Section 1

RULES, REGULATIONS, AND STANDARDS

INTRODUCTION TO SECTION 1

The broadcast industry is founded upon certain technical rules, regulations, and standards which form the necessary guides to the establishment of a healthy and prosperous system of broadcasting. Some of these standards are the culmination of much effort on the part of both government and industry and are constantly in a state of modification or revision as the state of the art develops. As new techniques are introduced, standards are reappraised and rewritten to reflect new thinking.

Here are presented certain rules and regulations, government-industry reports, and various standards which have a bearing upon daily operation. The Federal Communications Commission's Rules and Regulations set forth herein are those necessary for the construction and operation of broadcast stations to meet the technical requirements and for operation in the public interest along technical lines not specifically enunciated in the regulations. These Rules are based on the best engineering data available from evidence supplied in formal and informal hearings and extensive surveys conducted in the field. Numerous informal conferences have been held with radio engineers, manufacturers of radio equipment and others for the guidance of the Commission in the formulation of these standards.

While these rules provide for flexibility and set forth the conditions under which they are applicable, it is not expected that material deviation therefrom as to fundamental principles will be recognized unless full information is submitted regarding the reasonableness of such departure and the need therefor.

These rules will necessarily change as progress is made in the art, and accordingly it will be necessary to make revisions from time to time. The Commission will accumulate and analyze engineering data available concerning the progress of the art so that its rules may be kept current with the developments.

Part 1

FCC ADMINISTRATIVE PROCEDURES FOR AM, FM, TV, AND RELATED SERVICES

Any qualified citizen, firm, or group may apply to the Federal Communications Commission for authority to construct a commercial standard (AM), frequency modulation (FM), or television (TV) broadcast station.

Licensing of these facilities is prescribed by the Communications Act of 1934, as amended, which sets up certain basic requirements. In general, applicants must satisfy the Commission that they are legally, technically, and financially qualified, and that operation of the proposed station would serve the public convenience, interest, or necessity. The Communications Act also recognizes broadcasting as a competitive industry and invests the Commission with the responsibility of allocating facilities so as to provide a fair, efficient, and equitable distribution of radio service.

The licensing procedure is detailed in Part 1 of the Commission's "Rules Relating to Practice and Procedure," while station operation is covered by Part 3, "Rules Governing Radio Broadcast Services."

Following is a summary of the consecutive steps required in applying for authorization to build and operate a commercial broadcast station. The application procedure is substantially the same whether the facility sought is for AM, FM, or TV broadcast.

SELECTING A FREQUENCY

Standard (AM) broadcast stations operate on "local," "regional," or "clear" channels. Local stations are of 100 to 1000 watts power and serve smaller communities; stations of 500 watts to 5 kilowatts power cover larger centers of population and surrounding areas; stations of 10 to 50 kilowatt maximum power are for large area coverage, particularly at night. There is no separate classification for AM operation by educational stations.

To determine whether an AM frequency is available for assignment in a particular area, it is necessary for the applicant to have a frequency search made by a competent engineer. The Commission's engineering personnel cannot undertake to make such studies for prospective applicants.

An applicant for a commercial FM station must specify a frequency available to the area to be served. The demand for FM stations has not yet exceeded the supply of available frequencies. (The Noncommercial Educational FM Broadcast Service is a separate category with its own rules.)

An applicant for a new television station must request a channel assigned in the Table of Assignments to the community involved. However, a channel assigned to any community listed in the table can be requested for operation in any unlisted community within 15 miles of the listed community. Commercial TV stations are authorized for unlimited hours of operation with minimum power determined by the size of the principal city and maximum power dependent on antenna height and allocation zone. Channels are reserved for noncommercial educational TV operation.

In addition, TV translator stations are authorized to operate on the top 13 channels of the UHF band (470–890 Mc).

APPLYING FOR A CONSTRUCTION PERMIT

Once a prospective licensee has decided upon the type of station he wishes to apply for, the next step is to make application for a construction permit. This application must be in writing on a form supplied by the Commission (Form 301, "Application for Authority to Construct a New Broadcast Station," which covers AM, FM, and TV broadcast). This form requires information about the citizenship and character of the applicant, as well as his financial, technical, and other qualifications to construct and operate a station, plus details about the transmitting apparatus to be used, and the proposed new service. Triplicate copies are required, one of which must be executed under oath or affirmation.

APPLICATION PROCESSING

Applications for new broadcast stations are twice reported by the Commission—when first tendered, and, again, when accepted for filing. Such an application is not acted upon until at least 30 days after public notice is given of its acceptance.

Applications are reviewed in their engineering, legal, and financial aspects by the Broadcast Bureau, which makes recommendations to the Commission.

Applications are, in general, processed in the order in which accepted for filing.

If, upon examination of an application, the Commission determines that there are no engineering conflicts, that the applicant is qualified, and that all other requirements are met, the application is granted without hearing and a construction permit is issued.

Any grant made by the Commission without a hearing is subject to protest within a period of 30 days, during which the protesting party may request a hearing. Within 15 days thereafter the Commission must determine whether the objection merits a hearing.

The law requires that, in general, final decision on noncontested applications be rendered within three months from the date of the original filing, and within six months from the conclusion of a hearing in those cases which go through a hearing.

HEARINGS

Where it appears that an application violates provisions of the Commission's rules and regulations, that interference would be caused to another AM or FM broadcast station, or that the minimum separation requirements for TV stations are not met, or if other serious questions of a technical, legal, or financial character are involved, a hearing usually is required before a final decision on the application can be made. Often a hearing is necessary because two or more applicants seek to use the same frequency or immediately adjacent frequencies with such a proximity of stations that excessive interference would result. In such instances, the Commission is compelled by law to accord a hearing to the competing applicants and to make a comparative judgment as to which, if either, should be granted.

If unable to grant an application, the Commission is required to notify the applicant and other known parties of interest as to the reason. The applicant usually is given 30 days in which to reply. After that, if the Commission is still unable to make a grant, a hearing is ordered.

In designating an application for hearing, the Commission gives public notice of the issues for the information of the applicant and other parties who may be concerned. The hearing notice generally allows the applicant a period of 60 days or more in which to prepare. Even after being designated for hearing, an applicant may sometimes find it possible to satisfy the issues by amending his application, especially if the apparent deficiencies are of an engineering nature.

Competing applications for the same facility are not considered if filed more than

10 days after public notice designating the prior application or applications for hearing.

Hearings are customarily conducted by an examiner. The hearing examiner has authority to administer oaths, examine witnesses and rule upon the admission of evidence.

Pre-hearing conferences are held both prior to and after an exchange of exhibits by the parties. The latter takes place at least 20 days in advance of the hearing date, the second pre-hearing conference is held at least 10 days before the hearing commences.

Within 20 days after the close of a record by the hearing examiner, each party and the Chief of the Broadcast Bureau of the Commission has the privilege of filing proposed findings of fact and conclusions in support of their contentions. After review of the evidence and statements, the hearing examiner issues an initial decision.

In the event he wishes to contest the initial decision, the applicant or any other interested party has 20 days from the date on which the initial decision was announced to file exceptions and to request oral arguments before the Commission. In all cases heard by the examiner, the Commission will hear oral argument on request of either party. After oral argument, the Commission may adopt, modify or reverse the hearing examiner's initial decision. Within 30 days thereafter, any party involved may petition for rehearing.

If no exceptions are filed, and the Commission does not initiate a review of the hearing examiner's initial decision, the latter becomes effective 40 days after the issuance of the initial decision, unless otherwise ordered by the Commission. Court appeals can be taken within 30 days following announcement of the Commission decision.

CONSTRUCTION PERMIT

When and if an application meets statutory and other requirements, it is granted and a construction permit is issued. A maximum of 60 days from date of grant is provided in which construction shall begin, and a maximum of 6 months thereafter as the time for completion (or 8 months in all). Application to modify a broadcast construction authorization, or to make changes in an existing station, or to modify a license, is made on the same form (301) used in seeking initial construction authorization. If the permittee is unable to build his station within the time specified he can apply for extension of time on Form 701 ("Application for Additional Time to Construct a Radio Station"), giving the reasons. Upon completion of construction the permittee can engage in equipment tests.

LICENSE

The final step is to apply for the actual license. All applicants for broadcast license are required to fill out Form 302 ("Application for New Broadcast Station License"). Applicants must show compliance with all terms, conditions, and obligations set forth in the original application and the construction permit. After applying for a license and receiving authority from the Commission, the holder of a construction permit can conduct program tests. A station license is then issued if no new cause or circumstance has come to the attention of the Commission that would make operation of the station contrary to public interest.

AM, FM, and TV broadcast stations are licensed for the statutory limit of three years. Applications for renewal of license are made on Form 303 ("Application for Renewal of Broadcast Station License").

FORMS FOR OTHER PURPOSES

If the holder of a construction permit or license desires to assign the same to someone else, he makes application on Form 314 ("Application for Consent to Assignment of Radio Broadcast Station Construction Permit or License").

Should the permittee or the licensee wish to transfer corporate control, he applies

on Form 315 ("Application for Consent to Transfer Control of Corporation Holding Radio Broadcast Station Construction Permit or License").

In certain cases a permittee or licensee can apply for a transfer of corporate control or an assignment of license by using Form 316 ("Application for Assignment or Transfer–Short Form"). This form may only be used when the transfer or assignment is pro forma or technical in nature, i.e., where no substantial changes in interest occur.

In the event the licensee desires to operate his transmitter by remote control, application for such authorization should be made using Form 301-A.

Application for Subsidiary Communications Authorization (FM multiplex) should be made using Form 318.

Part 2

FREQUENCIES USED BY THE BROADCAST SERVICE

STANDARD BROADCAST (AM) STATIONS

Classes and Power of Standard Broadcast Stations

(FCC Rules, Section 3.22)

Class I Station: A Class I station is a dominant station operating on a clear channel and designed to render primary and secondary service over an extended area and at relatively long distances. Its primary service area is free from objectionable interference from other stations on the same and adjacent channels and its secondary service area free from interference, except from stations on the adjacent channel, and from stations on the same channel in accordance with the channel designation in Section 3.25 or in accordance with the Engineering Standards of Allocation. The operating power shall be not less than 10 kilowatts nor more than 50 kilowatts.

Class II Station: A Class II station is a secondary station which operates on a clear channel and is designed to render service over a primary service area which is limited by and subject to such interference as may be received from Class I stations. A station of this class shall operate with power not less than 0.25 kilowatt nor more than 50 kilowatts. Whenever necessary, a Class II station shall use a directional antenna or other means to avoid interference with Class I stations and with other Class II stations, in accordance with the Engineering Standards of Allocation.

Class III Station: A Class III station is a station which operates on a regional channel and is designed to render service primarily to a metropolitan district, and the rural area contiguous thereto. Class III stations are subdivided into two classes:

1. **Class III-A Station:** A Class III-A station is a Class III station which operates with power not less than 1 kilowatt nor more than 5 kilowatts and the service area of which is subject to interference in accordance with the Engineering Standards of Allocation.
2. **Class III-B Station:** A Class III-B station is a Class III station which operates with a power not less than 0.5 kilowatt, and not more than 1 kilowatt night and 5 kilowatts daytime, and the service area of which is subject to interference in accordance with the Engineering Standards of Allocation.

Class IV Station: A Class IV station is a station operating on a local channel and designed to render service primarily to a city or town and the suburban and rural areas contiguous thereto. The power of a station of this class shall not be less than 0.1 kilowatt and not more than 0.25 kilowatt night time, and 1 kilowatt daytime, and its service area is subject to interference in accordance with Section 3.182.

NOTE: The power ceiling for Class IV stations under the North American Regional Broadcasting Agreement (NARBA) is 250 watts. The Agreement between the United States of America and the United Mexican States Concerning Radio Broadcasting in the Standard

Broadcast Band [1] would permit daytime operation of Class IV stations with a maximum power of 1 kilowatt in all areas of the United States more than 100 kilometers (62 miles) from the United States/Mexican border. Pursuant to the U.S./Mexican Agreement and informal coordination with the other NARBA [1] signatories, the Commission will consider applications proposing the use of daytime power in excess of 250 watts by a Class IV station providing such station is located more than 100 kilometers (62 miles) from the U.S./Mexican border, or, if located in the State of Florida, providing that such station is not located south of 28 degrees north latitude and between 80 and 82 degrees west longitude.

"10% Rule"

Except for certain circumstances, FCC requires Class II, III, and IV stations to serve at least 90% of the population within their normally protected contours. For a more detailed explanation of the exceptions, see FCC Rules, Section 3.28(c).

Time of Operation of Standard Broadcast Stations

(FCC Rules, Section 3.23)

Standard broadcast stations may be licensed to operate in accordance with the following:

(a) *Unlimited time* permits operation without a maximum limit as to time.

(b) Limited time is applicable to Class II (secondary) stations operating on a clear channel with facilities authorized before October 30, 1959. It permits operation of the secondary station during daytime, and until local sunset if located west of the dominant station on the channel, or if located east thereof, until sunset at the dominant station, and in addition during night hours, if any, not used by the dominant station or stations on the channel.

(c) Daytime permits operation during the hours between average monthly sunrise and average monthly local sunset. Daytime stations operating on local channels with a power of 0.1 kw or 0.25 kw may, upon notification to the Commission and to the Engineer in Charge of the radio district in which they are located, operate at hours beyond those specified in their license.[2]

(d) *Sharing time* permits operation during hours which are so restricted by the station license as to require a division of time with one or more other stations using the same channel.

(e) *Specified hours* means that the exact operating hours are specified in the license. Specified hours stations operating on local channels except those sharing time with other stations may, upon notification to the Commission and the Engineer in Charge of the radio district in which they are located, operate at hours beyond those specified in their license.

