frequency instability, from the authorized carrier frequency. The frequency tolerance is expressed in parts in 10^6 or in cycles per second.

Gc/s (gigacycle per second). A gigacycle per second (gc/s) means one thousand megacycles.

Great Lakes Agreement. The Agreement for the Promotion of Safety on the Great Lakes by Means of Radio and the regulations referred to therein, made by and between the Governments of the United States and Canada, which came into force on November 13, 1954.

***Harmful interference.** Any emission, radiation or induction which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service.

Hertz. A unit of frequency equivalent to one cycle per second. The terms Hertz (Hz) and cycle(s) per second (c/s) are synonymous and may be used interchangeably.

Hours of service. The period of time during each calendar day when a station is used, in conformity with the terms of the station authorization, for the rendition of its normal service.

Industrial radio services. Any service of radiocommunication essential to, operated by, and for the sole use of, those enterprises which for purposes of safety or other necessity require radiocommunication in order to function efficiently, the radio transmitting facilities of which are defined as fixed, land, mobile or radiolocation stations.

Industrial, scientific and medical equipment (ISM equipment). Devices which use radio waves for industrial, scientific, medical, or any other purposes including the transfer of energy by radio and which are neither used nor intended to be used for radiocommunication.

Instructional television fixed station. A fixed station operated by an educational organization and used primarily for the transmission of visual and aural instructional,

cultural and other types of educational material to one or more fixed receiving locations.

ITFS response station. A fixed station operated at an authorized location to provide voice communication to an associated instructional television fixed station.

International broadcasting station. A broadcasting station employing frequencies allocated to the broadcasting service between 5950 kc/s and 26100 kc/s, whose transmissions are intended to be received directly by the general public in foreign countries.

International control station. A fixed station in the fixed public control service associated directly with the international fixed public radiocommunication service.

International fixed public radio service. A fixed service, the stations of which are open to public correspondence and which, in general, is intended to provide radiocommunication between any one of the contiguous 48 states (including the District of Columbia) and the State of Alaska, or the State of Hawaii, or any U. S. possession or any foreign point; or between any U. S. possession and any other point; or between the State of Alaska and any other point; or between the State of Hawaii and any other point. In addition, radiocommunications within the contiguous 48 states (including the District of Columbia) in connection with the relaying of international traffic between stations which provide the above service, are also deemed to be in the international fixed public radiocommunication service; provided, however, that communications solely between Alaska, or any one of the contiguous 48 states (including the District of Columbia), and either Canada or Mexico are not deemed to be in the international fixed public radiocommunication service when such radiocommunications are transmitted on frequencies above 72 mc/s.

International fixed public station. A fixed station in the international fixed public radio service.

International Radio Regulations. The Radio Regulations in force annexed to the International Telecommunication Convention, Geneva, 1959, as between the Government of the United States and other Contracting Governments; and such preceding international radio regulations as remain in force between the Government of the United States and other Contracting Governments.

Interzone station. A fixed station in the public safety (police) radio service using radiotelegraphy (A1 emission) for communication with zone stations within the zone and with interzone stations in other zones.

Ionospheric scatter. The propagation of radio waves by scattering as a result of irregularities or discontinuities in the ionization of the ionosphere.

Kc/s (kilocycle per second). A kilocycle per second (kc/s) means one thousand cycles per second.

***Land mobile service.** A mobile service between base stations and land mobile stations, or between land mobile stations.

Land mobile station. A mobile station in the land mobile service capable of surface movement within the geographical limits of a country or continent.

***Land station.** A station in the mobile service not intended to be used while in motion.

Land transportation radio service. Any private service of radiocommunication essential to the conduct of certain land transportation activities and operated for the use of persons engaged in those activities, the transmitting facilities of which are defined as fixed, land, mobile or radiolocation stations.

Loran station. A long distance radionavigation land station transmitting synchronized pulses. Hyperbolic lines of position are determined by the measurement of the difference in the time of arrival of these pulses.

Man-made structure. Any construction other than a tower, mast or pole.

Marine radiobeacon station. A radionavigation land station, the emissions of which are intended to enable a ship station to determine its bearing or its direction in relation to the marine radiobeacon station.

Maritime mobile service. A mobile service between coast stations and ship stations, or between ship stations, in which survival craft stations may also participate.

Maritime radionavigation service. A radionavigation service intended for the benefit of ships.

Mc/s (megacycle per second). A megacycle per second (mc/s) means one thousand kilocycles.

Mean power of radio transmitter. The power supplied to the antenna during normal operation, averaged over a time sufficiently long compared to the period corresponding to the lowest frequency encountered in actual modulation.

Meteorological aids service. A radiocommunication service used for meteorological, including hydrological, observations and exploration.

Meteorological-satellite earth station. An earth station in the meteorological-satellite service.

Meteorological-satellite service. A space service in which the results of meteorological observations, made by instruments on earth satellites, are transmitted to earth stations by space stations on these satellites.

Meteorological-satellite space station. A space station in the meteorological-satellite service, on an earth satellite.

Mobile earth station. An earth station intended to be used while in motion or during halts at unspecified points.

Mobile, except television pickup, station. Any mobile station other than a television pickup station.

Mobile relay station. A base station established for the automatic retransmission of mobile service communications which originate on the transmitting frequency of the mobile stations and which are retransmitted on the receiving frequency of the mobile stations.

***Mobile service.** A service of radiocommunication between mobile and land stations, or between mobile stations.

Mobile station. A station in the mobile service intended to be used while in motion or during halts at unspecified points.

Modulation. The process of producing a wave some characteristic of which varies as a function of the instantaneous value of another wave, called the modulating wave.

NARBA and the U.S./Mexican Agreement. "NARBA" means the North American Regional Broadcasting Agreement signed at Washington, D. C., November 15, 1950, which entered into force April 19, 1960 and to which the signatory countries are The Bahama Islands and Jamaica, Canada, Cuba, the Dominican Republic, and the United States of America. U.S./Mexican Agreement means the Agreement between the United States of America and the United Mexican States concerning radio broadcasting in the standard broadcast band signed at Mexico, D.F., January 29, 1957 which entered into force June 9, 1961.

Occupied Bandwidth. The frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

Operational land station. A land station, excluding aeronautical stations, not open to public correspondence, operated by and for the sole use of those agencies operating their own radiocommunication facilities in the public safety, industrial, land transportation, marine or aviation services.

Operational mobile station. A mobile station, excluding aircraft stations, not open to public correspondence, operated by and for the sole use of those agencies operating their own communication facilities in the public safety, industrial, land transportation, marine or aviation services.

Passive satellite. An earth satellite intended to transmit radiocommunication signals by reflection.

Peak envelope power. The average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle at the highest crest of the modulation envelope, taken under conditions of normal operation.

Peak power of a radio transmitter. The mean power supplied to the antenna during one radio frequency cycle at the highest crest of the modulation envelope, taken under conditions of normal operation.

Permittee. A person who holds a valid station construction permit.

Person. An individual, partnership, association, joint stock company, trust, or corporation.

Point of communication. This term, when applied to an Alaska-public fixed station, means a specified fixed station or specified geographic location with which such station is authorized to communicate.

Port operations. Communications in or near a port, or in locks or waterways, between coast stations and ship stations, or between ship stations, in which messages are restricted to those relating to the movement and safety of ships and, in emergency, to the safety of persons.

***Primary standard of frequency.** The primary standard of frequency for radio frequency measurements shall be the national standard of frequency maintained by the National Bureau of Standards, Department of Commerce, Washington, D. C. The operating frequency of all radio stations will be determined by comparison with this standard or the standard signals of station WWV of the National Bureau of Standards.

Public correspondence. Any telecommunication which the offices and stations must, by reason of their being at the disposal of the public, accept for transmission.

Public safety radio service. Any service of radiocommunication essential either to the discharge of non-Federal governmental functions or the alleviation of an emergency endangering life or property, the radio transmitting facilities of which are defined as fixed, land, mobile, or radiolocation stations.

Racon. A radionavigation system transmitting, automatically or in response to a predetermined received signal, a pulsed radio signal with specific characteristics.

Racon station. A radionavigation land station which employs a racon.

Radar. A radiodetermination system based on comparison of reference signals with radio signals reflected, or retransmitted, from the position to be determined.

Radio. A general term applied to the use of radio waves.

Radio astronomy. Astronomy based on the reception of radio waves of cosmic origin.

Radio astronomy service. A service involving the use of radio astronomy.

Radio astronomy station. A station in the radio astronomy service.

Radiobeacon station. A station in the radionavigation service, the emissions of which are intended to enable a mobile station to determine its bearing or direction in relation to the radiobeacon station.

Radiocommunication. Telecommunication by means of radio waves.

Radiodetermination. The determination of position, or the obtaining of information relating to position, by means of the propagation properties of radio waves.

Radiodetermination service. A service involving the use of radiodetermination.

Radiodetermination station. A station in the radiodetermination service.

Radio direction-finding. Radiodetermination using the reception of radio waves for the purpose of determining the direction of a station or object.

Radio direction-finding station. A radiodetermination station using radio direction-finding.

Radio district. The territory within each radio district.

Radiolocation. Radiodetermination used for purposes other than those of radionavigation.

Radiolocation land station. A station in the radiolocation service not intended to be used while in motion.

Radiolocation mobile station. A station in the radiolocation service intended to be used while in motion or during halts at unspecified points.

Radiolocation service. A radiodetermination service involving the use of radiolocation.

Radionavigation. Radiodetermination used for the purposes of navigation, including obstruction warning.

Radionavigation land station. A station in the radionavigation service not intended to be used while in motion.

Radionavigation mobile station. A station in the radionavigation service intended to be used while in motion or during halts at unspecified points.

Radionavigation-satellite earth station. An earth station in the radionavigation-satellite service.

Radionavigation-satellite service. A service using space stations on earth satellites for the purpose of radionavigation, including, in certain cases, transmission or re-transmission of supplementary information necessary for the operation of the radionavigation system.

Radionavigation-satellite space station. A space station in the radionavigation-satellite service, on an earth satellite.

Radionavigation service. A radiodetermination service involving the use of radionavigation.

Radionavigation station. A station in the radionavigation service.

Radio range station. A radionavigation land station in the aeronautical radionavigation service providing radial equisignal zones.

Radiosonde. An automatic radio transmitter in the meteorological aids service usually carried on an aircraft, free balloon, kite or parachute, and which transmits meteorological data.

Radio service. An administrative subdivision of the field of radiocommunication. In an engineering sense, the subdivisions may be made according to the method of operation, as, for example, mobile service and fixed service. In a regulatory sense, the subdivisions may be descriptive of particular groups of licensees.

Radio waves (or Hertzian waves). Electromagnetic waves of frequencies lower than 3,000 gc/s (3,000,000 mc/s), propagated in space without artificial guide.

Region 1, Region 2, and Region 3. Those geographic areas defined as "Region 1", "Region 2", and "Region 3" in Article 5 of the International Radio Regulations, Geneva, 1959.

Remote pickup broadcast base station. A base station licensed for communicating with remote pickup broadcast mobile stations.

Remote pickup broadcast mobile station. A land mobile station licensed for the transmission of program material and related communications from the scene of events which occur outside a studio to broadcasting station, and for communicating with other remote pickup broadcast base and mobile stations.

Repeater station. An operational fixed station established for the automatic retransmission of radio communications received from any station in the Mobile Service.

Safety Convention. The International Convention for the Safety of Life at Sea, London, 1960, including the Regulations annexed thereto.

Safety service. A radiocommunication service used permanently or temporarily for the safeguarding of human life and property.

Selective calling. A means of calling in which signals are transmitted in accordance with a prearranged code for the purpose of operating a particular automatic attention device in use at the selected station whose attention is sought.

Ship station. A mobile station in the maritime mobile service located on board a vessel, other than a survival craft, which is not permanently moored.

Ship station license. A license authorizing the operation of a ship station, a survival craft station associated with a ship, or a ship radionavigation station.

Signaling. Intermittent or periodic transmission (excluding radiotelephony or any type of Morse code) of intelligence by means of prearranged tones, impulses, or combinations thereof, designed to actuate a mechanism at the point of reception.

Simplex operation. Operating method in which transmission is made possible alternately in each direction, for example, by means of manual control.

Spacecraft. Any type of space vehicle including an earth satellite or a deep-space probe, whether manned or unmanned.

Space research earth station. An earth station in the space research service.

Space research service. A space service in which spacecraft or other objects in space are used for scientific or technological research purposes.

Space research space station. A space station in the space research service.

Space telecommand. The use of radiocommunication for the transmission of signals to a space station to initiate, modify or terminate functions of the equipment on a space object, including the space station.

Space telemetering. The use of telemetering for the transmission from a space station of results of measurements made in a spacecraft, including those relating to the functioning of the spacecraft.

Space tracking. Determination of the orbit, velocity or instantaneous position of an object in space by means of radio determination, excluding primary radar, for the purpose of following the movement of the object.

Space service. A radiocommunication service: (a) between earth stations and space stations, or (b) between space stations, or (c) between earth stations when the signals are retransmitted by space stations, or transmitted by reflection from objects in space, excluding reflection or scattering by the ionosphere or within the earth's atmosphere.

Spurious emission. Emission on a frequency or frequencies which are outside the necessary band, and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, and intermodulation products, but exclude emissions in the immediate vicinity of the necessary band, which are a result of the modulation process for the transmission of information.

Standard broadcasting station. A broadcasting station operated on a frequency in the band 535-1605 kilocycles.

Standard frequency service. A radiocommunication service for scientific, technical and other purposes, providing the transmission of specified frequencies of stated high precision, intended for general reception.

Stationary satellite. A satellite, the circular orbit of which lies in the plane of the earth's equator and which turns about the polar axis of the earth in the same direction and with the same period as those of the earth's rotation.

Station. One or more transmitters or receivers or a combination of transmitters and

receivers, including the accessory equipment, necessary at one location for carrying on a radiocommunication service. Each station shall be classified by the service in which it operates permanently or temporarily.

*Station authorization. Any construction permit, license, or special temporary authorization issued by the Commission.

Survival craft station. A mobile station in the maritime or aeronautical mobile service intended solely for survival purposes and located on any lifeboat, liferaft or other survival equipment.

Telecommunication. Any transmission, emission or reception of signs, signals, writing, images, and sounds, or intelligence of any nature by wire, radio, optical or other electromagnetic systems.

Telegraphy. A system of telecommunication which is concerned in any process providing transmission and reproduction at a distance of documentary matter, such as written or printed matter or fixed images, or the reproduction at a distance of any kind of information in such form. The foregoing definition appears in the International Telecommunication Convention, but, for the purposes of the Commission's rules, telegraphy shall mean, unless otherwise specified, "A system of telecommunication for the transmission of written matter by the use of a signal code."

Telemetering. The use of telecommunication for automatically indicating or recording measurements at a distance from the measuring instrument.

Telemetering fixed station. A fixed station, the emissions of which are used for telemetering.

Telemetering land station. A land station, the emissions of which are used for telemetering.

Telemetering mobile station. A mobile station, the emissions of which are used for telemetering.

Telephony. A system of telecommunication set up for the transmission of speech or, in some cases, other sounds.

Television. A system of telecommunication for transmission of transient images of fixed or moving objects.

Television broadcasting station. A broadcasting station utilizing both television and telephony to provide combination and simultaneous visual and aural programs intended to be received directly by the general public.

Terrestrial service. Any radio service defined in this Part, other than a space service or the radio astronomy service.

Terrestrial station. A station in a terrestrial service.

Tropospheric scatter. The propagation of radio waves by scattering as a result of irregularities or discontinuities in the physical properties of the troposphere.

Zone station. A fixed station in the public safety (police) radio service using radiotelegraph (A1 emission) for communication with other similar stations in the same zone and with an interzone station.

II Experimental Radio Services (other than broadcast)

Experimental Service. A service in which Hertzian waves are employed for purposes of experimentation in the radio art or for purposes of providing essential communications for research projects which could not be conducted without the benefit of such communications.

Experimental Service (Research). An Experimental Service (1) for research in the radio art not related to the development of an established or proposed new service, or (2) for providing essential communications for research projects which could not be conducted without the benefit of such communications.

Experimental Service (Developmental). An Experimental Radio Service for the development of equipment, engineering or operational data, or techniques for an existing or proposed radio service.

III Radio Frequency Devices

Community antenna television system. A restricted radiation device designed and used for the purpose of distributing television signals by means of conducted or guided radio frequency currents to a multiplicity of receivers outside the confines of a single building. **Note:** The television signals that are distributed are modulated radio frequency signals and may be: (a) Broadcast signals that have been received and amplified, (b) Broadcast signals that have been received and converted to another frequency, (c) Any other modulated radio frequency signals fed into the system.

Incidental radiation device: A device that radiates radio frequency energy during the course of its operation although the device is not intentionally designed to generate radio frequency energy.

Low power communication device. A low power communication device is a restricted radiation device, exclusive of those employing conducted or guided radio frequency techniques, used for the transmission of signs, signals, (including control signals), writing, images and sounds or intelligence of any nature by radiation of electromagnetic energy. Examples: Wireless microphone, phonograph oscillator, radio controlled garage door opener and radio controlled models.

Restricted radiation device. A device in which the generation of radio frequency energy is intentionally incorporated into the design and in which the radio frequency energy is conducted along wires or is radiated, exclusive of transmitters which require licensing under other parts of this chapter and exclusive of devices in which the radio frequency energy is used to produce physical, chemical, or biological effects in materials and which are regulated under the Rules.

Television broadcast receiver. Apparatus designed to receive television pictures broadcast simultaneously with sound.

IV Industrial, Scientific and Medical Equipment

Industrial heating equipment. Any apparatus which utilizes a radio frequency oscillator or any other type of radio frequency generator and transmits radio frequency energy used for or in connection with industrial heating operations utilized in a manufacturing or production process.

Industrial, scientific and medical equipment (ISM equipment). Devices which use radio waves for industrial, scientific, medical or any other purposes including the transfer of energy by radio and which are neither used nor intended to be used for radiocommunication.

ISM frequency. A frequency assigned for the use of ISM equipment. A specified tolerance is associated with each ISM frequency.

Medical diathermy equipment. Any apparatus (other than surgical diathermy apparatus designed for intermittent operation with low power) which utilizes a radio frequency oscillator or any other type of radio frequency generator and transmits radio frequency energy used for therapeutic purposes.

Miscellaneous equipment. Any apparatus other than that defined in or excepted above in which radio frequency energy is applied to materials to produce physical, biological, or chemical effects such as heating, ionization of gases, mechanical vibrations, hair removal and acceleration of charged particles, which do not involve communications or the use of radio receiving equipment.

Ultrasonic equipment. Any apparatus which generates radio frequency energy and utilizes that energy to excite or drive an electromechanical transducer for the production of sonic or ultrasonic mechanical energy for industrial, scientific, medical or other noncommunication purposes.

V Broadcast Services

A. STANDARD BROADCAST STATIONS

1. General Definitions

Auxiliary transmitter. A transmitter maintained only for transmitting the regular programs of a station in case of failure of the main transmitter.

*Broadcast day. Period of time between local sunrise and 12 midnight local standard time.

*Daytime. Period of time between local sunrise and local sunset.

Dominant station. A Class I station operating on a clear channel.

*Experimental period. That time between 12 midnight and local sunrise. This period may be used for experimental purposes in testing and maintaining apparatus by the licensee of any standard broadcast station on its assigned frequency and with its authorized power, provided no interference is caused to other stations maintaining a regular operating schedule within such period. No station licensed for "daytime" or "specified hours" of operation may broadcast any regular or scheduled program during this period.

*Nighttime. Time between local sunset and 12 midnight local standard time.

Portable transmitter. A transmitter so constructed that it may be moved about conveniently from place to place, and is in fact so moved about from time to time, but not ordinarily used while in motion. In the standard broadcast band, such a transmitter is used in making field intensity measurements for locating a transmitter site for a standard broadcast station. A portable broadcast station will not be licensed in the standard broadcast band for regular transmission of programs intended to be received by the public.

Secondary station. Any station except a Class I station operating on a clear channel.

Service areas. (a) Primary service area of a broadcast station means the area in which the groundwave is not subject to objectionable interference or objectionable fading. (b) Secondary service area of a broadcast station means the area served by the skywave and not subject to objectionable interference. The signal is subject to intermittent variations in intensity. (c) Intermittent service area of a broadcast station means the area receiving service from the groundwave but beyond the primary service area and subject to some interference and fading.