Minimum Operating Schedule

(FCC Rules, Section 3.71)

Except Sundays, the licensee of each standard broadcast station shall maintain a minimum operating schedule of two-thirds of the total hours that it is authorized to operate between 6 AM and 6 PM, local standard time, and two-thirds of the total hours it is authorized to operate between 6 PM and midnight, local standard time, except that in an emergency when, due to causes beyond the control of the licensee, it becomes impossible to continue operating, the station may cease operation for a period of not to exceed 10 days, provided that the Commission and the Engineer in Charge shall be notified in writing immediately after the emergency develops.

[1] Not yet ratified by the U.S. Senate. Various provisions of Part 3 of FCC Rules would be amended upon ratification.

[2] See footnotes 6 and 11 to Standard Broadcast Section.

Frequencies Used for Standard Broadcast Stations

The band 535–1605 Kc is used for standard broadcasting. It is divided into 107 channels of 10 Kc each. Following is a list of standard broadcast channels and the conditions under which each may be used in the United States. For further reference and additional information, see FCC Rules, Part 3, Subpart A, Radio Broadcast Service, and the 1950 North American Regional Broadcasting Agreement, as well as the U.S./Mexico Agreement.

Channel	*Classification*	*NARBA Class I Priority*	*Use Under FCC Rules*	*See Footnotes*
540	Clear	Canada (I-A) Mexico (I-A)	II	(1) (2) (3) (14) (21)
550	Regional	Cuba (I-C)	III-A, III-B	(4) (5) (6)
560	Regional		III-A, III-B	(4) (6)
570	Regional	Cuba (I-D)	III-A, III-B	(4) (6) (7)
580	Regional		III-A, III-B	(4) (6)
590	Regional	Cuba (I-D)	III-A, III-B	(4) (6) (7)
600	Regional		III-A, III-B	(4) (6)
610	Regional		III-A, III-B	(4) (6)
620	Regional	Dominican Republic (I-C)	III-A, III-B	(4) (5) (6)
630	Regional	Cuba (I-D)	III-A, III-B	(4) (6) (7)
640	Clear	USA (I-A) Canada (I-B) Cuba (I-C)	I, II	(5) (8) (9) (10) (11) (12) (19) (22)
650	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (22)
660	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (23)
670	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (24)
680	Clear	USA (I-B)	I, II	(10) (11) (13) (19)
690	Clear	Canada (I-A) Mexico (I-B) Cuba (I-C)	II	(1) (3) (5)
700	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (22)
710	Clear	USA (I-B)	I, II	(10) (11) (13) (19)
720	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (24)
730	Clear	Mexico (I-A)	II	(14) (21)
740	Clear	Canada (I-A) Cuba (I-D)	II	(1) (3) (7)
750	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19)
760	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (22)
770	Clear	USA (I-A)	I, II	(8) (9) (11) (20) (23)
780	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (24)
790	Regional		III-A, III-B	(4) (6)
800	Clear	Mexico (I-A)	II	(14) (21)
810	Clear	USA (I-B)	I, II	(10) (11) (13) (19)
820	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (22)
830	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (22)
840	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (22)
850	Clear	USA (I-B) Mexico (I-B)	I, II	(10) (11) (13) (19)
860	Clear	Canada (I-A) Cuba (I-C)	II	(1) (3) (5)
870	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (22)
880	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (23)
890	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (24)
900	Clear	Mexico (I-A)	II	(14) (21)
910	Regional		III-A, III-B	(4) (6)
920	Regional	Cuba (I-D)	III-A, III-B	(4) (6) (7)
930	Regional		III-A, III-B	(4) (6)
940	Clear	Canada & Mexico (I-B)	I, II	(11) (19)
950	Regional	Cuba (I-D)	III-A, III-B	(4) (6) (7)
960	Regional		III-A, III-B	(4) (6)
970	Regional		III-A, III-B	(4) (6)
980	Regional	Cuba (I-D)	III-A, III-B	(4) (6) (7)
990	Clear	Canada (I-A)	II	(1) (3)
1000	Clear	Mexico & USA (I-B)	I, II	(10) (11) (13) (19)
1010	Clear	Canada (I-A) Cuba (I-B)	II	(1) (3) (15)

Channel	*Classification*	*NARBA Class I Priority*	*Use Under FCC Rules*	*See Footnotes*
1020	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (24)
1030	Clear	USA (I-A)	I, II	(11) (13) (16) (20)
1040	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (22)
1050	Clear	Mexico (I-A)	II	(14) (17) (21)
1060	Clear	Mexico & USA (I-B)	I, II	(10) (11) (13) (19)
1070	Clear	Canada & USA (I-B)	I, II	(10) (11) (13) (19)
1080	Clear	USA (I-B)	I, II	(10) (11) (13) (19)
1090	Clear	Mexico & USA (I-B)	I, II	(10) (11) (13) (19)
1100	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (23)
1110	Clear	USA (I-B)	I, II	(10) (11) (13) (19)
1120	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (24)
1130	Clear	Canada & USA (I-B)	I, II	(10) (11) (13) (19)
1140	Clear	Mexico & USA (I-B)	I, II	(10) (11) (13) (19)
1150	Regional		III-A, III-B	(4) (6)
1160	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (22)
1170	Clear	USA (I-B)	I, II	(10) (11) (13) (19)
1180	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (23)
1190	Clear	Mexico & USA (I-B)	I, II	(10) (11) (13) (19)
1200	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (22)
1210	Clear	USA (I-A)	I, II	(8) (9) (10) (11) (19) (24)
1220	Clear	Mexico (I-A)	II	(14) (18) (21)
1230	Local		IV	
1240	Local		IV	(12)
1250	Regional		III-A, III-B	(4) (6)
1260	Regional		III-A, III-B	(4) (6)
1270	Regional		III-A, III-B	(4) (6)
1280	Regional		III-A, III-B	(4) (6)
1290	Regional		III-A, III-B	(4) (6)
1300	Regional		III-A, III-B	(4) (6)
1310	Regional		III-A, III-B	(4) (6)
1320	Regional		III-A, III-B	(4) (6)
1330	Regional		III-A, III-B	(4) (6)
1340	Local		IV	
1350	Regional		III-A, III-B	(4) (6)
1360	Regional		III-A, III-B	(4) (6)
1370	Regional		III-A, III-B	(4) (6)
1380	Regional		III-A, III-B	(4) (6)
1390	Regional		III-A, III-B	(4) (6)
1400	Local		IV	
1410	Regional		III-A, III-B	(4) (6)
1420	Regional		III-A, III-B	(4) (6)
1430	Regional		III-A, III-B	(4) (6)
1440	Regional		III-A, III-B	(4) (6)
1450	Local		IV	
1460	Regional		III-A, III-B	(4) (6)
1470	Regional		III-A, III-B	(4) (6)
1480	Regional		III-A, III-B	(4) (6)
1490	Local		IV	
1500	Clear	USA (I-B)	I, II	(11) (13) (19) (26)
1510	Clear	USA (I-B)	I, II	(11) (13) (19) (26)
1520	Clear	USA (I-B)	I, II	(11) (13) (19) (26)
1530	Clear	USA (I-B)	I, II	(11) (13) (19) (26)
1540	Clear	Bahamas (I-A) USA (I-B)	II	(13) (19) (25) (26)
1550	Clear	Canada & Mexico (I-B)	I, II	(11) (19)
1560	Clear	USA & Cuba (I-B)	I, II	(11) (13) (19) (26)
1570	Clear	Mexico (I-A)	II	(14) (21)
1580	Clear	Canada (I-A)	II	(1) (3)
1590	Regional		III-A, III-B	(4) (6)
1600	Regional		III-A, III-B	(4) (6)

Footnotes to Standard Broadcast Section

(1) For Class II stations which will not deliver over 5 microvolts per meter groundwave or 25 microvolts per meter 10% time skywave at any point on the Canadian border and provided that such stations operating nighttime (i.e., sunset to sunrise at the location of the Class II station) are located not less than 650 miles from the nearest Canadian border.

(2) Subject to the condition that no harmful interference be caused to services operating on 500 Kc and in the band 510–535 Kc.

(3) Proposed rule-making in Docket 10453 provides for certain assignments on this channel to be submitted to the Canadian government for comments, taking into account daytime skywave. No applications are being granted at this time which are not in conformity with the proposals contained in Docket 10453.

(4) Class IV stations presently operating on this channel are allowed to continue operation, but are not protected against interference from Class III stations. No new Class IV stations will be assigned to the channel.

(5) New assignments may not deliver over 25 microvolts per meter 10% time skywave at any point on the border of the country having priority for a Class I-C station on this channel. For definition of this class of station and requirements for daytime protection, see 1950 North American Regional Broadcasting Agreement.

(6) Class III-A and Class III-B stations on this channel may begin operations at 4:00 AM with their authorized daytime facilities. The FCC may order such operations to cease, however, if undue interference is caused to other stations on the same channel. (See FCC Rules, Section 3.87.)

(7) New assignments may not deliver over 50 microvolts per meter 10% time skywave at any point on the border of the country having priority for a Class I-D station on this channel. For definition of this class of station and requirements for daytime protection, see 1950 North American Regional Broadcasting Agreement.

(8) One Class I and one or more Class II stations may be assigned on this channel. Class II stations are restricted to limited time or daytime only operation in the continental limits of the United States. There may also be assigned to this frequency Class II stations operating unlimited time in Alaska, Hawaii, Virgin Islands, and Puerto Rico which will not deliver over 5 microvolts per meter groundwave day or night or 25 microvolts per meter 10 per cent time skywave at night at any point within the continental limits of the United States.

(9) Power shall not be less than 50 Kw for Class I stations on this channel.

(10) The Commission's decision in Docket 8333 pointed out that, as a general principle, the maintenance of the "freeze" on certain Class I channels was in accord with their decision of 1954 on Docket 6741, and still applies. That proceeding has been recently under more active consideration and study. Certain tentative judgments have been made which limit the classes of applications on which action must continue to be deferred. (See paragraph 34 of the 1954 decision, and Docket 6741 proposed rule making on April 15, 1958.) Developments enable certain changes in the scope of the "freeze" in two directions: (1) removing from the "freeze" those I-B frequencies which can have no relation to possible changes in the I-A structure, and (2) changing the classes of applications covered by the "freeze" so as to reflect the impingement of such applications on the possible "clear channel" assignments rather than merely the daytime skywave effects. Consequently, the "freeze" still applies, pending a decision in Docket 6741, except for the channels 1500, 1510, 1520, 1530, 1540, and 1560 Kc, and extends the "freeze" in the case of applications for changes in existing facilities to any proposal which would increase radiation or change station location.

(11) Class II stations on this channel may begin operations at 4:00 AM with their authorized daytime facilities provided no interference is caused within the 0.5 millivolt per meter 50% skywave of the Class I station(s) except

1. Where the Class I station is located east of the Class II station, in which case the Class II station may begin operations at local sunrise time of the Class I station; or
2. Where agreement has been reached with the Class I station to begin operations prior to local sunrise.

NOTE: FCC may order such operations to cease, however, if undue interference is caused to other stations on the same channel. (See FCC Rules, Section 3.87.)

(12) This is one of the two channels used for CONELRAD transmissions.

(13) One or more Class 1 stations may be assigned to this channel. Class II applications are subject to the same provisions as stated in Footnote 10.

(14) In continental U.S., for Class II stations which operate daytime only with power not in excess of 1 Kw and which will not deliver over 5 microvolts per meter groundwave at any point on the Mexican border, and in Alaska, Hawaii, Puerto Rico, and the Virgin Islands, for Class II stations which will not deliver over 5 microvolts per meter groundwave or 25 microvolts per meter 10% time skywave at any point on said border.

(15) A station on 1010 Kc shall also protect a Class I-B station at Havana, Cuba.

(16) Under terms of the 1950 North American Regional Broadcasting Agreement, Class I-A priority on this channel is assigned to USA, however FCC Rules continue to classify 1030 Kc as Class 1-B, pending ratification of the 1950 Agreement.

(17) The U.S. is permitted under the "Gentlemen's Agreement" to continue operation of one 50 Kw full-time Class II station with directional pattern that will direct the signal to the northeast and protect the Mexican station's signal in the U.S. as much as possible.

(18) The U.S. is permitted under the "Gentlemen's Agreement" to assign a station in in the Detroit, Michigan, area with a directional antenna that will direct the signal to the northward and protect the Mexican station's coverage in the U.S. as much as possible.

(19) All new assignments on this channel must be in accordance with Section 3.187.

(20) No applications will be processed on this channel until a decision is reached in Docket 6741. On the frequency of 770 Kc two Class I stations may be assigned.

(21) The United States may assign stations to operate with powers not in excess of 5 Kw daytime on this frequency. Stations with powers in excess of 1 Kw may not be assigned in areas within the following distances of the locations specified:

800 Kc 820 miles from Ciudad Juarez, Chihuahua
1050 Kc 620 miles from Monterrey, Nuevo Leon
1570 Kc 620 miles from Ciudad Acuna, Coahuila

Before the Commission will take final action with respect to an application proposing 5 Kw, appropriate coordination of the rules must be effected with other North American countries.

(22) Docket 6741 proposes no action at this time in regard to increased power for these channels.

(23) Docket 6741 proposes to assign a new Class I station in a designated state and require both the new and existing Class I stations to directionalize.

(24) Docket 6741 proposes to retain present maximum power of 50 Kw and assign unlimited time Class II stations in underserved areas.

(25) Class I and II stations on 1540 Kc shall deliver not over 5 microvolts per meter groundwave or 25 microvolts per meter 10 per cent time skywave at any point of land in the Bahama Islands, and such stations operating nighttime (i.e., sunset to sunrise at the location of the Class II station) shall be located not less than 650 miles from the nearest point of land in the Bahama Islands.

(26) In accordance with the Commission's decision in Docket 8333, these channels have been removed from the "freeze."