***Standard broadcast band.** The band of frequencies extending from 535 to 1605 kilocycles.

***Standard broadcast channel.** The band of frequencies occupied by the carrier and two sidebands of a broadcast signal with the carrier frequency at the center. Channels shall be designated by their assigned carrier frequencies. The 107 carrier frequencies assigned to standard broadcast stations shall begin at 540 kilocycles and be in successive steps of 10 kilocycles.

***Standard broadcast station.** A broadcasting station licensed for the transmission of radiotelephone emissions primarily intended to be received by the general public and operated on a channel in the band 535-1605 kilocycles.

***Sunrise and sunset.** For each particular location and during any particular month, the time of sunrise and sunset as specified in the instrument of authorization.

2. Technical Definitions

***Antenna current.** The radio frequency current in the antenna with no modulation.

***Antenna power.** Antenna input power or antenna power means the product of the square of the antenna current and the antenna resistance at the point where the current is measured.

***Antenna resistance.** Total resistance of the transmitting antenna system at the operating frequency and at the point at which the antenna current is measured.

Blanketing. Form of interference which is caused by the presence of a broadcast signal of 1 v/m or greater intensity in the area adjacent to the antenna of the transmitting station. The 1 v/m contour is referred to as the blanket contour and the area within this contour is referred to as the blanket area.

Combined audio harmonics. Arithmetical sum of the amplitudes of all the separate harmonic components. Root sum square harmonic readings may be accepted under conditions prescribed by the Commission.

Effective field. Effective field or effective field intensity is the root-mean-square (RMS) value of the inverse distance fields at a distance of 1 mile from the antenna in all directions in the horizontal plane.

***Grid modulation.** Modulation produced by introduction of the modulating wave into any of the grid circuits of any tube in which the carrier frequency wave is present.

***High level modulation.** Modulation produced in the plate circuit of the last radio stage of the system.

***Last radio stage.** Oscillator or radio-frequency-power amplifier stage which supplies power to the antenna.

***Low level modulation.** Modulation produced in an earlier stage than the final.

Maximum percentage of modulation. Greatest percentage of modulation that may be obtained by a transmitter without producing in its output harmonics of the modulating frequency in excess of those permitted by these regulations.

Maximum rated carrier power. Maximum power at which the transmitter can be operated satisfactorily. It is determined by the design of the transmitter and the type and number of vacuum tubes used in the last radio stage.

***Modulated stage.** The radio frequency stage to which the modulator is coupled and in which the continuous wave (carrier wave) is modulated in accordance with the system of modulation and the characteristics of the modulating wave.

***Modulator stage.** The last amplifier stage of the modulating wave which modulates a radio frequency stage.

***Operating power.** Power that is actually supplied to the radio station antenna.

***Percentage modulation (amplitude).** The ratio of half the difference between the maximum and minimum amplitudes of the amplitude modulated wave to the average amplitude expressed in percentage.

***Plate modulation.** Modulation produced by introduction of the modulating wave into the plate circuit of any tube in which the carrier frequency wave is present.

***Plate input power.** The product of the direct plate voltage applied to the tubes in the last radio stage and the total direct current flowing to the plates of these tubes, measured without modulation.

B. FM STATIONS

1. Frequency Modulation

Antenna height above average terrain. The average of the antenna heights above the terrain from 2 to 10 miles from the antenna for the eight directions spaced evenly for each 45 degrees of azimuth starting with True North. (In general, a different antenna height will be determined in each direction from the antenna. The average of these various heights is considered the antenna height above the average terrain. In some cases less than eight directions may be used.) Where circular or elliptical polarization is employed, the antenna height above average terrain shall be based upon the height of the radiation center of the antenna which transmits the horizontal component of radiation.

***Antenna power gain.** The square of the ratio of the root-mean-square free space field strength produced at 1 mile in the horizontal plane, in millivolts per meter for 1 kilowatt antenna input power to 137.6 mv/m. This ratio should be expressed in decibels (db). (If specified for a particular direction, antenna power gain is based on the field strength in that direction only.)

***Center frequency.** (1) The average frequency of the emitted wave when modulated by a sinusoidal signal. (2) The frequency of the emitted wave without modulation.

***Effective radiated power.** The product of the antenna power (transmitter output power less transmission line loss) times (1) the antenna power gain, or (2) the antenna field gain squared. Where circular or elliptical polarization is employed, the term effective radiated power is applied separately to the horizontal and vertical components of radiation. For allocation purposes, the effective radiated power authorized is the horizontally polarized component of radiation only.

***FM broadcast band.** The band of frequencies extending from 88 to 108 megacycles per second, which includes those assigned to noncommercial educational broadcasting.

***FM broadcast channel.** A band of frequencies 200 kc/s wide and designated by its center frequency. Channels for FM broadcast stations begin at 88.1 mc/s and continue in successive steps of 200 kc/s to and including 107.9 mc/s.

***FM broadcast station.** A station employing frequency modulation in the FM broadcast band and licensed primarily for the transmission of radiotelephone emissions intended to be received by the general public.

*Field strength. The electric field strength in the horizontal plane.

Free space field strength. The field strength that would exist at a point in the absence of waves reflected from the earth or other reflecting objects.

*Frequency Modulation. A system of modulation where the instantaneous radio frequency varies in proportion to the instantaneous amplitude of the modulating signal (amplitude of modulating signal to be measured after pre-emphasis, if used) and the instantaneous radio frequency is independent of the frequency of the modulating signal.

*Frequency swing. The instantaneous departure of the frequency of the emitted wave from the center frequency resulting from modulation.

*Multiplex transmission. The simultaneous transmission of two or more signals within a single channel. Multiplex transmission as applied to FM broadcast stations means the transmission of facsimile or other signals in addition to the regular broadcast signals.

*Percentage modulation. The ratio of the actual frequency swing to the frequency swing defined as 100 percent modulation, expressed in percentage. For FM broadcast stations, a frequency swing of ± 75 kilocycles is defined as 100 percent modulation.

2. Stereophonic Broadcasting

*Cross-talk. An undesired signal occurring in one channel caused by an electrical signal in another channel.

FM stereophonic broadcast. The transmission of a stereophonic program by a single FM broadcast station utilizing the main channel and a stereophonic subchannel.

*Left (or right) signal. The electrical output of a microphone or combination of microphones placed so as to convey the intensity, time, and location of sounds originating predominantly to the listener's left (or right) of the center of the performing area.

*Left (or right) stereophonic channel. The left (or right) signal as electrically reproduced in reception of FM stereophonic broadcasts.

*Main channel. The band of frequencies from 50 to 15,000 cycles per second which frequency-modulate the main carrier.

***Pilot subcarrier.** A subcarrier serving as a control signal for use in the reception of FM stereophonic broadcasts.

***Stereophonic separation.** The ratio of the electrical signal caused in the right (or left) stereophonic channel to the electrical signal caused in the left (or right) stereophonic channel by the transmission of only a right (or left) signal.

***Stereophonic subcarrier.** A subcarrier having a frequency which is the second harmonic of the pilot subcarrier frequency and which is employed in FM stereophonic broadcasting.

***Stereophonic subchannel.** The band of frequencies from 23 to 53 kilocycles per second containing the stereophonic subcarrier and its associated sidebands.

3. Facsimile

Available line. The portion of the total length of scanning line that can be used specifically for picture signals.

Index of cooperation. The product of the number of lines per inch, the available line length in inches, and the reciprocal of the line-use ratio (e.g., $105 \times 8.2 \times 8/7 = 984$).

Line-use ratio. The ratio of the available line to the total length of scanning line.

Optical density. The logarithm (to the base 10) of the ratio of incident to transmitted or reflected light.

Rectilinear scanning. The process of scanning an area in a predetermined sequence of narrow straight parallel strips.

C. TELEVISION BROADCAST STATIONS

Amplitude Modulation (AM). A system of modulation in which the envelope of the transmitted wave contains a component similar to the waveform of the signal to be transmitted.

Antenna height above average terrain. The average of the antenna heights above the terrain from two to ten miles from the antenna for the eight directions spaced evenly for each 45 degrees of azimuth starting with True North. (In general, a different antenna height will be determined in each direction from the antenna. The average of these various heights is considered the antenna height above the average terrain. In some cases less than 8 directions may be used.

Antenna power gain. The square of the ratio of the root-mean-square free space field intensity produced at one mile in the horizontal plane, in millivolts per meter for one kilowatt antenna input power to 137.6 mv/m. This ratio should be expressed in decibels (db). (If specified for a particular direction, antenna power gain is based on the field strength in that direction only.)

***Aspect ratio.** The ratio of picture width to picture height as transmitted. The standard now used is 4 to 3.

***Aural transmitter.** The radio equipment for the transmission of the aural signal only.

***Aural center frequency.** (1) The average frequency of the emitted wave when modulated by a sinusoidal signal; (2) the frequency of the emitted wave without modulation.

***Blanking level.** The level of the signal during the blanking interval, except the interval during the scanning synchronizing pulse and the chrominance subcarrier synchronizing burst.

***Chrominance.** The colorimetric difference between any color and a reference color of equal luminance, the reference color having a specific chromaticity.

***Chrominance subcarrier.** The carrier which is modulated by the chrominance information.

***Color transmission.** The transmission of color television signals which can be reproduced with different values of hue, saturation, and luminance.

***Effective radiated power.** The product of the antenna input power and the antenna power gain. This product should be expressed in kilowatts and in decibels above one kilowatt (dbk). (If specified for a particular direction, effective radiated power is based on the antenna power gain in that direction only. The licensed effective radiated power is based on the average antenna power gain for each horizontal plane direction.)

***Field.** Scanning through the picture area once in the chosen scanning pattern. In the line interlaced scanning pattern of two to one, the scanning of the alternate lines of the picture area once.

***Frame.** Scanning all of the picture area once. In the line interlaced scanning pattern of two to one, a frame consists of two fields.

***Free space field intensity.** The field intensity that would exist at a point in the absence of waves reflected from the earth or other reflecting objects.

***Frequency swing.** The instantaneous departure of the frequency of the emitted wave from the center frequency resulting from modulation.

***Interlaced scanning.** A scanning process in which successively scanned lines are spaced an integral number of line widths, and in which the adjacent lines are scanned during successive cycles of the field frequency.

***Luminance.** Luminous flux emitted, reflected, or transmitted per unit solid angle per unit projected area of the source.

***Monochrome transmission.** The transmission of television signals which can be reproduced in gradations of a single color only.

***Negative transmission.** Where a decrease in initial light intensity causes an increase in the transmitted power.

Noise figure of a television broadcast receiver. The ratio of (1) the total noise power delivered by the receiver into its output termination when the noise temperature of its input termination is standard (290°K) at all frequencies, to (2) the portion thereof engendered by the input termination. Note: For a television broadcast receiver, portion (2) includes only that noise from the input termination which appears in the output via the principal frequency transformation and does not include spurious contributions such as those from image frequency transformation.

Peak picture sensitivity for television broadcast receiver. The lowest input signal which results in standard picture test output when the receiver is tuned for maximum picture output. Note: Standard picture test output for symmetrical sine wave modulation shall be 20 volts peak-to-peak between the control elements of the picture tube.

***Peak power.** The power over a radio frequency cycle corresponding in amplitude to synchronizing peaks.

Percentage modulation. As applied to frequency modulation, the ratio of the actual frequency swing to the frequency swing defined as 100 percent modulation, expressed in percentage. For the aural transmitter of television broadcast stations, a frequency swing of ± 25 kilocycles is defined as 100 percent modulation.

Polarization. The direction of the electric field as radiated from the transmitting antenna.

*Reference black level. The level corresponding to the specified maximum excursion of the luminance signal in the black direction.

*Reference white level of the luminance signal. The level corresponding to the specified maximum excursion of the luminance signal in the white direction.

*Scanning. The process of analyzing successively, according to a predetermined method, the light values of picture elements constituting the total picture area.

*Scanning line. A single continuous narrow strip of the picture area containing highlights, shadows, and halftones, determined by the process of scanning.

*Standard television signal. A signal which conforms to the television transmission standards.

*Synchronization. The maintenance of one operation in step with another.

*Television broadcast band. The frequencies in the band extending from 54 to 890 megacycles which are assignable to television broadcast stations. These frequencies are 54 to 72 megacycles (channels 2 through 4), 76 to 88 megacycles (channels 5 and 6), 174 to 216 megacycles (channels 7 through 13), and 470 to 890 megacycles (channels 14 through 83).

Television broadcast station. A station in the television broadcast band transmitting simultaneous visual and aural signals intended to be received by the general public.

Television broadcast booster station. A station in the broadcasting service operated for the sole purpose of retransmitting the signals of a television broadcast station by amplifying and reradiating such signals which have been received directly through space, without significantly altering any characteristic of the incoming signal other than its amplitude.

Television broadcast translator station. A station in the broadcasting service operated for the purpose of retransmitting the signals of a television broadcast station, another television broadcast translator station, or a television translator relay station, by means of direct frequency conversion and amplification of the incoming signals without significantly altering any characteristic of the incoming signal other than its frequency and amplitude, for the purpose of providing television reception to the general public.

*Television channel. A band of frequencies 6 megacycles wide in the television broadcast band and designated either by number or by the extreme lower and upper frequencies.

Television intercity relay station. A fixed station used for intercity transmission of television program material and related communications for use by television broadcast stations.

Television pickup station. A land mobile station used for the transmission of television program material and related communications from the scenes of events occurring at points removed from television broadcast station studios to television broadcast stations.

Television STL station (studio-transmitter link). A fixed station used for the transmission of television program material and related communications from the studio to the transmitter of a television broadcast station.

***Television transmission standards.** The standards which determine the characteristics of a television signal as radiated by a television broadcast station.

Television transmitter. The radio transmitter or transmitters for the transmission of both visual and aural signals.

Television translator relay station. A fixed station used for relaying the signals of television broadcast stations to television broadcast translator stations.

UHF translator. A television broadcast translator station operating on a UHF television broadcast channel.

UHF translator signal booster. A station in the broadcasting service operated for the sole purpose of retransmitting the signals of a UHF translator station by amplifying and reradiating such signals which have been received directly through space, without significantly altering any characteristic of the incoming signal other than its amplitude.

VHF translator. A television broadcast translator station operating on a VHF television broadcast channel.

***Vestigial sideband transmission.** A system of transmission wherein one of the generated sidebands is partially attenuated at the transmitter and radiated only in part.

Visual carrier frequency. The frequency of the carrier which is modulated by the picture information.

Visual transmitter. The radio equipment for the transmission of the visual signal only.

*Visual transmitter power. The peak power output when transmitting a standard television signal.

D. INTERNATIONAL BROADCAST STATIONS

Autumnal equinox season. That period of any calendar year starting at 0000 EST on 1 August and ending at 2400 EST on 31 October.

Contract operation. Any nongovernment operation of an international broadcast station pursuant to a contract with an agency of the United States Government and subject to Governmental control as to program content, target areas to be covered, and time of broadcast.

Day. Any twenty-four hour period beginning 0000 EST and ending 2400 EST.

Delivered median field intensity or field intensity. The field intensity incident upon the target area expressed in microvolts per meter, or decibels above one microvolt per meter, which is exceeded by the hourly median value on 50 percent of the days of the reference month.

Frequency-hour. One frequency used for one hour.

International broadcast station. A broadcasting station employing frequencies allocated to the broadcasting service between 5950 and 26100 kc, whose transmissions are intended to be received directly by the general public in foreign countries.

Maximum usable frequency (MUF). The highest frequency which is returned to the surface of the earth for a particular path and time of day on 50 percent of the days of the reference month.

Optimum working frequency (OWF). The frequency which is returned to the surface of the earth for a particular path and time of day on 90 percent of the days of the reference month.

Primary station. The television broadcast station radiating the signals which are retransmitted by a television broadcast booster station or translator station.

Private operation. Any nongovernment operation of an International Broadcast station which is not contract operation.

Reference month. The middle month of any season in "Daily Frequency Hour Availability Table."

Summer season. That period of any calendar year starting at 0000 EST on 1 May and ending at 2400 EST on 31 July.

Sunspot number. The predicted 12 month running average of the number of sunspots for any month as indicated in the National Bureau of Standards CRPL Series D publications.

Target area. Geographic area in which the reception of particular programs is specifically intended and in which adequate broadcast coverage is contemplated.

Vernal equinox season. That period of any calendar year starting at 0000 EST on 1 February and ending at 2400 EST on 30 April.

Winter season. That period of any calendar year starting at 0000 EST on 1 November and ending at 2400 EST on 31 January.

E. EMERGENCY ACTION NOTIFICATION SYSTEM AND THE EMERGENCY BROADCAST SYSTEM

Emergency Action Notification System. The System by which all licensees and regulated services of the Federal Communications Commission, and the general public, are notified (with or without an Attack Warning) of the existence of an Emergency Action Condition resulting from a grave national crisis or war. The Emergency Action Notification System and the Emergency Broadcast System Implementation System consist only of the following approved facilities, systems, and arrangements:

(a) First Method. From the President of the United States via the White House Communications Agency to the Associated Press (AP) and United Press International (UPI); thence via automatic selective switching and teletype Emergency Action Notification to all standard, FM, and television broadcast and other stations subscribing to the AP and UPI Radio Wire Teletype Networks.

(b) Second Method. From the President of the United States via the White House Communications Agency to specified control points of the nationwide commercial Radio and Television Broadcast Networks, the American Telephone and Telegraph Co. and other specified points via a dedicated teletypewriter network; thence to all affiliates via any available internal commercial radio and television network alerting facilities.

(c) Third Method. Off-the-air monitoring of specified standard, FM, and television broadcast stations by standard, FM, and television broadcast stations and other licensees and regulated services for receipt of the Emergency Action Notification. All broadcast licensees are required to install, maintain, and operate radio receiving equipment for receipt of the Emergency Action Notification.

(d) Fourth Method. Off-the-air monitoring of standard, FM, and television broadcast stations by the general public who are listening or viewing or whose radio or

television receivers are equipped for actuation by the Attention Signal to receive the Emergency Action Notification.

Attention Signal. The signaling arrangement transmitted by all standard, FM, and television broadcast stations for the purpose of actuating muted standard, FM, and television receivers.

***Emergency Action Notification.** Notice (with or without an Attack Warning) to all licensees and regulated services of the Federal Communications Commission and to the general public of the existence of an Emergency Action Condition. The Emergency Action Notification is released upon direction of the President of the United States and is disseminated only via the Emergency Action Notification System.

***Emergency Action Condition.** The Emergency Action Condition is the period of time between the transmission of an Emergency Action Notification and the transmission of the Emergency Action Condition Termination.

***Emergency Action Condition Termination.** The Emergency Action Condition Termination is the notice to all licensees and regulated services of the Federal Communications Commission and to the general public of the termination of an Emergency Action Condition. The Emergency Action Condition Termination is released upon direction of the President of the United States and is disseminated only via the Emergency Action Notification System.

Emergency Broadcast System (EBS). System of facilities and personnel of nongovernment broadcast stations and other authorized facilities licensed or regulated by the Federal Communications Commission, including approved and authorized integral facilities or systems, arrangements, procedures, and interconnecting facilities, which have been authorized by the Commission to operate in a controlled manner during a grave national crisis or war.

***Basic Emergency Broadcast System (EBS) Plan.** Plan containing, among other things, approved basic concepts and designated national-level systems, arrangements, procedures, and interconnecting facilities to satisfy the White House Statement of Requirements for Presidential Messages and National Programing and News. Provision is made therein for the development, designation, and approval of facilities, mutually compatible operational arrangements, procedures, and interconnecting facilities to satisfy the Department of Defense (Office of Civil Defense) statement of requirements for the dissemination of emergency information and instructions by Regional, State, and Operational Area (Local) authorities in addition to Presidential Messages and National Programing and News, as set forth above.

NIAC Order. Service order previously filed with the American Telephone and

Telegraph Co. providing for approved arrangements for program origination reconfiguration of the major commercial Radio and Television (aural) Broadcast Networks (except UPI Audio) voluntarily participating in the Emergency Broadcast System (EBS). Broadcast networks presently participating are American Broadcasting Co. (ABC), Columbia Broadcasting System (CBS), Mutual Broadcasting System (MBS), National Broadcasting Co. (NBC), Intermountain Network (IMN), and the United Press International Audio (UPI). Any NIAC Order must meet White House requirements and may be activated only when requested by the White House Communications Agency in accordance with approved established procedures.