FM STATIONS

Classes and Power of FM Stations

Class A Station: A Class A station is a station which operates on a Class A channel and is designed to render service primarily to a community or to a city or town other than the principal city of an area, and the surrounding rural area. The coverage of a Class A station shall be not more than the equivalent of 1 kilowatt effective radiated power and antenna height of 250 feet above average terrain, as determined by the methods prescribed in the Standards of Good Engineering Practice Concerning FM Broadcast Stations. A Class A station will not be licensed with more than 1 kilowatt effective radiated power. The power rating of the transmitter used for a Class A station shall be not less than 250 watts nor more than 1 kilowatt. The signal intensity requirements of Section 2 of the Standards of Good Engineering Practice Concerning FM Broadcast Stations shall determine the minimum coverage of a Class A station. Class A stations will normally be protected to the 1 mv/m

contour; however, assignments will be made in a manner to insure, in so far as possible, a maximum of service to all listeners, whether urban or rural, giving consideration to the minimum signal capable of providing service. (FCC Rules, Section 3.203)

Class B Station: The coverage of a Class B station in Area II * shall normally be not more than the equivalent of 20 kilowatts effective radiated power and antenna height of 500 feet above average terrain. The use of greater power and antenna height will be encouraged in those portions of Area II where such use would not result in undue interference to stations already authorized or to probable assignments in so far as can be determined at the time of the grant. In such cases, the power, antenna height, and area will be determined on the merits of each application with particular attention being given to rural areas which would not otherwise receive service. (FCC Rules, Section 3.204)

Time of Operation

All FM broadcast stations are licensed for unlimited time operation. A minimum of 36 hours per week during the hours of 6 AM to midnight, consisting of not less than five hours in any one day, must be devoted to FM broadcast operation. Time devoted to operations conducted under a Subsidiary Communications Authorization is not included in meeting this requirement. In an emergency when, due to causes beyond the control of a licensee, it becomes impossible to continue operation, the station may cease operation 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 in writing immediately after the emergency develops. (FCC Rules, Section 3.261)

Subsidiary Communications Authorizations (SCA)

FM broadcast stations may engage in "functional (background) music" operations in addition to their regular FM broadcast service. The SCA will run concurrently with the FM broadcast license, and may not be renewed unless the FM broadcast license is also renewed. (For further details, see FCC Rules, Sections 3.293, 3.294, 3.295 and 3.296, Subpart B—FM Broadcast stations.)

Frequencies Used for FM Broadcast Stations

The band 88–108 Mc is reserved for the FM Broadcast Service. These are 100 channels of 200 Kc each (80 for commercial broadcasting and 20 for educational broadcasting). Educational channels are in the 88–92 Mc portion of the FM band, and commercial broadcasting is allotted the remainder, 92–108 Mc.

For further reference, see FCC Rules, Part 3, Subpart B, and the Standards of Good Engineering Practice Concerning FM Broadcast Stations.

Channel No.	*Frequency*	*For Class*	*Channel No.*	*Frequency*	*For Class*
221	92.1 Mc	A	233	94.5 Mc	B
222	92.3 Mc	B	234	94.7 Mc	B
223	92.5 Mc	B	235	94.9 Mc	B
224	92.7 Mc	A	236	95.1 Mc	B
225	92.9 Mc	B	237	95.3 Mc	A
226	93.1 Mc	B	238	95.5 Mc	B
227	93.3 Mc	B	239	95.7 Mc	B
228	93.5 Mc	A	240	95.9 Mc	A
229	93.7 Mc	B	241	96.1 Mc	B
230	93.9 Mc	B	242	96.3 Mc	B
231	94.1 Mc	B	243	96.5 Mc	B
232	94.3 Mc	A	244	96.7 Mc	A

* See Footnote 1 at end of channel tabulation.

Channel No.	*Frequency*	*For Class*	*Channel No.*	*Frequency*	*For Class*
245	96.9 Mc	B	273*	102.5 Mc	B
246	97.1 Mc	B	274*	102.7 Mc	B
247	97.3 Mc	B	275*	102.9 Mc	B
248	97.5 Mc	B	276*	103.1 Mc	A
249	97.7 Mc	A	277*	103.3 Mc	B
250	97.9 Mc	B	278*	103.5 Mc	B
251*	98.1 Mc	B	279*	103.7 Mc	B
252*	98.3 Mc	A	280*	103.9 Mc	A
253*	98.5 Mc	B	281*	104.1 Mc	B
254*	98.7 Mc	B	282*	104.3 Mc	B
255*	98.9 Mc	B	283*	104.5 Mc	B
256*	99.1 Mc	B	284*	104.7 Mc	B
257*	99.3 Mc	A	285*	104.9 Mc	A
258*	99.5 Mc	B	286*	105.1 Mc	B
259*	99.7 Mc	B	287*	105.3 Mc	B
260*	99.9 Mc	B	288*	105.5 Mc	A
261*	100.1 Mc	A	289*	105.7 Mc	B
262*	100.3 Mc	B	290*	105.9 Mc	B
263*	100.5 Mc	B	291*	106.1 Mc	B
264*	100.7 Mc	B	292*	106.3 Mc	A
265*	100.9 Mc	A	293*	106.5 Mc	B
266*	101.1 Mc	B	294*	106.7 Mc	B
267*	101.3 Mc	B	295*	106.9 Mc	B
268*	101.5 Mc	B	296*	107.1 Mc	A
269*	101.7 Mc	A	297*	107.3 Mc	B
270*	101.9 Mc	B	298*	107.5 Mc	B
271*	102.1 Mc	B	299*	107.7 Mc	B
272*	102.3 Mc	A	300*	107.9 Mc	B

* See Footnote 2.

Footnotes to FM Broadcast Section

(1) Area I includes southern New Hampshire; all of Massachusetts, Rhode Island, and Connecticut; southeastern New York as far north as Albany-Troy-Schenectady; all of New Jersey, Delaware, and the District of Columbia; Maryland as far west as Hagerstown; and eastern Pennsylvania as far west as Harrisburg.
Area II comprehends the remainder of the United States not included in Area 1.

(2) In Hawaii, the band 98–108 Mc is allocated for non-broadcast use, and the frequencies 98.1–107.9 Mc will not be assigned in Hawaii for use by FM broadcast stations.

TELEVISION STATIONS

Minimum and Maximum Visual Effective Radiated Power (ERP)

Minimum

Applications will not be accepted for filing if they specify less than −10 dbk (100 watts) visual effective radiated power in any horizontal direction. No minimum antenna height above average terrain is specified.

Maximum

Channel Nos.	*Maximum Visual ERP*
2–6	20 dbk (100 Kw)
7–13	25 dbk (316 Kw)
14–83	37 dbk (5000 Kw)

NOTE: The maximum visual effective radiated power of television broadcast stations operating on Channels 14–83 within 250 miles of the Canadian-USA border may not be in excess of 30 dbk (1000 Kw).

Time of Operation

All television broadcast stations are licensed for unlimited time operation. Each station must maintain a regular program operating schedule as follows:

First 18 months of operation: Not less than 2 hours daily in any five broadcast days per week, and not less than a total of 12 hours per week.

Each successive 6-month period: Not less than 2 hours daily in any five broadcast days per week, and not less than a total of 16 hours, 20 hours, and 24 hours per week respectively. *Third year of operation and thereafter:* Not less than 2 hours in each of the seven days of the week, and not less than a total of 28 hours per week. See FCC Rules, Section 3.651.

Frequencies Used for Television Stations

There are 82 channels in the Television Broadcast Service, 12 for VHF television and 70 for UHF television. Each channel has a bandwidth of 6 Mc.

Assignment of a channel to an applicant is made in accordance with the Table of Assignments given in FCC Rules, Section 3.606(b).

For further reference, see FCC Rules, Part 3, Subpart E.

The channel numbers and frequency bands for television stations are as follows:

Channel No.	*Frequency Band*	*Channel No.*	*Frequency Band*
2	54–60 Mc	37	608–614 Mc
3	60–66 Mc	38	614–620 Mc
4	66–72 Mc *	39	620–626 Mc
5	76–82 Mc	40	626–632 Mc
6	82–88 Mc	41	632–638 Mc
7	174–180 Mc	42	638–644 Mc
8	180–186 Mc	43	644–650 Mc
9	186–192 Mc	44	650–656 Mc
10	192–198 Mc	45	656–662 Mc
11	198–204 Mc	46	662–668 Mc
12	204–210 Mc	47	668–674 Mc
13	210–216 Mc	48	674–680 Mc
14	470–476 Mc	49	680–686 Mc
15	476–482 Mc	50	686–692 Mc
16	482–488 Mc	51	692–698 Mc
17	488–494 Mc	52	698–704 Mc
18	494–500 Mc	53	704–710 Mc
19	500–506 Mc	54	710–716 Mc
20	506–512 Mc	55	716–722 Mc
21	512–518 Mc	56	722–728 Mc
22	518–524 Mc	57	728–734 Mc
23	524–530 Mc	58	734–740 Mc
24	530–536 Mc	59	740–746 Mc
25	536–542 Mc	60	746–752 Mc
26	542–548 Mc	61	752–758 Mc
27	548–554 Mc	62	758–764 Mc
28	554–560 Mc	63	764–770 Mc
29	560–566 Mc	64	770–776 Mc
30	566–572 Mc	65	776–782 Mc
31	572–578 Mc	66	782–788 Mc
32	578–584 Mc	67	788–794 Mc
33	584–590 Mc	68	794–800 Mc
34	590–596 Mc	69	800–806 Mc
35	596–602 Mc	70	806–812 Mc
36	602–608 Mc	71	812–818 Mc

* NOTE: 72–76 Mc is used for assignment of Fixed Radio (nonbroadcast) stations on the condition that no harmful interference be caused to TV channels 4 and 5.

Channel No.	*Frequency Band*	*Channel No.*	*Frequency Band*
72	818–824 Mc	78	854–860 Mc
73	824–830 Mc	79	860–866 Mc
74	830–836 Mc	80	866–872 Mc
75	836–842 Mc	81	872–878 Mc
76	842–848 Mc	82	878–884 Mc
77	848–854 Mc	83	884–890 Mc

FREQUENCY SELECTION

Service	*Choice*
Standard Broadcasting (AM)	Applicant must specify frequency. Search must be made for an available frequency by the applicant, or his consultant.
FM Broadcasting	Applicant must specify frequency.
Television Broadcasting	Applicant may select any unassigned channel from Section 3.606(b). Applications will not be accepted by FCC if they are not in accord with 3.606(b). Petition for rule-making to change the Table of Assignments (3.606b) may be filed, and if granted, then application may be filed for new channel so added. Petitions to change 3.606(b) should be considered in the light of the following: Sec. 3.607–Availability of channels. Sec. 3.608–International agreements. Sec. 3.610–Separations.

TRANSLATOR STATIONS

Definition

A television translator is a station in the broadcasting service operated solely for the purpose of retransmitting the signals of a television broadcast station or another television broadcast translator station, by means of direct frequency conversion and amplification of the incoming signals and 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.

Power

A television broadcast translator station will not be authorized to operate with a transmitter power output in excess of the rated power output of the transmitter and in no event shall the rated peak visual power output of the transmitter be in excess of 100 watts.

Frequencies Used for Translator Stations

There are 14 channels in the translator service. Each channel has a bandwidth of 6 Mc. Assignment of a channel to an applicant is made in accordance with the Frequency Assignment given in FCC Rules, Section 4.702. The channel numbers and frequency band for translator stations are as follows:

Channel No.	*Frequency Band*
70	806–812 Mc
71	812–818 Mc
72	818–824 Mc
73	824–830 Mc
74	830–836 Mc
75	836–842 Mc
76	842–848 Mc
77	848–854 Mc
78	854–860 Mc
79	860–866 Mc
80	866–872 Mc
81	872–878 Mc
82	878–884 Mc
83	884–890 Mc

For further information on this subject see Part 4 of the FCC Rules-Experimental, Auxiliary and Special Broadcast Services—Subpart G. FCC proposed rule making in Docket 11331 would permit operation of VHF booster transmitters under certain conditions. See Docket 11331 for full details.

AUXILIARY BROADCAST SERVICES

Introduction

FCC Rules provide for the use of radio transmitting apparatus to supply certain auxiliary services in connection with broadcasting. These services fall into four general categories:

1. *Portable or mobile stations* which may be used to relay programs from places of origination other than a studio.
2. *Base stations*, usually located at the studio or transmitter of a broadcast station, and used to co-ordinate the activities of portable or mobile stations.
3. *Fixed stations* (*STL*) which may be used to provide a program circuit between the main or auxiliary studios to the transmitter of a broadcast station.
4. *Fixed stations* (*Inter-city Relay*) which may be used to relay programs from one broadcast station to other broadcast stations for network programming.

Category (1) includes two classes of stations, i.e., *Remote Pickup Broadcast Mobile Stations* which may be used for relaying aural broadcast program material or the aural portion of television programs and are available to AM, FM, and TV broadcast station licensees; and *Television Pickup Stations* which may be used for relaying television program material, either visual alone or the combined visual and aural program material by means of multiplexing. Television pickup stations are available only to television broadcast stations.

Category (2) contains a class of station called a *Remote Pickup Broadcast Base Station*. From the standpoint of equipment, frequency assignments, technical operation, and availability, they are identical with Remote Pickup Broadcast Mobile Stations. A differentiation is made because they are permanently installed at a fixed location and do not normally carry program material. The primary purpose of such base stations is to provide communication with remote mobile stations or television pickup stations, however, other uses are permitted under special circumstances.

Category (3) includes three classes of stations; *Standard Broadcast STL Stations, FM Broadcast STL Stations*, and *Television STL Stations*. STLs (studio-transmitter links) are used to provide a program circuit between the studio and the transmitter of a broadcast station. They are available to AM, FM and TV broadcast stations. AM, FM, and TV STLs which are used to carry only the aural portion of TV programs, operate in the same general portion of the spectrum and the same type of transmitting equipment is used in all three services. Television STLs which are used to carry the visual portion of television programs operate in the so-called "micro-

wave" portion of the spectrum. Some equipment is designed to simultaneously carry the aural portion of the program material on the same carrier by means of multiplexing and such use is permitted if it can be accomplished without degrading the visual and aural signal to a point where the overall performance of the television system cannot meet the minimum requirements of the Rules Governing Television Broadcast Stations. Television broadcasters contemplating the use of multiplexing in their STL circuit should assure themselves that the equipment proposed to be used has sufficient performance capability to enable them to meet the requirements of Sec. 3.687.