National Defense Emergency Authorization (NDEA). Authorization issued by the Federal Communications Commission only to the licensees of broadcast stations to permit controlled operation of such stations, as well as associated auxiliary broadcast stations on a voluntary organized basis during an Emergency Action Condition, also consistent with the Basic Emergency Broadcast System (EBS) Plan, including the annexes and supplements to that plan. A broadcast station licensee will be issued a National Defense Emergency Authorization only in accordance with the Criteria for Eligibility set forth in the Basic Emergency Broadcast System (EBS) Plan, which will remain valid concurrently with the term of the broadcast station license, so long as the station licensee continues to comply with the Criteria for Eligibility.

Primary Station National Defense Emergency Authorization (NDEA). Authorization issued to one or more broadcast station licensees in an Operational Area assigning such licensees the responsibility for broadcasting a common emergency program for the initial period of, or for the duration of, and Emergency Action Condition. Broadcasts by such stations are intended for direct public reception in an Operational Area, as specified in an approved Detailed State Emergency Broadcast System (EBS) Operational Plan.

Alternate Station National Defense Emergency Authorization (NDEA). Authorization issued to one or more broadcast licensees in an Operational Area assigning such licensees as specified alternates. An Alternate station will assume broadcasting responsibility in accordance with the Detailed State Emergency Broadcast System (EBS) Operational Plan.

Primary Relay National Defense Emergency Authorization (NDEA). Authorization issued to one or more broadcast licensees in an Operational Area assigning such licensees the function of emergency program distribution or relay service of emergency programing to stations holding Primary or Alternate Station National Defense Emergency Authorizations, in accordance with an approved Detailed State Emergency Broadcast System (EBS) Operational Plan. A Relay station will not generally broadcast emergency program material intended for direct public reception.

Alternate Relay National Defense Emergency Authorization (NDEA). Authorization issued to one or more broadcast licensees in an Operational Area assigning such licensees as specified alternates to stations holding Primary Relay National Defense Emergency Authorizations. In the event a Primary Relay station is unable to assume its initial operational functions, or discontinues such operation for any reason, an alternate Relay station will assume those operational functions, in accordance with the "alternate" designations (1st, 2d, 3d, 4th, etc.) contained in an approved Detailed State Emergency Broadcast System (EBS) Operational Plan.

Non-NDEA Station. A broadcast station which is not voluntarily participating in the Emergency Broadcast System (EBS) and does not hold a National Defense Emergency Authorization. Such stations are required to discontinue operations for the duration of an Emergency Action Condition.

Detailed Regional Emergency Broadcast System (EBS) Operational Plan. Plan providing for a regional emergency programing origination capability at the Federal Regional Center in coordination with the State Industry Advisory Committees and integrated into the Detailed State Emergency Broadcast System (EBS) Operational Plans within the Federal Region as a coordinated Regional/State operation.

Detailed State Emergency Broadcast System (EBS) Operational Plan. Plan containing the designation of facilities, approved detailed mutually compatible operational arrangements, procedures, instructions, and interconnecting facilities to satisfy the requirements of the President and the Federal Government, as well as State and Operational Area (Local) authorities for communicating with the general public during the Emergency Action Condition. Such a plan includes approved and authorized detailed emergency operational communications facilities, systems, procedures, and interconnecting systems.

Operational Area. Geographical area which may encompass a number of contiguous communities, as mutually determined by the State Industry Advisory Committee and State authorities, and as delineated in the approved Detailed State Emergency Broadcast System, (EBS) Operational Plan.

Common Program Control Broadcast Station. A Primary NDEA broadcast station in each Operational Area assigned the responsibility for coordinating the operations for the broadcasting of the common program for the Operational Area.

F. REMOTE PICKUP BROADCAST STATIONS

Associated broadcasting station. The broadcasting station with which a remote pickup broadcast base or mobile station is licensed as an auxiliary and with which it is principally used.

Attended operation. Operation of a station by a qualified operator on duty at the place where the transmitting apparatus is located with the transmitter in plain view of the operator.

Automatic mobile relay station. A remote pickup broadcast base station actuated by automatic means and used to relay communications between base and mobile stations, between mobile stations, and from mobile stations licensed under the rules of this subpart, to broadcast stations.

Operational communications. Communications related to the technical operation of a broadcasting station and its auxiliaries, other than the transmission of program material and cues and orders directly concerned therewith.

Remote control operation. Operation of a station by a qualified operator at a control position from which the transmitter is not visible but which control position is equipped with suitable control and telemetering circuits so that the essential functions which could be performed at the transmitter can also be performed from the control point.

Remote pickup broadcast base station. A base station licensed for communicating with remote pickup broadcast mobile stations.

Remote pickup broadcast mobile station. A land mobile station licensed for the transmission of program material and related communications from the scene of events, which occur outside a studio, to broadcasting stations and for communicating with other remote pickup broadcast base and mobile stations. (As used in this part, land mobile station includes hand-carried, pack-carried, and other portable transmitters.)

Studio. Any room or series of rooms equipped for the regular production of broadcast programs of various kinds. A broadcasting booth at a stadium, convention hall, church, or other similar place is not considered to be a studio.

VI Maritime Services (Land and Shipboard Stations)

A. GENERAL

Categories of ships. (1) Where use of the term "passenger ship" or "cargo ship" occurs in reference to the provisions of Part II of Title III of the Communications Act, such use of the term shall be construed as follows: A ship is a passenger ship if it

carries or is licensed or certificated to carry more than twelve passengers. A cargo ship is any ship not a passenger ship. (2) Where use of the term "passenger ship" or "cargo ship" occurs in reference to the radio provisions of the Safety Convention or in reference to frequency assignment, such use of the term shall be construed as follows: A ship is a passenger ship if it carries more than twelve passengers. A cargo ship is any ship not a passenger ship. (3) A "commercial transport vessel" is any ship or vessel which is used primarily in commerce (i) for transporting persons or goods to or from any harbor(s) or port(s) or between places within a harbor or port area, or (ii) in connection with the construction, change in construction, servicing, maintenance, repair, loading, unloading, movement, piloting, or salvaging of any other ship or vessel. (4) The term "passenger carrying vessel," as used in this part solely in reference to requirements of the Great Lakes Agreement, means any vessel transporting persons for hire.

Day. (1) Where the word "day" is applied to the use of a specific frequency assignment or to a specific authorized transmitter-power, such use of the word "day" shall be construed to mean transmission on such frequency assignment or with such authorized transmitter-power during that period of time included between one hour after local sunrise and one hour before local sunset. (2) Where the word "day" occurs in reference to watch requirements, or to the provisions of §83.449, such use of the word "day" shall be construed to mean the calendar day, from midnight to midnight, local ship's time.

Destination. In reference to the Great Lakes Agreement this term means a port which a vessel enters for the purpose of initiating or completing the specific activity which characterizes the vessel. For example, with respect to vessels carrying passengers or goods, a port at which a vessel, either partially or completely, loads or unloads passengers or goods, would constitute its destination.

Great Lakes. This term, as used in this part solely in reference to the Great Lakes Agreement, means all of the Great Lakes, their connecting and tributary waters, and the St. Lawrence River as far east as the lower exit of the Lachine Canal and the Victoria Bridge at Montreal, but shall not include tributary rivers which are not also connecting rivers, and shall not include the Niagara River (including the Black Rock Canal).

Installed. As used in this part with respect to the requirements of radio apparatus authorized under the provisions of this part for use on board ship or in stations subject to this part, the term "installed" means installed on board the particular ship or in the particular station to which the pertinent rule or regulation, involving the use of this term, is applied.

Mile. As used in this part, the term "mile" means a statute mile or 5,280 feet.

Safety Convention Certificates. (1) **Nuclear Passenger Ship Safety Certificate.** A certificate issued after inspection and survey to a nuclear passenger ship which complies with the relevant requirements of the Safety Convention. (2) **Passenger Ship Safety Certificate.** A certificate issued after inspection and survey to a passenger ship which complies with the relevant requirements of the Safety Convention. (3) **Nuclear Cargo Ship Safety Certificate.** A certificate issued after inspection and survey to a nuclear cargo ship which complies with the relevant requirements of the Safety Convention. (4) **Cargo Ship Safety Radiotelegraphy Certificate.** A certificate issued after inspection to a cargo ship which complies with the Safety Convention radio requirements applicable to cargo ships carrying a radiotelegraph station for the purpose of meeting such requirements. (5) **Cargo Ship Safety Radiotelephony Certificate.** A certificate issued after inspection to a cargo ship which complies with the Safety Convention radio requirements applicable to cargo ships carrying a radiotelephone station for the purpose of meeting such requirements. (6) **Exemption Certificate.** A certificate issued to a ship which is granted partial, conditional, or complete exemption from applicable provisions of the Safety Convention.

Ship or vessel. "Ship" or "vessel" includes every description of watercraft or other artificial contrivance, except aircraft, used or capable of being used as a means of transportation on water whether or not it is actually afloat.

B. MARITIME MOBILE SERVICE

Base Station. A land station in the land mobile service carrying on a service with land mobile stations.

Class I coast station. A coast station (public or limited) licensed to provide a maritime mobile service to ships at sea, including such service over distances up to several thousand miles, whose frequency assignment for this purpose includes appropriate frequencies below 150 kc/s or between 5,000 kc/s and 25,500 kc/s.

Class II coast station. A coast station (public or limited) licensed to provide a maritime mobile service, primarily of a regional character, whose frequency assignment does not include any frequency below 150 kc/s or between 5,000 kc/s and 25,000 kc/s except on a secondary basis under specified conditions intended to minimize the possibility of interference to other stations having priority on these frequencies.

Class III coast station. A coast station (public or limited) licensed to provide a maritime mobile service, primarily of a local character, whose frequency assignment does not include any frequency below 25,000 kc/s.

Coast station. A land station in the maritime mobile service.

Land mobile station. A mobile station in the land mobile service capable of surface movement within the geographical limits of a country or continent.

Land station. A station in the mobile service not intended to be used while in motion.

Limited coast station. A coast station, not open to public correspondence, which serves the operational and business needs of ships.

Limited ship station. A ship station not open to public correspondence.

Marine-utility coast station. A coast station, readily portable for use as a limited coast station at unspecified points ashore within a designated local area.

Marine-utility ship station. A ship station, readily portable for use as a limited ship station on mobile vessels within a designated local area.

Marine-utility station. A coast or ship station in the maritime mobile service having a frequency assignment which is available for both marine-utility coast stations and marine-utility ship stations and licensed under one station authorization to operate as either a marine-utility coast station or a marine-utility ship station according to its location.

Maritime and land mobile service. (1) Maritime mobile service. A mobile service between coast stations and ship stations, or between ship stations, in which survival craft stations may also participate. (Aircraft stations, when transmitting on frequencies allocated to the maritime mobile service, may communicate in this service with ship stations and coast stations.) **(2) Land mobile service.** A mobile service between base stations and land mobile stations, or between land mobile stations. (Only land mobile service carried on exclusively for maritime purposes is governed by this part.)

Mobile service. A service of radiocommunication between mobile and land stations, or between mobile stations.

Mobile station. A station in the mobile service intended to be used while in motion or during halts at unspecified points.

Operational designator. The letter "A," "B," or "F," appended to the term "class I," "class II," or "class III," designates that the coast station is licensed to render its normal service by means of (A) telegraphy, (B) telephony, or (F) facsimile. The designator "L" means "local" and is used to indicate (in lieu of a separate class III coast station license for the same station) that a class I or a class II station provides maritime mobile service of a local character on a frequency or frequencies above 30 mc/s in addition to its service on other frequencies.

Public coast station. A coast station open to public correspondence.

Public ship station. (1) A ship station open to public correspondence. (2) Public ship stations authorized to employ telegraphy for public correspondence are further classified according to their hours of service for telegraphy as designated in this section: **(a) First Category.** These stations carry on a continuous service of public correspondence. **(b) Second Category.** These stations carry on a designated service of public correspondence of prescribed but limited duration at least during the period designated for ship stations of the second category by the International Radio Regulations or, in the case of voyages of short duration, as otherwise designated by the Commission in accordance with those Regulations. **(c) Third Category.** These stations carry on a service of public correspondence, the duration of which is prescribed but is less than that of stations of the "Second Category," or is not prescribed but is determined by the master of vessel pursuant to his authority under Section 360 of the Communications Act.

Shipyard land mobile unit. A land vehicle operated and controlled by a shipyard and used for the transportation of shipyard personnel, material, or supplies.

Shipyard base station. A land station, licensed and operated primarily as a limited coast station in the maritime mobile service, which is authorized additionally to be operated on a secondary basis as a base station for communication with shipyard mobile stations of the same licensee within a local geographic area designated by the Commission.

Ship station. A mobile station in the maritime mobile service located on board a vessel, other than a survival craft, which is not permanently moored.

Shipyard mobile station. A land mobile station on a shipyard land mobile unit used for communication solely with one or more shipyard base stations of the same licensee within a local geographic area designated by the Commission.

Survival craft station. A mobile station in the maritime or aeronautical mobile service intended solely for survival purposes and located on any lifeboat, liferaft or other survival equipment.

C. MARITIME RADIO DETERMINATION SERVICE

Direction finder (radio compass). Apparatus capable of receiving clearly perceptible radio signals and capable of taking bearings on these signals from which the true bearing and direction of the point of origin of such signals with respect to the point of reception may be determined.

Maritime radiodetermination service. A radiodetermination service intended for the benefit of ships.

Maritime radiolocation service. A radiolocation service intended for the benefit of ships.

Maritime radionavigation service. A radionavigation service intended for the benefit of ships.

Radar. A radiodetermination system based on the comparison of reference signals with radio signals reflected, or retransmitted, from the position to be determined.

Radiodetermination. The determination of position, or the obtaining of information relating to position, by means of the propagation properties of radio waves.

Radiodetermination service. A service involving the use of radiodetermination.

Radio direction finding. Radiodetermination using the reception of radio waves for the purpose of determining the direction of a station or object.

Radiolocation. Radiodetermination used for purposes other than those of radionavigation.

Radiolocation land station. A station in the radiolocation service not intended to be used while in motion.

Radiolocation mobile station. A station in the radiolocation service intended to be used while in motion or during halts at unspecified points.

Radiolocation service. A radiodetermination service involving the use of radiolocation.

Radionavigation. Radiodetermination used for the purposes of navigation, including obstruction warning.

Radionavigation land station. A station in the radionavigation service not intended to be used while in motion.

Radionavigation mobile station. A station in the radionavigation service intended to be used while in motion or during halts at unspecified points.

Radionavigation service. A radiodetermination service involving the use of radionavigation.

Ship radar station. A ship radionavigation station utilizing radar.

Ship radiolocation station. A radiolocation mobile station located on board a ship and used solely for maritime radiolocation service.

Ship radiolocation test station. A ship radiolocation station used solely for testing maritime radionavigation apparatus incident to its manufacture, installation, repair, servicing, and/or maintenance.

Ship radionavigation station. A radionavigation mobile station located on board a ship and used solely for maritime radionavigation service.

Shore radar station. A shore radionavigation station utilizing radar.

Shore radiolocation station. A radiolocation land station performing a maritime radiolocation service.

Shore radiolocation test station. A shore radiolocation station used solely for testing maritime radiodetermination apparatus incident to its manufacture, installation, repair, servicing, or maintenance.

Shore radiolocation training station. A shore radiolocation station used solely to train and qualify persons in the effective use of maritime radiodetermination.

Shore radionavigation station. A radionavigation land station performing a maritime radionavigation service.

D. MARITIME FIXED SERVICES

Marine control station. An operational fixed station used to control the emissions or operation of a coast station at a separate location.

Marine fixed station. A fixed station, used primarily for safety communication which is established at a designated location in a water area of, or contiguous to, the United States, and isolated from the mainland by water or marsh.

Marine receiver-test station. A fixed station used to simulate transmission from a ship station to a coast station for the purpose of periodically testing the normal receiving installation of a licensed coast station to determine that such receiving installation is in good working condition.

Marine repeater station. An operational fixed station used to retransmit, to a point of destination or to a message routing center, radiocommunications received at a coast station from ship or aircraft stations in the maritime mobile service.

Marine relay station. An operational fixed station used for communication between coast stations or between a coast station and an associated remote control point, which is intended to expedite the movement of message traffic to or from mobile stations in the maritime mobile service.

Operational fixed station. A fixed station, not open to public correspondence, operated by and for the sole use of those agencies operating their own radiocommunication facilities in the public safety, industrial, land transportation, marine, or aviation services.

E. DEVELOPMENTAL MARITIME STATIONS

Developmental fixed station. A fixed station operated for the express purpose of developing equipment or a technique solely for use only in that portion of the nongovernment fixed service which has been specifically allocated the authorized frequency (or frequencies) of the developmental fixed station.

Developmental land station. A land station operated for the express purpose of developing equipment or a technique solely for use only in that portion of the nongovernment mobile service which has been specifically allocated the authorized frequency (or frequencies) of the developmental land station.

Developmental mobile station. A mobile station operated for the express purpose of developing equipment or a technique solely for use only in that portion of the non-Government mobile service which has been specifically allocated the authorized frequency (or frequencies) of the developmental mobile station.

Developmental radiodetermination station. A radiodetermination station operated for the express purpose of developing equipment or a technique solely for use only in that portion of the nongovernment radiodetermination service (including the nongovernment radionavigation service) which has been specifically allocated the authorized frequency (or frequencies) of the developmental radiodetermination station.

Specific classification. The specific classes of developmental stations on land licensed in the maritime mobile service, the maritime radiodetermination service (including maritime radionavigation service), and the maritime fixed services, are the same as the particular class of station followed by the parenthetical indicator "(developmental)", for example: "Public class III coast station (developmental)".

F. OPERATIONAL

Business communication. Radiocommunication pertaining to economic, com-

mercial, or governmental matters related directly to the purposes for which a ship is being used.

Calling. Transmission from a station solely to secure the attention of another station, or other stations, for a particular purpose.

Control point. An operating position associated with a particular station or stations which is: (1) Under the control and supervision of the station licensee or his authorized agent; and (2) A place at which the required monitoring and control facilities are available; and (3) A place at which a duly licensed operator (or other person if the requirement for a licensed operator is waived by the Commission) responsible for the operation of the transmitter(s) is stationed.

Dispatch point. A place from which radiocommunication may be transmitted under supervision of a responsible operator at a control point.

Distress signal. (1) The distress signal is the international radiotelegraph or radiotelephone signal which indicates that a ship, aircraft, or other vehicle is threatened by grave and imminent danger and requests immediate assistance. (2) In radiotelegraphy, the international distress signal consists of the group "three dots, three dashes, three dots", transmitted as a single signal in which the dashes are emphasized so as to be distinguished clearly from the dots. (3) In radiotelephony, the international distress signal consists of the oral enunciation of the word "Mayday", pronounced as the French expression "m'aider". In case of distress, transmission of this particular signal is intended to insure recognition of a radiotelephone distress call by stations of any nationality.

Distress traffic. All messages relative to the immediate assistance required by the ship, aircraft, or other vehicle in distress.

500 kilocycles silent period. The three-minute period twice an hour beginning at x h 15 and x h 45, Greenwich mean time (GMT), during which the International Radio Regulations require that all transmissions (except for certain emissions designated in those Regulations) must cease on all frequencies within a designated frequency-band centered on 500 kc/s.

Operational communication. Radiocommunication concerning the navigation, movement, or management of a ship or ships. (1) **Navigation.** This includes the piloting of a vessel. (2) **Movement.** This includes information and necessary communications relative to when and where the boat or ship will move or be moved as, for example, rendezvous at a port, basin, or marina, or for maneuvers during a cruise. (3) **Management.** This includes the obtaining of necessary supplies for the ship, limited to immediate needs, and the scheduling of repairs or modifications to the ship, limited to

communications with those directly involved in the repairs or modification or concerned with changes in the movement of the ship because of those repairs or modifications.

Port operations. Communications in or near a port, or in locks or waterways, between coast stations and ship stations, or between ship stations, in which messages are restricted to those relating to the movement and safety of ships and, in emergency, to the safety of persons.

Safety communication. The transmission or reception of distress, alarm, urgency, or safety signals, or any communication preceded by one of these signals, or any form of radiocommunication which, if delayed in transmission or reception, may adversely affect the safety of life or property.

Safety signal. (1) The safety signal is the international radiotelegraph or radiotelephone signal which indicates that the station sending this signal is ready to transmit a message concerning the safety of navigation or giving important meteorological warnings. (2) In radiotelegraphy, the international safety signal consists of three repetitions of the group "TTT", sent before the call, with the letters of each group and the successive groups clearly separated from each other. (3) In radiotelephony, the international safety signal consists of three oral repetitions of the French word "Securite", sent before the call.