Category (4) includes two classes of stations; *FM Broadcast Inter-city Relay Stations* and *TV Inter-city Relay Stations*. (There is no AM Inter-city Relay Service.) Inter-city relay stations are used for the interexchange of programs between broadcast stations for network operation. Circuits for the interexchange of broadcast programs are normally operated by communications common carriers, however, in the case of FM broadcasting, where high-quality aural circuits are required and in the case of television, where special video circuits as well as high-quality aural circuits are required, the telephone company serving a certain area may not be able to supply the desired service due to lack of adequate facilities. Under such circumstances, inter-city relay stations are available to FM and TV broadcasters on *an interim basis* pending the availability of adequate common carrier circuits. No provision is made for inter-city relay stations to be used in conjunction with AM broadcast stations since telephone circuits of suitable broadcast quality are generally available or can be made available on short notice. FM inter-city relay stations and TV inter-city relay stations which carry only the aural portion of the television program operate in the same general portion of the spectrum as AM, FM, and TV STL stations. TV inter-city relay stations used for the visual portion of television programs operate in the microwave bands used by TV pickup and TV STL stations. As in the case of TV STLs, the aural portion of the TV program may be transmitted on the same carrier as the visual program material by means of multiplexing. Quality standards for inter-city relay stations are left to the discretion of the individual broadcaster.

Some broadcasters prefer to keep equipment running on a 24-hour basis, feeling this is a factor in economical and trouble-free operation. Radiation of an unmodulated carrier is not authorized for the auxiliary broadcast services except during brief test periods, but equipment may be kept operating when no program material is being transmitted by shunting the output into a dummy antenna or a similar non-radiating load.

Remote pickup broadcast stations are required to monitor for CONELRAD Radio Alerts and go off the air until the Radio All Clear. They may obtain the Radio Alert by monitoring any standard, FM, or TV station. Since the remote personnel would naturally be in communication with the mother station, and monitoring its transmissions in any case, no special receiver is required.

All of the material in this section is intended to be an explanation of the FCC Rules relating to the operation of auxiliary broadcast stations. It should not be understood to replace the need for reference to the full text of Part 4 of the FCC Rules which covers the services. The material in this article is arranged according to classes of broadcasting stations which may use auxiliary stations, and reference is made throughout to the pertinent sections of Part 4 for further study.

AM/FM SECTION

Remote Pickup Broadcast Stations

See page 1–17, categories (1) and (2) for definitions. Broadcasters may use remote pickup broadcast stations at their discretion, and the choice between radio and wire lines does not depend on whether or not wire lines are available.

Remote pickup broadcast stations may be used for:

1. Transmission of AM, FM or the aural portion of TV program material originating outside a regular studio. (Normally, only Mobile stations are used.)

2. Orders and related communications directly concerning such transmissions, but *may not be used* to provide private mobile telephone systems to station personnel. (Both Base and Mobile stations may be so used.)
3. Emergency program or order circuits from studios in the event of failure of regular wire circuits, but *may not be used* for such purposes on a regular basis. (Both Base and Mobile stations may be so used.)
4. In Alaska, Hawaii, Puerto Rico and Virgin Islands for inter-city relays and STL's, provided such transmissions are not intended to be received directly by the public. Such use is not authorized in the continental limits of the U.S. (Both Base and Mobile stations may be so used.)
5. Under STA for mobile communications in connection with adjustment and maintenance of antenna system, or in connection with field intensity surveys. (Both Base and Mobile stations may be so used.)
6. Coordination of the activities of portable or mobile stations.
7. Two-way communication between the studio and transmitter of a broadcast station which has a radio STL. (Base stations only.)

Wire lines may be used to complete remote pickup circuits, if necessary.

Remote pickup broadcast stations will not be granted exclusive frequency assignments, and the same frequency or frequencies may be assigned to other licensees in the same area. (In the television section, it will be noted that some exclusive assignments of auxiliary frequencies are made for television purposes.)

Applicants may request information about the existing remote pickup assignments in a particular area, and apply for unassigned frequencies to the extent permitted by the FCC rules. The Commission is unable to supply information regarding existing assignments to the Industrial Radio Stations in the band shared by remote pickup stations with the service.

Where a frequency is shared by two or more remote pickup stations and simultaneous operation is contemplated, the transmission of actual program material has first priority, the transmission of cues and orders including preparatory communications has second priority, and the use of the remote pickup station for other authorized communication has the lowest priority. An exception to this rule is made for the frequencies 26.07 Mc, 26.09 Mc, 26.11 Mc, 26.13 Mc, 26.45 Mc and 26.47 Mc as noted below.

The following groups of frequencies are allocated for assignment to remote pickup broadcast stations. A licensee may have one or more frequencies assigned for operation in the same area, but is limited within each "division" to assignments from a single "group."

Division	*Group*	*Frequencies*	*Type of Emission*	*Notes*
1	A	1606 Kc [1] 1622 Kc 1646 Kc	10-A-3	Not shared with other services.
2	D	25.87 Mc [2] 26.15 Mc 26.25 Mc 26.35 Mc		Finalization of Docket 11696 now enables the operation of wireless microphones and cueing circuits in the bands 26.10–26.48 Mc and 450–451 Mc.
2	E	25.91 Mc [2] 26.17 Mc 26.27 Mc 26.37 Mc	20-A-3 or 20-F-3	Not shared with other services.
2	F	25.95 Mc [2] 26.19 Mc 26.29 Mc 26.39 Mc		

Division	*Group*	*Frequencies*	*Type of Emission*	*Notes*
2	G	25.99 Mc [2] 26.21 Mc 26.31 Mc 26.41 Mc	20-A-3 or 20-F-3	
2	H	26.03 Mc [2] 26.23 Mc 26.33 Mc 26.43 Mc		
3	I	26.07 Mc [2] 26.11 Mc 26.45 Mc	20-A-3 or 20-F-3	Not shared with other services. When used for radio order circuits (see page 1–22), such use is secondary to all other permissible uses.
3	J	26.09 Mc [2] 26.13 Mc 26.47 Mc		
4	K	152.87 Mc 152.93 Mc 152.99 Mc 153.05 Mc 153.11 Mc 153.17 Mc 153.23 Mc 153.29 Mc 153.35 Mc	30-A-3 or 60-F-3	Shared with Industrial Services which have 1st priority of use. Such operation on basis of "split channel" provisions of Doc. 11959, which do not apply to Broadcast remote pickup stations. In Doc. 11997 NAB requested that such shared use with Industrial be continued.
		159.51 Mc 159.57 Mc 159.63 Mc 159.69 Mc 159.75 Mc 159.81 Mc 159.87 Mc 159.93 Mc 159.99 Mc	30-A-3 or 60-F-3	For assignment to remote pickup base and mobile stations in the Island of Puerto Rico only.
5	L	166.25 Mc	30-A-3 or	Use is subject to the condition that harmful interference will not be caused to present or future government stations in the band 162–174 Mc. Also, operation on these frequencies is not authorized in the TVA area, nor within 150 miles of New York City, nor outside the continental limits of the U.S.
5	M	170.15 Mc	60-F-3	
6	N	450.05 Mc 450.15 Mc 450.25 Mc 450.35 Mc 450.45 Mc 450.55 Mc 450.65 Mc 450.75 Mc 450.85 Mc 450.95 Mc 455.05 Mc 455.15 Mc	30-A-3 or 100-F-3	Not shared with other services. Docket 11959 proposes to reduce present 100 Kc bandwidths to 50 Kc. See Note Group D. Docket 11959 proposes six exclusive channels be assigned the Broadcast Service at 161.645–161.825 Mc with 30 Kc widths.

Division	Group	Frequencies	Type of Emission	Notes
		455.25 Mc		
		455.35 Mc		
		455.45 Mc		
		455.55 Mc		
		455.65 Mc		
		455.75 Mc		
		455.85 Mc		
		455.95 Mc		

[1] Use is subject to the condition that no harmful interference is caused to the reception of standard broadcast stations.

[2] Use is subject to the condition that no harmful interference is caused to the reception of high-frequency broadcast stations.

AM/FM Studio-transmitter Link Stations

STL stations are available to the licensees of both AM and FM broadcast stations and are used to relay programs from the studio to the transmitter of the station. Where the licensee of an AM station is also the licensee of an FM station, the same STL may be used for both stations. (See Section 4.532a.) The STL may also be used for the purpose of providing communication between studio and transmitter when no programs are being transmitted, or if multiplexing is employed, may be used for communication during program transmission.

Broadcasters may use radio STLs at their discretion, and the choice between radio STL and wire line (common carrier) STL does not depend on whether or not wire lines are available.

Any AM or FM station employing a radio STL may also use remote pickup base stations to provide an "order circuit" for communication of information concerning program service. Radio circuits may be used for this purpose *only* when the broadcast station uses a radio STL. See page 1–22.

Exclusive assignments will be made to STL stations providing the program circuit from the main studio to the transmitter of FM broadcast stations. In the case of AM STL stations, and FM STL stations at secondary studios, exclusive assignments will be made wherever practicable.

The following frequencies are available for broadcast STL stations including TV STL, TV Inter-city relays. Aural portion only.

Frequency	Type of Emission	Notes
942.5 Mc	430-F-3	Not shared with other services. May also be used for FM Inter-city Relay Stations. Licensed for unlimited time operation. Directional antenna is required. See FCC Rules, Section 4.536. May be operated by remote control in accordance with the provisions of FCC Rules, Sec. 4.533.
943.0 Mc		
943.5 Mc		
944.0 Mc		
944.5 Mc		
945.0 Mc		
945.5 Mc		
946.0 Mc		
946.5 Mc		
947.0 Mc		
947.5 Mc		
948.0 Mc		
948.5 Mc		
949.0 Mc		
949.5 Mc		
950.0 Mc		
950.5 Mc		
951.0 Mc		
951.5 Mc		

No new fixed stations, including tropospheric scatter stations in the international fixed service, will be authorized in the band 890–942 Mc, provided that all stations presently authorized to operate on frequencies in the band 890–942 Mc may continue to operate pursuant to the provisions of their existing authorizations until the termination of such authorizations. Renewal of authorizations for such stations will be issued only on the condition (1) that they accept any harmful interference that may be experienced from either ISM equipment in the band 890–940 Mc, or from the radio-positioning service in the band 890–942 Mc and (2) that they do not cause harmful interference to the radio-positioning service.

Radio Order Circuits

Remote pickup base stations may be authorized to provide two-way communication between the studio and transmitter of a broadcast station which has a radio STL.

The following frequencies may be assigned for radio order circuits. They are licensed for unlimited time operation, but their use is secondary to other need for the same frequency(s).

Group	*Frequency*	*Type of Emission*
I	26.07 Mc *	20-A-3
	26.09 Mc *	or
	26.11 Mc	20-F-3
	26.45 Mc	
J	26.13 Mc	20-A-3
	26.47 Mc	or
		20-F-3

* Use is subject to the condition that no harmful interference is caused to the reception of high frequency broadcast stations.

FM Inter-city Relay Stations

The operation of FM inter-city relay stations is subject to the condition that no harmful interference is caused to other radio stations, present or future, operating in accordance with the Table of Frequency Allocations.

Wire lines may be used to complete circuits for FM inter-city relays. Inter-city relay stations may be used for communication of program information when no programs are being transmitted, or if multiplexing is employed, may be used for communication during program transmission.

Relay stations will be authorized only when suitable common carrier facilities are not available. Each application for a new FM inter-city relay system, or for renewal of an existing system must be accompanied by verified statements showing:

1. Why the facilities are needed, including reasons why common carrier facilities are not available.
2. That the applicant has requested such facilities from the common carrier serving the area, and including copies of such request(s) and reply(s).

Frequencies available for FM inter-city relay stations are the same as those used for broadcast STLs (see listing on page 1–21).

As in the case of STLs, they are licensed for unlimited time operation, directional antennas are required, and they may be operated by remote control.

TELEVISION SECTION

Television Pickup Stations

Television pickup stations may be used for:

1. Transmission of program material originating outside a regular studio. These channels are primarily used for the transmission of the video portion of the

pickup, but the aural portion may be multiplexed on the same channel. Applications must clearly state the nature of any multiplexing proposed.

If only the video portion is transmitted on the television pickup channel, the aural portion may be transmitted by wire line, or on one of the frequencies designated for remote pickup broadcast stations. Listed on pages 1–19, 1–20, and 1–21.

2. To provide temporary studio-transmitter links (without further authority of the FCC provided the installation of the antenna does not increase the height of any existing structure by more than 20 feet. Authority for increase of more than 20 feet may be obtained from FCC if necessary).
3. Orders and related communications concerning such transmissions. They *may not be used* solely for this purpose.

No standards are specified in either the FCC Rules or in any existing proposed rule-making concerning the quality of television pickups.

Television STL Stations

The TV STL may be nsed for communications relating to program continuity during periods when no programs are being transmitted, or by multiplexing at any time.

The aural signal may be multiplexed on the STL, but broadcasters contemplating the use of multiplexing should assure themselves that the equipment proposed to be used has sufficient performance quality to enable them to meet the requirements of Section 3.687 of the FCC Rules.

The television broadcaster may elect to have a communications common carrier provide television pickup or television STL service, and in this case, the common carrier may use the same channels which would normally be assigned to the television station.

When the television station uses a television channel STL, it may also use remote pickup base stations to provide an "order circuit" for communication of information concerning program service. Radio circuits may be used for this purpose *only* when a television channel STL is used.