Superfluous radiocommunication. Any transmission that is not necessary in properly carrying on the service for which the station is licensed.

Urgency signal. (1) The urgency signal is the international radiotelegraph or radiotelephone signal which indicates that the calling station has a very urgent message to transmit concerning the safety of a ship, aircraft, or other vehicle, or of some person on board or within sight. (2) In radiotelegraphy, the international urgency signal consists of three repetitions of the group "XXX", sent before the call, with the letters of each group and the successive groups clearly separated from each other. (3) In radiotelephony, the international urgency signal consists of three oral repetitions of the word "Pan" pronounced as the French word "panne" and sent before the call.

Watch. The act of listening on a designated frequency.

Working. Radiocommunication carried on, for a purpose other than calling, by any station or stations using telegraphy, telephony, or facsimile.

VII Aviation Services

Aeronautical advisory station. An aeronautical station used for advisory and civil defense communications primarily with private aircraft stations.

Aeronautical enroute station. An aeronautical station carrying on a service with aircraft stations, but which may also carry on a limited communication service with other aeronautical enroute stations.

Aeronautical fixed service. A fixed service intended for the transmission of information relating to air navigation, preparation for and safety of flight.

Aeronautical fixed station. A station in the aeronautical fixed service.

Aeronautical metropolitan station. An aeronautical station used for communication with aircraft, including helicopters, operating between a main air terminal of a metropolitan area and subordinate landing areas.

Aeronautical mobile service. A mobile service between aeronautical stations and aircraft stations, or between aircraft stations, in which survival craft stations may also participate.

Aeronautical multicom land station. An aeronautical station operating in the aeronautical multicom service.

Aeronautical multicom mobile station. A mobile station operating in the aeronautical multicom service.

Aeronautical multicom service. A mobile service not open to public correspondence, used to provide communications essential to conduct of activities being performed by or directed from private aircraft.

Aeronautical public communication service. A communication service carried on between aircraft and land radio stations for the purpose of providing a public communication service for persons aboard aircraft.

Aeronautical public service station. A radio station, ground or aircraft, operated in the aeronautical public communication service.

Aeronautical radionavigation service. A radio navigation service intended for the benefit of aircraft.

Aeronautical search and rescue station. A land or mobile station in the aeronautical mobile service used for communication with aircraft and other aeronautical search and rescue stations pertaining to search and rescue activities with aircraft.

Aeronautical station. A land station in the aeronautical mobile service. In certain instances an aeronautical station may be placed on board a ship.

Aeronautical telemetering land station. A telemetering mobile station used in the flight testing of manned or unmanned aircraft, missiles, or major components thereof.

Aeronautical telemetering mobile station. A telemetering mobile station used in the flight testing of manned or unmanned aircraft, missiles, or major components thereof.

Aeronautical utility land station. A land station located at airdrome control towers and used for control of ground vehicles and aircraft on the ground at airdromes.

Aeronautical utility mobile station. A mobile station used for communication, at airdromes, with the aeronautical utility land station, ground vehicles, and aircraft on the ground.

Air carrier aircraft station. An aircraft station aboard an aircraft engaged in or essential to, transportation of passengers or cargo for hire. For the purpose of the rules in this part an aircraft weighing less than 10,000 lbs. may be considered at the option of the applicant, as a private aircraft even though actually engaged in air carrier operations. The election by the applicant will determine the equipment and frequencies to be employed and the regulations applicable to the aircraft radio station.

Aircraft station. A mobile station in the aeronautical mobile service on board an aircraft.

Airdrome control station. An aeronautical station providing communication between an airdrome control tower and aircraft.

Aviation instructional station. A land or mobile station in the aeronautical mobile service used for radiocommunications pertaining to instructions to students or pilots while actually operating aircraft or engaged in soaring activities.

Aviation services. Aviation services are primarily for the safe, expeditious and economical operation of the aircraft. They include the aeronautical fixed service,

aeronautical mobile service, aeronautical radionavigation service, and secondarily, the handling of public correspondence to and from aircraft.

Civil Air Patrol Land Station. A land station used exclusively for communications of the Civil Air Patrol.

Civil Air Patrol Mobile Station. A mobile station used exclusively for communications of the Civil Air Patrol.

Earth-space service. A radiocommunication service between earth stations and space stations.

Earth Station. A station in the earth-space service located either on the earth's surface or on an object which is limited to flight between points on the earth's surface.

Flight test aircraft station. An aircraft station aboard an aircraft used for the transmission of essential communications in connection with the tests of aircraft or major components of aircraft.

Flight test station. An aeronautical station used for the transmission of essential communications in connection with the testing of aircraft or major components of aircraft: Provided, however, flight test stations, when operating on the frequency 3281 kc/s, are designated as land stations, only with respect to operation on the frequency 3281 kc/s.

Glide path station. A directional radio beacon associated with an instrument landing system which provides guidance in the vertical plane to an aircraft for the purpose of approach in landing.

Ground radio station. Any radio station on the ground equipped or engaged in radiocommunication or radio transmission of energy.

Instrument landing system. A radionavigation system which provides aircraft with horizontal and vertical guidance just before and during landing and, at certain fixed points, indicates the distance to the reference point of landing.

Instrument landing system glide path. A system of vertical guidance embodied in the instrument landing system which indicates the vertical deviation of the aircraft from its optimum path of descent.

Instrument landing system localizer. A system of horizontal guidance embodied in the instrument landing system which indicates the horizontal deviation of the aircraft from its optimum path of descent along the axis of the runway.

Landing area. Any locality, either land or water, including airports and intermediate landing fields, which is used, or intended to be used, for the landing and take-off of aircraft, whether or not facilities are provided for shelter, servicing, or repair of aircraft, or for receiving or discharging passengers or cargo.

Localizer station. A radionavigation land station in the aeronautical radionavigation service which provides signals for the lateral guidance of aircraft with respect to a runway center line.

Marker beacon. A transmitter in the aeronautical radionavigation service which radiates vertically a distinctive pattern for providing position information to aircraft.

Marker beacon station. An aeronautical radionavigation land station employing a marker beacon.

Omni-directional range station. A radionavigation land station in the aeronautical radionavigation service providing direct indication of the bearing (omni-bearing) of that station from an aircraft.

Private aircraft station. An aircraft station on board an aircraft not operated as an air carrier.

Public correspondence. Any telecommunication which the offices and stations must, by reason of their being at the disposal of the public, accept for transmission.

Radio altimeter. A radionavigation equipment, on board an aircraft, which makes use of the reflection of radio waves from the ground to determine the height of the aircraft above the ground. (For the purpose of this definition, "ground" refers to the surface of the earth.)

Radionavigation land test station (MTF). A radionavigation land station (Maintenance Test Facility) in the aeronautical radionavigation service which is used as a radionavigation calibration station for the transmission of essential information in connection with the testing and calibration of aircraft navigational aids, receiving equipment, and interrogators at predetermined surface locations. The primary purpose of this facility is to permit maintenance testing by aircraft radio service personnel.

Radionavigation land test station (OTF). A radionavigation land station (Operational Test Facility) in the aeronautical radionavigation service which is used as a radionavigation calibration station for the transmission of essential information in connection with the testing and calibration of aircraft navigational aids, receiving equipment, and interrogators at predetermined surface locations. The primary purpose of this facility is to permit the pilot to check a radionavigation system aboard the aircraft prior to takeoff.

***Space station.** A station in the earth-space service or the space service located on an object which is beyond, or intended to go beyond, the major portion of the earth's atmosphere and which is not intended for flight between points on the earth's surface.

Surveillance radar station. A radionavigation land station in the aeronautical radionavigation service employing radar to display the presence of aircraft within its range.

VIII Public Safety Radio Services

Fire Radio Service. A public safety service of radiocommunication essential to official fire activities.

Forestry-Conservation Radio Service. A public safety service of radiocommunication essential to forestry-conservation activities.

Highway Maintenance Radio Service. A public safety service of radiocommunication essential to official highway activities.

Interzone station. A fixed station in the Police Radio Service using radiotelegraphy (A1 emission) for communication with zone stations within the zone and with interzone stations in other zones.

Local Government Radio Service. A service of radiocommunication essential to official activities of states, possessions, and territories, including counties, towns, cities, and similar governmental subdivisions.

Police Radio Service. A public safety service of radiocommunication essential to official police activities.

Public safety radio services. Any service of radiocommunication essential either to the discharge of non-Federal government functions or the alleviation of an emergency endangering life or property, the radio transmitting facilities of which are defined as fixed, land, mobile, or radiolocation stations.

Safety service. A radiocommunication service used permanently or temporarily for the safeguarding of human life and property.

Special Emergency Radio Service. A public safety service of radiocommunication essential to the alleviation of an emergency endangering life or property.

State Guard Radio Service. A public safety service of radiocommunication essential to official activities of state guards or comparable organizations of states, territories, possessions, or the District of Columbia.

Zone station. A fixed station in the Police Radio Service using radiotelegraphy (A1 emission) for communication with other similar stations in the same zone and with an interzone station.

IX Industrial Radio Services

Community antenna television systems. The term "community antenna television system" ("CATV system") means any facility which, in whole or in part, receives directly or indirectly over the air and amplifies or otherwise modifies the signals transmitting programs broadcast by one or more television stations and distributes such signals by wire or cable to subscribing members of the public who pay for such service, but such term shall not include (1) any such facility which serves fewer than 50 subscribers, or (2) any such facility which serves only the residents of one or more apartment dwellings under common ownership, control, or management, and commercial establishments located on the premises of such an apartment house.

Distant signal. The term "distant signal" means the signal of a television broadcast station which is extended or received beyond the Grade B contour of that station.

Grade A and Grade B contours. The terms "Grade A contour" and "Grade B contour" means the field intensity contours.

Independent station. The term "independent station" means a television station which is not affiliated with any national television network organization.

Network programing. The term "network programing" means the programing supplied by a national television network organization.

Principal community contour. Signal contour which a television station is required to place over its entire principal community.

Substantially duplicated. The term "substantially duplicated" means regularly duplicated by the network programing of one or more other stations, singly or collectively, in a normal week during the hours of 6 to 11 p.m., local time, for a total of 14 or more hours.

X Land Transportation Radio Services

Automobile Emergency Radio Service. The term "Automobile Emergency Radio Service" as used in this part means a radiocommunication service for use in connection with the dispatching of emergency road service vehicles for the purpose of providing

assistance to disabled automotive vehicles used on streets or highways.