Television Inter-city Relay Stations

Television inter-city relay stations provide a means whereby television broadcast licenses may provide their own inter-city television transmission services in connection with the operation of their television broadcast stations.

The use of channels for television inter-city relay stations is on a secondary basis, and is subject to the condition that no harmful interference is caused to stations operating in accordance with the Table of Frequency Allocations.

No standards are specified in either FCC Rules or in any existing proposed rule-making concerning the quality of television inter-city relay stations. Inter-city relay stations may be used for communication of program information either by multiplexing, or by simplex during periods of non-use for program transmission.

Assignment of Channels for the Television Auxiliary Services

The television auxiliary frequencies are assigned interchangeably for television pickups, STLs, or inter-city relay stations.

Television stations may request the assignment of one channel in Band A or Band B, and one channel in Band D, or the following list of channels for use on an exclusive basis. In addition, they may request the assignment of additional channels which will be assigned, if available in the area, on a non-exclusive basis. The non-exclusive channels may be withdrawn any time they are needed to provide exclnsive channels for other television stations in the same area.

No exclusive assignments are made in Band C.*

* Channels in Band A marked with (**) and all channels in Band C are allocated to accommodate the incidental radiations of industrial, scientific, and medical equipment, and

If two television stations in the same area are so located that they may share a single STL, they may by mutual agreement request the same assignment of the exclusive channel and, in addition, may be granted a second exclusive channel for each station from either Band A or Band B and a third exclusive channel from Band D.

Where only one exclusive channel is assigned, it is normally assigned to the main studio STL (where the television station employs a television channel STL); additional STLs may be operated at the broadcaster's discretion. Operation of the STL on a non-exclusive channel is subject to the condition that no harmful interference is caused to the operation of television pickup stations.

Any suitable type of emission may be used for the frequencies above 1500 Mc. Identification of the emission may be by whatever means the emission is authorized for, except that a visual-only transmitter may be identified by means of a keyed signal, either interrupting the carrier or by means of modulation impressed on the carrier, giving the call sign of the station.

Directional antennas are not required, but are usually employed at these frequencies.

Band A	*Band B*	*Band C* **
1990–2008 Mc	6875–6900 Mc	10550–10575 Mc
2008–2025 Mc	6900–6925 Mc	10575–10600 Mc
2025–2042 Mc	6925–6950 Mc	10600–10625 Mc
2042–2059 Mc	6950–6975 Mc	10625–10650 Mc
2059–2076 Mc	6975–7000 Mc	10650–10675 Mc
2076–2093 Mc	7000–7025 Mc	10675–10700 Mc
2093–2110 Mc	7025–7050 Mc	
2450–2467 Mc **	7050–7075 Mc ***	
2467–2484 Mc **	7075–7100 Mc ***	
2484–2500 Mc **	7100–7125 Mc ***	

** See previous footnote.

*** Until further order by the Commission, these three channels will not be assigned to television broadcast stations in order that they may be used by communications common carriers to provide television pickup and STL services to television stations.

Band D		
12700–12725 Mc	12875–12900 Mc	13050–13075 Mc
12725–12750 Mc	12900–12925 Mc	13075–13100 Mc
12750–12775 Mc	12925–12950 Mc	13100–13125 Mc
12775–12800 Mc	12950–12975 Mc	13125–13150 Mc
12800–12825 Mc	12975–13000 Mc	13150–13175 Mc
12825–12850 Mc	13000–13025 Mc	13175–13200 Mc
12850–12875 Mc	13025–13050 Mc	13200–13225 Mc

Additional frequencies for the transmission of the aural portion of a television pickup may be selected from the remote pickup broadcast frequencies assigned by the FCC.°

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stations operating therein must accept any interference that may be caused by the operation of such equipment. These frequencies are also shared with other communications services and exclusive channel assignments will not be made, nor is the channeling shown in Bands A and C necessarily that which will be employed by such other services. By final Report and Order in Docket 11866, the Commission proposes to delete Band C for use by broadcast auxiliary services.

° Frequencies in the bands 16000–18000 Mc and 26000–30000 Mc are available for assignment on a case-by-case basis for television pickup, STL, and inter-city relay purposes. Channel widths and frequency tolerance will be specified in individual authorizations. The frequencies between 17850 and 18000 Mc must accept any interference that may be caused by incidental radiations of industrial, scientific, and medical (ISM) equipment.

Radio Order Circuits

Remote pickup base stations may be authorized to provide two-way communication between the studio and transmitter of a television station which has a television channel STL.

The following frequencies may be assigned for radio order circuits. They are licensed for unlimited time operation, but their use is secondary to other need for the same frequency(s).

Group	*Frequency*	*Type of Emission*
I	26.07 Mc ° 26.09 Mc ° 26.11 Mc 26.45 Mc	20-A-3 or 20-F-3
J	26.13 Mc 26.47 Mc	20-A-3 or 20-F-3

° Use is subject to the condition that no harmful interference is caused to the reception of high-frequency broadcast stations.

OTHER FREQUENCIES OF INTEREST TO BROADCASTERS

Motion Picture Radio Service

Rules and regulations governing the Motion Picture Radio Service are found in Part 11, Subpart I. Part 11 covers all of the Industrial Radio Services and was set up to prescribe the manner in which frequencies may be made available for radio communication and control facilities to various industrial enterprises which, for safety purposes or other necessity, require radio transmitting facilities in order to function efficiently.

Of all the types of industrial enterprises covered in Part 11, only the Motion Picture Radio Service seems to be applicable to use by broadcasters, and this service may only be used by broadcasters while they are engaged in the production or filming of motion pictures (newsreels, documentaries, features, etc.). Since other services are both more practicable and more economical for general use as auxiliary broadcast stations, the Motion Picture Radio Service should be considered only by television stations which employ full-time motion picture crews, or by companies engaged in the business of making motion pictures for use either by theatres or television stations.

The frequencies allocated to this service cannot be used for video transmissions, but would provide a mobile telephone service, or a radio telephone circuit for transmission of communications relating to the operation of a film crew, or to coordinate action during the filming of motion pictures.

Motion Picture Radio Service stations may communicate with other stations in the same service, and with Government stations where such communication is needed for cooperation and coordination of activities. They may not communicate with broadcast or auxiliary stations, or be used for direct transmission of program material to any broadcast or auxiliary station. For a more detailed explanation of permissible communications, see Sec. 11.151.

All communications in this service are to be limited to the minimum practicable transmission time, and some type of standard operating procedure must be employed by each licensee. Continuous radiation of an unmodulated carrier is prohibited, except when necessary for test purposes, or when specifically authorized in writing by the Commission.

The power which may be used by a station in the Motion Picture Radio Service is limited to the minimum required for satisfactory technical operation commensurate with the size of the area to be served and local conditions which affect radio trans-

mission and reception. In cases of harmful interference, the Commission may order a change in power, or antenna height, or both.

All transmitter adjustments or tests during or coincident with the installation, servicing, or maintenance of a Motion Picture Radio Station which may affect the proper operation of the station must be made by, or under the immediate supervision and responsibility of a first or second-class commercial radio operator licensee. If use of radio telegraphy is contemplated, either a first or second-class commercial radiotelegraph operator licensee is required.

Stations in the Motion Picture Radio Service which employ radiotelephony may be operated by persons holding a commercial radio license or permit of any class except the Aircraft Radiotelephone Operators Authorization. Under certain conditions, some of the stations may be operated by unlicensed persons, but in no case is the station licensee relieved of the responsibility for the station's proper operation, and as stated above all adjustments and tests require either a first- or second-class commercial radio operator. For a detailed discussion of operator requirements, see Sec. 11.154.

Motion Picture Radio Service stations may be remotely controlled if wire lines are used for the control.

Frequencies Used for Motion Picture Radio Service Stations

All assignments of frequencies to base and mobile stations in the Motion Picture Radio Service are on *a shared basis with other services.*

Certain other frequencies are available to the Motion Picture Radio Service for use in developmental operations for the service, but only the frequencies available for assignment without this limitation are shown below. For a complete listing of frequencies for this service see Secs. 11.402, 11.403 and 11.404 of Subpart I of Part 11 of the FCC Rules.

Base and Mobile Stations

Frequency	*Type of Emission*	*Notes*
1628 Kc	8-A-3 or 40-F-3	All shared with other services.
1652 Kc		
2292 Kc *		* Also subject to the conditions that harmful interference shall not be caused to the service of any station not in the Industrial Radio Service which, at the discretion of the Commission, may have priority on the frequency or frequencies used for the service to which interference is caused.
2398 Kc *		
4637.5 Kc *		
49.70 Mc		
49.74 Mc		** These frequencies are available for assignment to remote pickup stations and the same transmitting equipment may be cross-licensed as a remote pickup station under which license it could perform the services of a remote pickup station.
49.78 Mc		
49.82 Mc		
152.87 Mc **		
152.93 Mc **		
152.99 Mc **		
173.225 Mc		
173.275 Mc		
173.325 Mc		
173.375 Mc		

Operational Fixed Stations

Subject to the condition that no harmful interference will be caused to reception of television channel numbers 4 or 5, the following frequencies are available for assignment to operational fixed stations in the Motion Picture Radio Service *on a shared basis* with other services.

The type of emission employed for these stations is either 8-A-3 or 40-F-3.

72.02 Mc	72.82 Mc	73.66 Mc	74.50 Mc
72.06 Mc	72.86 Mc	73.70 Mc	74.54 Mc
72.10 Mc	72.90 Mc	73.74 Mc	74.58 Mc
72.14 Mc	72.94 Mc	73.78 Mc	75.42 Mc
72.18 Mc	73.02 Mc	73.82 Mc	75.46 Mc
72.22 Mc	73.06 Mc	73.90 Mc	75.50 Mc
72.26 Mc	73.10 Mc	73.94 Mc	75.54 Mc
72.30 Mc	73.14 Mc	73.98 Mc	75.58 Mc
72.34 Mc	73.18 Mc	74.02 Mc	75.62 Mc
72.38 Mc	73.22 Mc	74.06 Mc	75.66 Mc
72.42 Mc	73.26 Mc	74.10 Mc	75.70 Mc
72.46 Mc	73.30 Mc	74.14 Mc	75.74 Mc
72.50 Mc	73.34 Mc	74.18 Mc	75.78 Mc
72.54 Mc	73.38 Mc	74.22 Mc	75.82 Mc
72.58 Mc	73.42 Mc	74.26 Mc	75.86 Mc
72.62 Mc	73.46 Mc	74.30 Mc	75.90 Mc
72.66 Mc	73.50 Mc	74.34 Mc	75.94 Mc
72.70 Mc	73.54 Mc	74.38 Mc	75.98 Mc
72.74 Mc	73.58 Mc	74.42 Mc	
72.78 Mc	73.62 Mc	74.46 Mc	

Citizens Radio Service

Rules and regulations governing the Citizens Radio Service are found in Part 19, which begins with this statement of basis and purpose:

"The following rules and regulations are issued pursuant to the provisions of Title III of the Communications Act of 1934, as amended, which vests authority in the Federal Communications Commission to regulate radio transmissions and to issue licenses for radio stations. These rules are designed to provide for private short-distance radio communication, radio signaling, and control of objects or devices by radio, with minimum licensing requirements, and to provide procedures whereby manufacturers of radio and equipment to be used or operated in the Citizens Radio Service may obtain type approval of such equipment."

Possible Uses of the Citizens Radio Service by Broadcasters

Class A, B, and D Stations: Each station in the Citizens Radio Service is authorized to communicate *only with other stations in the same service.* Communications with stations licensed under other parts of the FCC rules, such as radio broadcast or auxiliary broadcast stations, are prohibited. Citizens Radio Service stations, where authorized by the FCC, may be used as a privately owned mobile radiotelephone, as a privately owned radiotelephone circuit for any combination of broadcast station offices/studios/transmitter/home of a staff member licensed in this service, or as a cue and order circuit when the radio or television station is ineligible for a cue and order circuit under Part 4 of the FCC Rules. They may also be used for communications purposes in connection with adjustment and maintenance of antenna systems or in connection with field intensity surveys.

Transmissions must, however, be confined to business or personal communications; they may not be used to carry program material of any kind, either directly or indirectly, for use in connection with radio broadcasting, or for direct transmission to the public through public address systems or any other means. The stations may not be used to carry communications for hire, or for any purpose contrary to federal, state or local law.

Citizens Radio Service transmissions may be made at any time during day or night, but must be limited to the minimum practicable transmission time. An unmodulated carrier wave may not be emitted except for brief tests or during adjustments to the transmitter.

Class C Stations: Class C stations may be used only for radio control of objects and devices. They would provide a means of radio controlled alarm devices, or could be used to open and shut doors for convenience in moving scenery in television stations, or other uses of a similar nature.

Eligibility for Use of the Citizens Radio Service

No hard and fast definitions of "eligibility" for the Citizens Radio Service may be laid down. In general, the Commission will not authorize the use of one service if the applicant is eligible for a like assignment in another service. This policy would preclude the use of a Citizens Radio Service station as a cue and order circuit where the station had a radio studio-transmitter link circuit in Part 4 of the Rules. Applications must clearly show (1) what use is intended to be made of the stations, and (2) why the applicant is not eligible to conduct the proposed operation under the rules governing some other service.

Any individual, partnership, association, trust, corporation, or duly authorized Civil Defense organization may apply for a Citizens Radio Service license, provided:

(a) Not more than one person shall be eligible as licensee of the same apparatus, and,

(b) The licensee of a Class A, B, or D station must be 18 or more years of age. The licensee of a Class C station must be 12 or more years of age.

(c) The licensee must be a United States citizen.

Citizens Radio Service stations, when employing radiotelephony, may be operated by any person designated by the licensee, but the licensee will be held responsible for the operation of the station in accordance with all applicable provisions of treaty, laws, and regulations. The operator need hold no special license, however, *all transmitter adjustments or tests during or coincident with the installation, servicing, or maintenance of a Citizens Radio Station which may affect the proper operation of the station must be made by or under the immediate supervision and responsibility of a first- or second-class radio-telephone operator licensee.* If use of radio telegraphy is contemplated, see Sec. 19.71 for operator requirements.

The license for a Citizens Radio Service station is issued for a term of five years from date of issuance.

Either amplitude, phase, or frequency modulation may be employed for radiotelephony on Class A and Class B Citizens Radio Service stations. Class C stations may be used only for remote control of objects and devices, and except when used to control model aircraft, may use only on-off unmodulated or amplitude tone modulated carrier. Class D stations are authorized to use amplitude voice modulation for radiotelephone communications only.

Frequencies Used for Citizens Radio Service Stations

Frequencies for use in this service are generally contained in the following blocks. For specific information regarding their usage see Subpart C, Part 19 of the FCC Rules.

26.965–27.255 Mc
460.05–460.95 Mc
462.55–466.45 Mc

FREQUENCY TOLERANCES

Standard Broadcast

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

FM Broadcast

The center frequency of each FM broadcast station shall be maintained within ±2,000 cycles of the assigned center frequency.

TV Broadcast

(a) The carrier frequency of the visual transmitter shall be maintained within ±1,000 cycles of the authorized carrier frequency.

(b) The center frequency of the aural transmitter shall be maintained 4.5 megacycles, ±1,000 cycles, above the visual carrier frequency.

Non-commercial—FM

(a) The center of each noncommercial educational FM broadcast station licensed for transmitter power output of 10 watts or less shall be maintained within 3,000 cycles of the assigned center frequency.

(b) The center frequency of each non-commercial educational FM broadcast station licensed for transmitter power output above 10 watts shall be maintained within 2,000 cycles of the assigned center frequency.

Remote Pickup

The licensee of a remote pickup broadcast station shall maintain the operating frequency of its stations in accordance with the following: *

Frequency range	Tolerance (percent)	
	Base station	Mobile station
1606 to 2830 Kc:		
200 watts or less	0.01	0.02
Over 200 watts [1]	0.005	0.02
26.11 to 26.47 Mc:		
5 watts or less	0.005	0.02
Over 5 watts	0.005	0.005
152.87 to 153.35, 166.25 and 170.15 Mc:		
5 watts or less	0.005	0.01
Over 5 watts	0.005	0.005
450.05 to 451.95 Mc:		
All powers	0.01	0.01

[1] The listing of tolerance for power over 200 watts is in accordance with treaty values and shall not be construed as a finding that such power will be authorized.

AM/FM/TV (Aural Only) STL and FM Intercity Relay

The licensee of each broadcast STL or FM intercity relay station shall maintain the operating frequency of the station within ±0.005 percent of the assigned frequency.

TV STL Remote Pickup or TV Intercity Relay

(a) The licensee of a television auxiliary broadcast station shall maintain the operating frequency of its station so that the normal sideband energy shall fall within the assigned channel. If transmission is by asymmetrical sideband operation,

* Remote pickup broadcast stations now operating in the frequency range 30–40 Mc and on frequencies above 154 Mc will, during the period such operation continues pending frequency reassignment of these stations pursuant to the proceedings in Docket No. 6651, retain the frequency tolerance requirements of their present licenses.

suitable filters or other devices shall be employed to insure a minimum of radiated energy outside the assigned channel.

(b) Television STL stations operating on frequencies shown in Section 4.603(b) shall maintain their operating frequency within 0.005 percent of the assigned frequency.

TV Translators

The licensee of a television broadcast translator station shall maintain the visual carrier frequency and the aural center frequency at the output of the translator within 0.01 percent of its assigned frequencies when the primary station is not on its assigned frequencies, by more than the amount of the departure by the primary station.

Motion Picture Radio Service

(a) Except as provided in paragraph (b) of this section, a permittee or licensee in these services shall maintain the carrier frequency of each authorized transmitter within the following percentage of the assigned frequency:

Frequency range	All fixed and base stations, %	All mobile stations	
		Over 3 watts, %	3 watts or less, %
Below 25 Mc....	0.01	0.01	0.02
25 to 50 Mc.....	0.002	0.002	0.005
50 to 1000 Mc...	0.0005	0.005	0.005
Above 1000 Mc..	[1]	[1]	[1]

[1] To be specified in the station authorization.

(b) In lieu of meeting the requirements of paragraph (a) of this section for the frequency ranges shown below, transmitters authorized prior to November 1, 1958, and transmitters which are operationally integrated with existing radio systems authorized prior to November 1, 1958, may conform to the following frequency tolerances until not later than October 13, 1963:

Frequency range	Transmitter power	
	Over 3 watts, %	3 watts or less, %
25 to 50 Mc.....	0.01	0.02
50 to 220 Mc.....	0.005	0.01
220 to 1000 Mc.....	[1]	[1]

[1] To be specified in the authorization.

(c) For the purpose of determining the frequency tolerance applicable to a particular transmitter in accordance with the foregoing provisions of this section, the power of a transmitter shall he the maximum rated plate power input to its final radio frequency stage, as specified by the manufacturer.

Citizens Radio

The carrier frequency of a station in this service shall be maintained within the following percentage of the authorized frequency:

Class of station	Maximum authorized plate power input	Frequency tolerance	
		Fixed and base, %	Mobile, %
A	3 watts or less	0.001	0.005
A	Over 3 watts	0.001	0.001
B	3 watts or less	.....	0.5
B	Over 3 watts	.....	0.3
C	5 watts or less [1]	.....	0.005
C	Over 5 watts (25.255 Mc only)	.....	0.005
D	5 watts or less	.....	0.005

[1] Class C stations of 3 watts or less plate power input which are used solely for the remote control of objects or devices by radio (other than devices used solely as a means of attracting attention) are permitted a frequency tolerance of 0.01%.

SUMMARY OF FREQUENCIES ALLOCATED TO THE BROADCAST SERVICES

Frequency or Band	*Use*	*Exclusive to Broadcast Service*
535–1605 Kc	107 AM Channels	Yes
1606 Kc 1622 Kc	Remote Pickup Broadcast	Yes
1646 Kc	Remote Pickup Broadcast	Yes
25.87–26.47 Mc	26 Remote Pickup B/c Channels	Yes
54–72 Mc	TV Channels 2–4	Yes
72–76 Mc	78 Motion Picture Radio Serv. Operational and Fixed Channels	No
76–88 Mc	TV Channels 5 & 6	Yes
88–92	20 Non-commercial FM Channels	Yes
92–108 Mc	80 Commercial FM Channels	Yes—except in Hawaii where the 98–108 Mc portion is assigned to Fixed Services and is not used for FM Broadcast.
152.87–153.35 Mc	9 Remote Pickup B/c Channels	No—shared with Industrial Services which have first priority of use.
166.25 Mc 170.15 Mc	Remote Pickup Broadcast	No—Government stations operating on these two frequencies must be protected.
174–216 Mc	TV Channels 7–13	Yes
450–451 Mc 455–456 Mc	20 Remote Pickup B/c Channels	Yes
470–890 Mc	TV Channels 14–83	Yes—except 806–890 Mc which may be assigned for television broadcast translator station operation on a secondary basis. (Sec. 4.702)
942–952 Mc	19 STL Channels	Yes
1990–2110 Mc	7 TV Pickup/STL/Intercity Relay Channels	Yes

SUMMARY OF FREQUENCIES ALLOCATED TO THE BROADCAST SERVICES—(*Continued*)

Frequency or Band	*Use*	*Exclusive to Broadcast Service*
2450–2500 Mc	3 TV Pickup/STL/Intercity Relay Channels	No—must accept interference from I-S-M services. Also used by Fixed and Mobile Services.
6875–7050 Mc	7 TV Pickup/STL/Intercity Relay Channels	Yes
7050–7125 Mc	3 TV Pickup/STL Channels	Yes—bnt temporarily to be used by common carriers to provide service to broadcasters.
10550–10700 Mc	6 TV Pickup/STL/Intercity Relay Channels	No—must accept interference from I-S-M services. Also used by Fixed and Mobile Services.
12700–13225 Mc	21 TV Pickup/STL/Intercity Relay Channels	Yes
16000–18000 Mc	TV Pickup/STL/Intercity Relay Channels	Yes—except 17850–18000 Mc must accept interference from I-S-M services.
26000–30000 Mc	TV Pickup/STL/Intercity Relay Channels	Yes

Part 3

FEDERAL COMMUNICATIONS COMMISSION
PART 3 — RADIO BROADCAST SERVICES

TITLE 47—TELECOMMUNICATION

Chapter 1—Federal Communications Commission

Part 3—Radio Broadcast Services

SUBPART A—STANDARD BROADCAST STATIONS

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DEFINITIONS AND ALLOCATION OF FACILITIES

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SUBPART G—CONELRAD FOR STANDARD, FM, AND TELEVISION BROADCAST STATIONS

SCOPE AND OBJECTIVES

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SUBPART A—STANDARD BROADCAST STATIONS

Definitions

§ 3.1 **Standard broadcast station.** The term "standard broadcast station" means 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.

§ 3.2 **Standard broadcast band.** The term "standard broadcast band" means the band of frequencies extending from 535 to 1605 kilocycles.

§3.3 **Standard broadcast channel.** The term "standard broadcast channel" means the band of frequencies occupied by the carrier and two side bands 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.

§ 3.4 **Dominant station.** The term "dominant station" means a Class I station, as hereinafter defined, operating on a clear channel.

§ 3.5 **Secondary station.** The term "secondary station" means any station except a Class I station operating on a clear channel.

§ 3.6 **Daytime.** The term "daytime" means that period of time between local sunrise and local sunset.

§ 3.7 **Nighttime.** The term "nighttime" means that period of time between local sunset and 12 midnight local standard time.

§ 3.8 **Sunrise and sunset.** The terms "sunrise and sunset" mean, for each particular location and during any particular month, the time of sunrise and sunset as specified in the instrument of authorization.

§ 3.9 **Broadcast day.** The term "broadcast day" means that period of time between local sunrise and 12 midnight local standard time.

§ 3.10 **Experimental period.** The term "experimental period" means 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.

§ 3.11 **Service areas.** (a) The term "primary service area" of a broadcast station means the area in which the groundwave is not subject to objectionable interference or objectionable fading.

(b) The term "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) The term "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.

§ 3.12 **Portable transmitter.** The term "portable transmitter" means 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.

§ 3.13 **Auxiliary transmitter.** The term "auxiliary transmitter" means a transmitter maintained only for transmitting the regular programs of a station in case of failure of the main transmitter.

§ 3.14 **Technical definitions.** (a) *Combined audio harmonics.* The term "combined audio harmonics" means the 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.

(b) *Effective field.* The term "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.

(c) *Operating power.* "Operating power" is the power that is actually snpplied to the radio station antenna.

(d) *Maximum rated carrier power.* "Maximum rated carrier power" is the maximum power at which the transmitter can be operated satisfactorily and is determined by the design of the transmitter and the type and number of vacuum tubes used in the last radio stage.

(e) *Plate input power.* "Plate input power" means 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.

(f) *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.

(g) *Antenna current.* "Antenna current" means the radio-frequency current in the antenna with no modulation.

(h) *Antenna resistance.* "Antenna resistance" means the total resistance of the transmitting antenna system at the operating frequency and at the point at which the antenna current is measured.

(i) *Modulator stage.* "Modulator stage" means the last amplifier stage of the modulating wave which modulates a radio-frequency stage.

(j) *Modulated stage.* "Modulated stage" means 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.

(k) *Last radio stage.* "Last radio stage" means the oscillator or radio-frequency-power amplifier stage which supplies power to the antenna.

(l) *Percentage modulation (amplitude).* "Percentage modulation" with respect to an amplitude modulated wave means the ratio of half the difference between the maximum and minimum amplitudes of the amplitude modulated wave to the average amplitude expressed in percentage.

(m) *Maximum percentage of modulation.* "Maximum percentage of modulation" means the 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.

(n) *High level modulation.* "High level modulation" is modulation produced in the plate circuit of the last radio stage of the system.

(o) *Low level modulation.* "Low level modulation" is modulation produced in an earlier stage than the final.

(p) *Plate modulation.* "Plate modulation" is modulation produced by introduction of the modulating wave into the plate circuit of any tube in which the carrier frequency wave is present.

(q) *Grid modulation.* "Grid modulation" is 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.

(r) *Blanketing.* Blanketing is that 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.

Administrative Procedure

§ 3.17 **Cross reference.** See §§ 1.300 to 1.364, Subpart D of Part 1 of this chapter, for general requirements as to applications, filing of applications and description of application forms, other forms and information to be filed with the Commission, the manner in which applications are processed, and provisions applying to action on applications.

§ 3.18 **Notification of filing of applications.** In order to minimize harmful interference at the National Radio Astronomy Observatory site located at Green Bank, Pocahontas County, West Virginia, and at the Naval Radio Research Observatory at Sugar Grove, Pendleton County, West Virginia, an applicant for authority to construct a new standard broadcast station or for authority to make changes in the frequency, power, antenna height, or antenna directivity of an existing station within the area bounded by 39° 15′ N on the north, 78° 30′ W on the east, 37° 30′ N on the south, and 80° 30′ W on the west shall, at the time of filing such application with the Commission, simultaneously notify the Director, National Radio Astronomy Observatory, P.O. Box No. 2, Green Bank, West Virginia, in writing, of the technical particulars of the proposed station. Such notification shall include the geographical coordinates of the antenna, antenna height, antenna directivity if any, proposed frequency, type of emission, and power. In addition, the applicant shall indicate in his application to the Commission the date notification was made to the observatory. After receipt of such applications, the Commission will allow a period of twenty (20) days for comments or objections in response to the notifications indicated. If an objection to the proposed operation is received during the twenty-day period from the National Radio Astronomy Observatory for itself or on behalf of the Naval Radio Research Observatory, the Commission will consider all aspects of the problem and take whatever action is deemed appropriate.