Common carrier. As used in the Motor Carrier Radio Service, a person who holds himself out to the general public to engage in the transportation of passengers or property without discrimination, for compensation as a regular occupation or business.

Contract carrier. As used in the Motor Carrier Radio Service, a person who under individual contracts or agreements engages in the transportation of passengers or property for compensation as a regular occupation or business.

Land transportation radio services. Any private service of radiocommunication essential to the conduct of certain land transportation activities, the transmitting facilities of which are defined as fixed, land, mobile or radiolocation stations.

Mobile relay station. A base station in the mobile service, authorized primarily to retransmit automatically on a mobile service frequency, communications originated either by associated mobile units or by an associated control station. (Authorized in the Railroad Radio Service only.)

Mobile Repeater station. A mobile station in the mobile service, authorized to retransmit automatically on a mobile service frequency, communications originated either by associated pack-carried or hand-carried mobile units or by other mobile or base stations directed to such pack-carried or hand-carried units. (Authorized in the Railroad Radio Service only.)

Motor carrier. Any streetcar, bus, truck, or other land motor vehicle operated over public streets or highways by a common or contract carrier and used for the transportation of passengers or property (freight) for compensation: Provided, however, that motor vehicles used as taxicabs, livery vehicles, or school buses, and motor vehicles used for sightseeing or special charter purposes, shall not be included within the meaning of this term as used in the Motor Carrier Radio Service.

Motor Carrier Radio Service. A radiocommunication service for use in connection with the operation of a motor carrier land transportation system.

Railroad Radio Service. Radiocommunication service for use in connection with the operation and maintenance of a railroad common carrier.

Taxicab Radio Service. The term "Taxicab Radio Service", as used in this part means a radiocommunication service for use in connection with the transportation facilities of a taxicab common carrier.

Urban area. As used in the Motor Carrier Radio Service, one or more contiguous,

incorporated or unincorporated cities, boroughs, towns, or villages, having aggregate population of 2,500 or more persons.

XI Citizens Radio Service

Citizens Radio Service. A radiocommunications service of fixed, land, and mobile stations intended for short-distance personal or business radiocommunications, radio signaling, and control of remote objects or devices by radio; all to the extent that these uses are not specifically prohibited in this part.

Class A station. A station in the citizens Radio Service licensed to be operated on an assigned frequency in the 460-470 mc/s band and with input power of 60 watts or less.

Class B station. A station in the Citizens Radio Service licensed to be operated on an authorized frequency in the 460-470 mc/s band and with input power of 5 watts or less.

Class C station. A station in the Citizens Radio Service licensed to be operated on an authorized frequency in the 26.96-27.23 mc/s band, or on the frequency 27.255 mc/s, for the control of remote objects or devices by radio, or for the remote actuation of devices which are used solely as a means of attracting attention, or on an authorized frequency in the 72-76 mc/s band for the control of model aircraft only.

Class D station. A station in the Citizens Radio Service licensed to be operated on an authorized frequency in the 26.96-27.23 mc/s band or on the frequency 27.255 mc/s, with input power of 5 watts or less, and for radiotelephony only.

Remote control. The term "remote control" when applied to the use or operation of a citizens radio station means control of the transmitting equipment of that station from any place other than the location of the transmitting equipment, except that direct mechanical control or direct electrical control by wired connections of transmitting equipment from some other point on the same premises, craft or vehicle shall not be considered to be remote control.

XII Amateur Radio Service

Amateur mobile station. An amateur station that is so constructed that it may conveniently be transferred to or from a mobile unit or from one such unit to another, and is ordinarily used while such mobile unit is in motion.

Amateur operator. A person interested in radio technique solely with a personal aim and without pecuniary interest, holding a valid license issued by the Federal Communications Commission authorizing him to operate licensed amateur stations.

Amateur portable station. An amateur station that is so constructed that it may conveniently be moved about from place to place for communication, but which is not operated while in motion.

Amateur radiocommunication. Radiocommunication between amateur stations solely with a personal aim and without pecuniary interest.

Amateur service. A radio service carried on by amateur stations.

Amateur station. A station used by an amateur operator, and embracing all radio transmitting apparatus at a particular location used for amateur service and operated under a single instrument of authorization.

XIII Disaster Communications Service

Associated station. A disaster station is considered to be associated with a licensed station in some other service when both stations are licensed to the same licensee at the same location and both stations are included in at least one coordinated disaster communications plan of the area concerned. A portable station or a mobile station in the Disaster Communications Service will be considered to be associated with the station in the other service which is located at its base of operations.

Competent local authority. That authority within a community or larger area which is so designated in the coordinated disaster communications plan for the area concerned, including any alternate authority who may be so designated in such plan. In the absence of the specifically designated authority, the individual in charge of the net control station, or his representative, for the organized disaster station network established in accordance with the coordinated disaster communications plan, shall be considered as competent authority for the activation of the stations of that network. Duly designated civil defense officials will be considered competent local authority in the organization or operation of disaster communications radio networks and stations, and in the coordination of disaster communications plans.

Disaster. An occurrence of such nature as to involve the health or safety of a community or large area, or the health or safety of any group of individuals in an isolated area to whom no normal means of communications are available, and include, but are not limited to, floods, earthquakes, hurricanes, explosions, aircraft or train wrecks, and consequences of armed attack.

Disaster communications. Communications essential to the establishment and maintenance of communication channels to be used in connection with disasters or other incidents involving loss of communications facilities normally available or which demand the temporary establishment of communications facilities beyond those normally available, including communications necessary or incidental to drills and simulated disaster relief activity on the part of persons or organizations participating in the use of such communication channels; or communications or signals essential to the public welfare, or that of any segment of the public, including communications directly concerning safety of life, preservation of property, maintenance of law and order, and alleviation of human suffering and need, in the case of any actual or imminent disaster or other such incident.

Disaster Communications Service. A service of fixed, land, and mobile stations licensed, or authorized, to provide essential communications incident to or in connection with disasters or other incidents which involve loss of communications facilities normally available or which require the temporary establishment of communications facilities beyond those normally available.

Disaster station. Any government or nongovernment radio station able to function as a fixed, land, or mobile station and authorized, if government, by its controlling federal government agency or licensed, if nongovernment, by the Federal Communications Commission to operate in the Disaster Communications Service. A single disaster station may consist of more than one unit, each capable of being operated independently as a fixed, land, or mobile station.

Portable station. A land station in the Disaster Communications Service which is capable of being moved from place to place and is in fact, from time to time, moved to and operated at unspecified fixed locations for the purpose of communicating with other fixed, land, or mobile stations.

XIV Domestic Public Radio Services

Auxiliary test station. A fixed station used for test transmissions only, operating on mobile station frequencies from a specified fixed location, for the purpose of determining the performance of fixed receiving equipment which is remotely located from the base station with which it is associated, or where the receiving equipment is located with the base station and both are remotely located from the control point of the station.

Central office. A landline termination center used for switching and interconnection of public message communication circuits.

Central office station. A fixed station used for transmitting communications to rural subscriber stations associated therewith.

Domestic fixed public service. A fixed service, the stations of which are open to public correspondence, for radiocommunication between points all of which lie within: (a) the State of Alaska, or (b) the State of Hawaii, or (c) the remaining 48 states and the District of Columbia, or (d) a single possession of the United States.

Domestic public land mobile radio service. A public communication service for hire between land mobile stations wherever located and their associated base stations which are located within the United States or its possessions, or between land mobile stations in the United States and base stations in Canada.

Domestic public radio service. The land mobile and domestic fixed public services the stations of which are open to public correspondence.

Effective radiated power. The product of the antenna power input and the antenna power gain. This product should be expressed in watts. (If specified for a particular direction, effective radiated power is based on the antenna power gain in that direction only.)

Exchange. A unit of a communication company or companies for the administration of communication service in a specified area, which usually embraces a city, town, or village and its environs, and consisting of one or more central offices, together with the associated plant, used in furnishing communication service in that area.

Exchange area. The geographic area included within the boundaries of an exchange.

Fixed microwave auxiliary station. A fixed station used in connection with (1) the alignment of microwave transmitting and receiving antenna systems and equipment, (2) coordination of microwave radio survey operations, and (3) cue and contact control of television pickup station operations.

Frequency tolerance. The frequency tolerance, expressed as a percentage or in cycles per second, is the maximum permissible deviation, with respect to the reference frequency of the corresponding characteristic frequency of an emission.

General communication. Two-way voice communication, through a base station, between a common carrier land mobile station and a landline telephone station connected to a public message landline telephone system, or between two common carrier land mobile stations via a base station.

Inter-office station. A fixed station in the domestic fixed public service which is used exclusively for interconnection of telephone central offices.

Local television transmission service. A domestic public radiocommunication service for the transmission of television material and related communications.

Message center. The point at which messages from members of the public are accepted by the carrier for transmission to the addressee.

Microwave frequencies. As used in this part, this term refers to frequencies of 890 mc and above.

Miscellaneous common carriers. Communications common carriers which are not engaged in the business of providing either a public landline message telephone service or public message telegraph service.

Mobile microwave auxiliary station. A mobile station used in connection with (1) the alignment of microwave transmitting and receiving antenna systems and equipment, (2) coordination of microwave radio survey operations, and (3) cue and contact control of television pickup station operations.

Point-to-point microwave radio service. A domestic public radio service rendered on microwave frequencies by fixed stations between points which lie within the United States or between points in its possessions or to points in Canada or Mexico.

Private line service. A service whereby facilities for communication between two or more designated points are set aside for the exclusive use or availability for use of a particular customer and authorized users during stated periods of time.

WHY DO YOU WANT TO SUCCEED?

There are several answers to this question. You may want to succeed for the very human reason that you want more money with which to enjoy life, or you may have a family for whom you want to provide those comforts they so well deserve -- a home, a new car, good clothes, life insurance, and financial security.

Your ambition to succeed may be prompted by the desire to bring happiness to an aged father, mother, or relative whose chief hope in life is to see you enjoy prosperity and prestige, to see you on the pinnacle of success.

Pause for just a minute and think -- what is your reason for wanting success? With this reason in mind, resolve firmly that you will never allow your ambition to weaken. Resolve that you will never swerve from the direct path of your goal. Make this resolution now and keep it, so the years to come will be happier and more prosperous for you.

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