Allocation of Facilities

§ 3.21 **Three classes of standard broadcast channels.** (a) *Clear channel.* A clear channel is one on which the dominant station or stations render service over wide areas and which are cleared of objectionable interference within their primary service areas and over all or a substantial portion of their secondary service areas.

(b) *Regional channel.* A regional channel is one on which several stations may operate with powers not in excess of 5 kilowatts. The primary service area of a station operating on any such channel may be limited as a consequence of interference to a given field intensity contour.

(c) *Local channel.* A local channel is one on which several stations operate with powers not in excess of 1 kilowatt daytime, and 250 watts nighttime. The primary service area of a station operating on any such channel may be limited as a consequence of interference to a given field intensity contour.

NOTE: The power ceiling for Class IV stations under the North American Regional Broadcasting Agreement (NARBA) is 250 watts. The Agreement between the United States of America and the United Mexican States Concerning Radio Broadcasting in the Standard Broadcast Band would permit daytime operation of Class IV stations with a maximum power of 1 kilowatt in all areas of the United States more than 100 kilometers (62 miles) from the United States-Mexican border. Accordingly, before the Commission will take final action with respect to an application proposing the use of daytime power in excess of 250 watts by a Class IV station, appropriate coordination of the rules providing for the use of such power must be effected with other North American countries. (See note under § 3.28(b).)

§ 3.22 **Classes and power of standard broadcast stations.** (a) *Class I station.* A Class 1 station is a dominant station operating on a clear channel and designed

to render primary and secondary service over an extended area and at relatively long distances. Its primary service area is free from objectionable interference from other stations on the same and adjacent channels, and its secondary service area free from interference except from stations on the adjacent channel, and from stations on the same channel in accordance with the channel designation in § 3.25 or § 3.182. The operating power shall be not less than 10 kilowatts nor more than 50 kilowatts. (Also see § 3.25(a) for further power limitation.)

(b) *Class II station.* A Class II station is a secondary station which operates on a clear channel (see § 3.25) and is designed to render service over a primary service area which is limited by and subject to such interference as may be received from Class I stations. A station of this class shall operate with power not less than 0.25 kilowatt nor more than 50 kilowatts. Whenever necessary a Class II station shall use a directional antenna or other means to avoid interference with Class I stations and with other Class II stations, in accordance with § 3.182.

(c) *Class III station.* A Class III station is a station which operates on a regional channel and is designed to render service primarily to a metropolitan district and the rural area contiguous thereto. Class III stations are subdivided into two classes. (The term "metropolitan district" as used in this paragraph is not limited in accordance with the definition given by the Bureau of the Census but includes any principal center of population in any area.)

(1) *Class III-A station.* A Class III-A station is a Class III station which operates with power not less than 1 kilowatt nor more than 5 kilowatts and the service area of which is subject to interference in accordance with § 3.182.

(2) *Class III-B station.* A Class III-B station is a Class III station which operates with a power not less than 0.5 kilowatt, and not more than 1 kilowatt nighttime and 5 kilowatts daytime, and the service area of which is subject to interference in accordance with § 3.182.

(d) *Class IV Station.* A Class IV station is a station operating on a local channel and designed to render service primarily to a city or town and the suburban and rural areas contiguous thereto. The power of a station of this class shall not be less than 0.1 kilowatt and not more than 0.25 kilowatt nighttime, and 1 kilowatt daytime, and its service area is subject to interference in accordance with § 3.182.

§ 3.23 Time of operation of the several classes of stations. The several classes of standard broadcast stations may be licensed to operate in accordance with the following:

(a) Unlimited time permits operation without a maximum limit as to time.

(b) Limited time is applicable to Class II (secondary stations) operating on a clear channel with facilities authorized before Oct. 30, 1959. It permits operation of the secondary station during daytime, and until local sunset if located west of the dominant station on the channel, or if located east thereof, until sunset at the dominant station, and in addition during night hours, if any, not used by the dominant station or stations on the channel.

(c) Daytime permits operation during the hours between average monthly local sunrise and average monthly local sunset. Daytime stations operating on local channels with a power of 0.1 kw or 0.25 kw may, upon notification to the Commission and to the Engineer in Charge of the radio district in which they are located, operate at hours beyond those specified in their license.

(d) Sharing time permits operation during hours which are so restricted by the station license as to require a division of time with one or more other stations using the same channel.

(e) Specified hours means that the exact operating hours are specified in the license. (The minimum hours that any station shall operate are specified in § 3.71.) Specified hours stations operating on local channels with a power of 0.1 kw or 0.25 kw, except those sharing time with other stations may, upon notification to the Commission and the Engineer in Charge of the radio district in which they are located, operate at hours beyond those specified in their license.

§ 3.24 Broadcast facilities; showing required. An authorization for a new standard broadcast station or increase in facilities of an existing station will be issued only

after a satisfactory showing has been made in regard to the following, among others:

(a) That the proposed assignment will tend to effect a fair, efficient, and equitable distribution of radio service among the several states and communities.

(b) That objectionable interference will not be caused to existing stations or that if interference will be caused the need for the proposed service outweighs the need for the service which will be lost by reason of such interference. That the proposed station will not suffer interference to such an extent that its service would be reduced to an unsatisfactory degree. (For determining objectionable interference, see §§ 3.182 and 3.186.)

(c) That the applicant is financially qualified to construct and operate the proposed station.

(d) That the applicant is legally qualified. That the applicant (or the person or persons in control of an applicant corporation or other organization) is of good character and possesses other qualifications sufficient to provide a satisfactory public service.

(e) That the technical equipment proposed, the location of the transmitter, and other technical phases of operation comply with the regulations governing the same, and the requirements of good engineering practice. (See technical regulations of this subpart and § 3.188.)

(f) That the facilities sought are subject to assignment as requested under existing international agreements and the rules and regulations of the Commission.

(g) That the population within the 1 v/m contour does not exceed 1.0 percent of the population within the 25 mv/m contour: *Provided, however,* That where the number of persons within the 1 v/m contour is 300 or less the provisions of this subparagraph are not applicable.

(h) That, in the case of an application for a Class II station, the proposed station would radiate, during two hours following local sunrise and two hours preceding local sunset, in any direction toward the 0.1 mv/m groundwave contour of a co-channel United States Class I station, no more than the maximum radiation values permitted under the provisions of 3.187.

(i) That the public interest, convenience, and necessity will be served through the operation under the proposed assignment.

Frequency Allocation by Classes of Stations

§ 3.25 Clear channels: Class I and II stations. The frequencies in the following tabulations are designated as clear channels and assigned for use by the Classes of stations given:

(a) To each of the channels below, except as provided in paragraph (e) of this section, there will be assigned one Class I station and there may be assigned one or more Class II stations within the continental limits of the United States operating limited time or daytime only: 640, 650, 660, 670, 700, 720, 750, 760, 770, 780, 820, 830, 840, 870, 880, 890, 1020, 1040, 1100, 1120, 1160, 1180, 1200, and 1210 kc. There also may be assigned to these frequencies Class II stations operating unlimited time in Alaska, Hawaii, Virgin Islands and Puerto Rico which will not deliver over 5 microvolts per meter groundwave day or night or 25 microvolts per meter 10 percent time skywave at night at any point within the continental limits of the United States. The power of the Class I stations on these channels shall not be less than 50 kw.

NOTE: On the frequency 770 kilocycles, two Class I stations may be assigned.

(b) To each of the channels below there may be assigned Class I and Class II stations: 680, 710, 810, 850, 940, 1000, 1030, 1060, 1070, 1080, 1090, 1110, 1130, 1140, 1170, 1190, 1500, 1510, 1520, 1530, 1540, 1550, and 1560 kilocycles.

NOTE: Class I and II stations on 1540 kc shall deliver not over 5 microvolts per meter groundwave or 25 microvolts per meter 10 percent time skywave at any point of land in the Bahama Islands, and such stations operating nighttime (i.e., sunset to sunrise at the

location of the Class II station) shall be located not less than 650 miles from the nearest point of land in the Bahama Islands.

(c) For Class II stations which will not deliver over 5 microvolts per meter groundwave or 25 microvolts per meter 10 percent time skywave at any point on the Canadian border and provided that such stations operating nighttime (i.e., sunset to sunrise at the location of the Class II station) are located not less than 650 miles from the nearest Canadian border, 540, 690, 740, 860, 990, 1010, and 1580 kilocycles.

NOTE 1: See § 2.104(a) of this chapter with respect to use of 540 kc.
NOTE 2: A station on 1010 kilocycles shall also protect a Class I-B station at Havana, Cuba.

(d) In continental United States, for Class II stations which operate daytime only with power not in excess of 1 kilowatt and which will not deliver over 5 microvolts per meter groundwave at any point on the Mexican border, and in Alaska, Hawaii, Puerto Rico, and the Virgin Islands, for Class II stations which will not deliver over 5 microvolts per meter groundwave or 25 microvolts per meter 10 percent time skywave at any point on the said border: 730, 800, 900, 1050, 1220 and 1570 kilocycles.

NOTE 1: See North American Regional Broadcasting Agreement, Havana, 1937 (Appendix I, Table IV), for use of 1050 kc by a station in New York.
NOTE 2: See agreement with Mexico for further use of 1220 kc.

§ 3.26 Regional channels: Classes III-A and III-B stations. The following frequencies are designated as regional channels and are assigned for use by Class III-A and III-B stations: 550, 560, 570, 580, 590, 600, 610, 620, 630, 790, 910, 920, 930, 950, 960, 970, 980, 1150, 1250, 1260, 1270, 1280, 1290, 1300, 1310, 1320, 1330, 1350, 1360, 1370, 1380, 1390, 1410, 1420, 1430, 1440, 1460, 1470, 1480, 1590, and 1600 kilocycles.

NOTE: See North American Regional Broadcasting Agreement for special provisions concerning the assigning of Class II stations in other countries of North America to 560, 570, 590, 630, and 1270 kcs. Such stations shall be protected from interference in accordance with appendix II, table 1, of said agreement.

§ 3.27 Local channels: Class IV stations. The following frequencies are designated as local channels and are assigned for use by Class IV stations: 1230, 1240, 1340, 1400, 1450, and 1490 kilocycles.

§ 3.28 Assignment of stations to channels. (a) The individual assignments of stations to channels which may cause interference to other United States stations only, shall be made in accordance with the provisions of this part for the respective classes of stations involved. (For determining objectionable interference, see §§ 3.182 and 3.186.)

(b) In all cases where an individual station assignment may cause interference with or may involve a channel assigned for priority of use by a station in another North American country, the classifications, allocation requirements and engineering standards set forth in the North American Regional Broadcasting Agreement shall be observed.

NOTE: Pending action with respect to ratification and entry into force of the North American Regional Broadcasting Agreement, Washington, 1950 (referred to herein as NARBA), and the Agreement between the United States of America and the United Mexican States Concerning Radio Broadcasting in Standard Broadcast Band (referred to herein as the U.S./Mexican Agreement) no assignment for a standard broadcast station will be made which would be inconsistent with the terms of these agreements.

On an interim basis while protection by countries not signatory to either of these agreements continues for assignments in the United States, no assignment for a standard broadcast station will be made which would cause objectionable interference to a duly notified station in a North American country which is not signatory to the NARBA or the U.S./Mexican Agreement (i.e., Haiti). For purposes of this paragraph, interference will, in general, be determined in accordance with the engineering standards set forth in the NARBA.

The Haitian stations considered to be duly notified will be those notified and accepted in

accordance with past agreements, and those subsequently notified in substantial accordance with the procedures and understandings that have pertained thus far.

Engineering standards now in force domestically differ in some respects from those specified for international purposes. For example, the engineering standards specified for international purposes will be used to determine (1) the extent to which interference might be caused by a proposed station in the United States to a station in another North American country and (2) whether the United States should register an objection to any new or changed assignment notified by another North American country. The domestic standards in effect in the United States will be used to determine the extent to which interference exists or would exist from a foreign station where the value of such interference enters into a calculation (1) of the service to be rendered by a proposed operation in the United States or (2) of the permissible interfering signal from one station in the United States towards another United States station.

In general, an application for standard broadcast station assignment, the grant of which would be consistent with provisions of the NARBA and the U.S./Mexican Agreement and would not cause objectionable interference to a duly notified station in a North American country not signatory to either agreement, will be considered and acted upon by the Commission in accordance with its rules and established procedure for action upon such applications, even though these agreements may not yet have entered into force. However, in particular cases such applications may also present considerations of an international nature which require that a different procedure be followed. In such cases the procedure to be followed will be determined by the Commission in the light of the special considerations involved.

Special provisions of a procedural nature respecting the consideration of applications for standard broadcast station assignments pending action with respect to ratification and entry into force of NARBA and the U.S./Mexican Agreement, and respecting the consideration of applications the grant of which would cause objectionable interference to duly notified station in countries not signatory to either of these agreements are set out in § 1.300 of this chapter.

(c) Upon showing that a need exists, a Class II, III, or IV station may be assigned to a channel available for such class, even though interference will be received within its normally protected contour; *Provided:* (1) No objectionable interference will be caused by the proposed station to existing stations or that if interference will be caused, the need for the proposed service outweighs the need for the service which will be lost by reason of such interference; and (2) primary service will be provided to the community in which the proposed station is to be located; and (3) the interference received does not affect more than 10 percent of the population in the proposed station's normally protected primary service area. However, in the event that the nighttime interference received by the proposed station would exceed this amount, then an assignment may be made if the proposed station would provide either a standard broadcast nighttime facility to a community not having such a facility or if 25 percent or more of the nighttime primary service area of the proposed station is without primary nighttime service.

§ 3.29 **Class IV stations on regional channels.** No license will be granted for the operation of a Class IV station on a regional channel: *Provided, however,* That Class IV stations presently authorized to operate on regional channels will not be required to change frequency, or power, but will not be protected against interference from Class III stations.

§ 3.30 **Station location and program origination.** (a) Except as provided in paragraph (b) of this section, each standard broadcast station will be licensed to serve primarily a particular city, town, or other political subdivision which will be specified in the station license and the station will be considered to be located in such place. Unless licensed as a synchronous amplifier transmitter, each station shall maintain a studio, which will be known as the main studio, in the place where the station is located provided that the main studio may be located at the transmitter site whether or not the transmitter site is in the place where the station is located. A majority (computed on the basis of duration and not number) of a station's programs or in the case of a station affiliated with a network, ⅔ of such station's non-network programs, whichever is smaller, shall originate from the main studio or from other studios or remote points situated in the place where the station is located.

(b) Stations will be licensed to serve more than one city, town, or other political

subdivision only where a satisfactory showing is made that each such place meets all the requirements of the rules and regulations of this subpart with respect to the location of main studios, that the station can and will originate a substantial number of local live programs from each such place; and that the requirements as to origination of programs contained in paragraph (a) of this section would place an unreasonable burden on the station if it were licensed to serve only one city, town, or other political sub-division. A station licensed to serve more than one place shall be considered to be located in and shall maintain main studios in each such place. With respect to such station the requirements as to origination of programs contained in paragraph (a) of this section shall be satisfied by the origination of programs from any or all of the main studios or from other studios and remote points situated in any or all of the places in which the main studios are located.

(c) The transmitter of each standard broadcast station shall be so located that primary service is delivered to the borough or city in which the main studio is located in accordance with the rules and regulations of this subpart.

§ 3.31 **Authority to move main studio.** The licensee of a station shall not move its main studio outside the borders of the borough or city, state, district, territory, or possession in which it is located, unless such move is to the location of the station's transmitter, without first securing a modification of construction permit or license. The licensee shall promptly notify the Commission of any other change in location of the main studio.

§ 3.32 **Special experimental authorizations.** (a) Special experimental authorization may be issued to the licensee of a standard broadcast station in addition to the regular license upon informal application therefor and upon a satisfactory showing in regard to the following, among others:

(1) That the applicant has a program of research and experimentation which indicates reasonable promise of contribution to the development and practical application of broadcasting, and will be in addition to and advancement of the work that can be accomplished under its regular license.

(2) That the experimental operation and experimentation will be under the direct supervision of a qualified engineer with an adequate staff of engineers qualified to carry on the program of research and experimentation.

(3) That the public interest, convenience, and necessity will be served by granting the authorization requested.

(b) In case a special experimental authorization permits additional hours of operation, no licensee shall transmit any commercial or sponsored program or make any commercial announcement during such time of operation. In case of other additional facilities, no additional charge shall be made by reason of transmission with such facilities.

(c) A special experimental authorization will not be extended after the actual experimentation is concluded.

(d) The program of research and experimentation as outlined in the application for a special experimental authorization shall be adhered to in the main unless the licensee is authorized to do otherwise by the Commission.

(e) The Commission may require from time to time a broadcast station holding such experimental authorization to conduct experiments that are deemed desirable and reasonable.

(f) A supplemental report shall be filed with and made a part of each application for an extension of a special experimental authorization and shall include statements of the following:

(1) Comprehensive summary of all research and experimentation conducted.

(2) Conclusions and outline of proposed program for further research and development.

(3) Comprehensive summary and conclusions as to the social and economic effects of its use.

§ 3.33 **Antenna systems; showing required.** (a) An application for authority to install a broadcast antenna shall specify a definite site and include full details of the antenna design and expected performance. (Site-to-be-determined applications

which were on file prior to October 28, 1953, may be granted conditioned upon the filing within 60 days of such grant of an application for modification of permit specifying a site conforming to Commission's rules and standards.)

(b) All data necessary to show compliance with the terms and conditions of the construction permit must be filed with the license application. If the station is using a directional antenna, a proof of performance must also be filed.

§ 3.34 **Normal license period.** All standard broadcast station licenses will be issued for a normal license period of three years. Licenses will be issued to expire at the hour of 3:00 a.m., e.s.t., in accordance with the following schedule and at three-year intervals thereafter.

(1) For stations located in Delaware and Pennsylvania, August 1, 1957.
(2) For stations located in Maryland, District of Columbia, Virginia, West Virginia, October 1, 1957.
(3) For stations located in North Carolina, South Carolina, December 1, 1957.
(4) For stations located in Florida, Puerto Rico and Virgin Islands, February 1, 1958.
(5) For stations located in Alabama and Georgia, April 1, 1958.
(6) For stations located in Arkansas, Louisiana and Mississippi, June 1, 1958.
(7) For stations located in Tennessee, Kentucky and Indiana, August 1, 1958.
(8) For stations located in Ohio and Michigan, October 1, 1958.
(9) For stations located in Illinois and Wisconsin, December 1, 1958.
(10) For stations located in Iowa and Missouri, February 1, 1956.
(11) For stations located in Minnesota, North Dakota, South Dakota, Montana and Colorado, April 1, 1956.
(12) For stations located in Kansas, Oklahoma, Nebraska, June 1, 1956.
(13) For stations located in Texas, August 1, 1956.
(14) For stations located in Wyoming, Nevada, Arizona, Utah, New Mexico and Idaho, October 1, 1956.
(15) For stations located in California, December 1, 1956.
(16) For stations located in Washington, Oregon, Alaska, Guam and Hawaii, February 1, 1957.
(17) For stations located in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont, April 1, 1957.
(18) For stations located in New Jersey and New York, June 1, 1957.

§ 3.35 **Multiple ownership.** No license for a standard broadcast station shall be granted to any party (including all parties under common control) if:

(a) Such party directly or indirectly owns, operates or controls another standard broadcast station, a substantial portion of whose primary service area would receive primary service from the station in question, except npon a showing that public interest, convenience and necessity will be served through such multiple owuership situation; or

(b) Such party, or any stockholder, officer or director of such party, directly or indirectly owns, operates, controls, or has any interest in, or is an officer or director of any other standard broadcast station if the grant of such license would result in a concentration of control of standard broadcasting in a manner inconsistent with public interest, convenience, or necessity. In determining whether there is such a concentration of control, consideration will be given to the facts of each case with particular reference to such factors as the size, extent and location of areas served, the number of people served, classes of stations involved and the extent of other competitive service to the areas in question. The Commission, however, will in any event consider that there would be such a concentration of control contrary to the public interest, convenience or necessity for any party or any of its stockholders, officers or directors to have a direct or indirect interest in, or be stockholders, officers, or directors of, more than seven standard broadcast stations.

NOTE: 1. The word "control" as used herein is not limited to majority stock ownership, but includes actual working control in whatever manner exercised.

2. In applying the foregoing provisions to the stockholders of a corporation which has more than 50 voting stockholders, only those stockholders need be considered who are officers or directors or who directly or indirectly own 1 percent or more of the outstanding voting stock.

§ 3.36 **Special field test authorization.** (a) Upon a showing that a need exists, a special test authorization to operate a portable or regularly authorized transmitter may be issued to persons desiring to make field intensity surveys to determine values of soil conductivity, or other factors influencing radio wave propagation, in particular areas or paths for the period necessary to conduct the survey. Such authorizations may be granted upon the following conditions:

(1) No objectionable interference will result to the operation of other authorized radio services; in this connection, the power requested shall not exceed that necessary for the purposes of the test.

(2) The carrier will be unmodulated except for half-hourly voice identification.

(3) The plate power ($E_p \times I_p$) of the final stage of the transmitter shall not exceed authorized test power and the antenna current shall be maintained at a constant value for each phase of the test.

(4) The test equipment shall not be permanently installed, unless such installation has been separately authorized. Mobile units shall not be deemed permanent installations.

(5) The equipment must be operated by or under the personal direction of either a licensed radiotelephone first-class or second-class operator.

(6) A report, under oath, containing the measurements, their analysis and other results of the survey shall be filed with the Commission within sixty (60) days from the termination of the test authorization. The measurements taken shall be sufficiently complete, in accordance with § 3.186, so as to permit a determination of the inverse distance field at 1 mile in pertinent directions.

(7) The plate voltage (E_p) and plate current (I_p) of the final stage of the transmitter shall be logged at half-hour intervals and at any time that such power is changed. Certified copies of such log notations shall be submitted to the Commission with the required report.

(8) Operation shall conform to the requirements of Subpart G of this part.

(b) The test equipment, installation and operation thereof need not comply with the requirements of Commission rules and standards except as specified in this section: *Provided however,* That the equipment, installation and operation shall be consistent with good engineering principles and practices.

(c) No authorization shall be issued unless the applicant for such authorization is determined to be legally qualified. Requests for authorizations to operate a transmitter under this section shall be made in writing, signed by the applicant under oath or affirmation (with no special form provided, however), and shall set forth the following information:

(1) Purpose, duration and need for the survey.

(2) Frequency, plate power and time of operation.

(3) A brief description of the test antenna system and its estimated effective field and its proposed location.

(4) In the case of a directional test antenna, an estimate of the maximum fields expected to be radiated in the direction of pertinent broadcast stations.

(5) In the case of a person who is not a licensee or permittee of this Commission the information required by section II of FCC Form 301.

(d) The authorization may be modified or terminated by notification from the Commission if in its judgment such action will promote the public interest, convenience or necessity.

§ 3.37 **Minimum separation between stations.** A license will not be granted for a station on a frequency of ±30 kc from that of another station if the area enclosed by the 25 mv/m groundwave contours of the two stations overlap, nor will a license be granted for the operation of a station on a frequency ±20 kc or ±10 kc from the frequency of another station if the area enclosed by the 25 mv/m groundwave contour of either one overlaps the area enclosed by the 2 mv/m groundwave contour of the other.

§ 3.38 **Limited time authorizations.** No authorization for new Class II Limited Time facilities will be granted. No authorization for modification of existing Class II Limited Time facilities will be granted for a change in frequency, an increase in power, a change in antenna radiation pattern, or a change in station location.

Equipment

§ 3.39 **Indicating instruments—specifications.**

(a) Instruments indicating the plate current or plate voltage of the last radio stage (linear scale instruments) shall meet the following specifications:

(1) Length of scale shall be not less than $2\frac{3}{10}$ inches.

(2) Accuracy shall be at least 2 percent of the full scale reading.

(3) The maximum rating of the meter shall be such that it does not read off scale during modulation.

(4) Scale shall have at least 40 divisions.

(5) Full scale reading shall not be greater than five times the minimum normal indication.

(b) Instruments indicating antenna current, common point current, and base currents shall meet the following specifications:

(1) Instruments having logarithmic or square law scales.

(i) Shall meet same requirements as paragraph (a) (1), (2) and (3) of this section for linear scale instruments.

(ii) Full scale reading shall not be greater than three times the minimum normal indication.

(iii) No scale division above one-third full scale reading (in amperes) shall be greater than one-thirtieth of the full scale reading. (Example: An ammeter meeting requirement (i) having full scale reading of 6 amperes is acceptable for reading currents from 2 to 6 amperes, provided no scale division between 2 and 6 amperes is greater than one-thirtieth of 6 amperes, 0.2 ampere.)

(2) Radio frequency instruments having expanded scales.

(i) Shall meet same requirements as paragraph (a) (1), (2) and (3) of this section for linear scale instruments.

(ii) Full scale reading shall not be greater than five times the minimum normal indication.

(iii) No scale division above one-fifth full scale reading (in amperes) shall be greater than one-fiftieth of the full scale reading. (Example: An ammeter meeting the requirement (i) is acceptable for indicating currents from 1 to 5 amperes, provided no division between 1 and 5 amperes is greater than one-fiftieth of 5 amperes, 0.1 ampere.)

(iv) Manufacturers of instruments of the expanded scale type must submit data to the Commission showing that these instruments have acceptable expanded scales, and the type number of these instruments must include suitable designation.

(c) A thermocouple type ammeter meeting the requirements of paragraph (b) of this section shall be installed in the antenna circuit so as to indicate the antenna current. In the case of directional antennas the same type of ammeters shall be installed to indicate the common point current and the base current of each tower. (The ammeter may be so connected that it is short circuited or open circuited when not actually being read. If open circuited, a make-before-break switch must be employed.)

(d) Remote reading antenna ammeter(s) may be employed and the indications logged as the antenna current, or in the case of directional antenna, the common point current and base currents, in accordance with the following:

(1) Remote reading antenna, common point or base ammeters may be provided by:

(i) Inserting second thermocouple directly in the antenna circuit with remote leads to the indicating instrument.

(ii) Inductive coupling to thermocouple or other device for providing direct current to indicating instrument.

(iii) Capacity coupling to thermocouple or other device for providing direct current to indicating instrument.

(iv) Current transformer connected to second thermocouple or other device for providing direct current to indicating instrument.

(v) Using transmission line current meter at transmitter as remote reading ammeter. See subparagraph (7) of this paragraph.

(vi) Using indications of phase monitor for determining the antenna base currents or their ratio in the case of directional antennas, provided that the base current readings are read and logged in accordance with the provision of the station license, and provided further that the indicating instruments in the unit are connected directly in the current sampling circuits with no other shunt circuits of any nature. The meters in the phase monitor may utilize arbitrary scale divisions provided a calibration curve showing the relationship between the arbitrary scale and the scale of the base meters is maintained at the transmitter location.

(vii) Using indications of remote control equipment provided that the indicating instruments are capable of being connected directly into the antenna circuit at the same point as, but below (transmitter side), the antenna ammeter. The meter(s) in the remote control equipment may utilize an arbitrary scale division provided a calibration curve showing the relationship between the arbitrary scale and the scale of the antenna ammeter is maintained at the remote control point. The meter(s) in the remote control equipment must be calibrated once a week against the regular meter and the results thereof entered in the operating log.

(2) Remote ammeters shall be connected into the antenna circuit at the same point as, but below (transmitter side), the antenna ammeter(s), and shall be calibrated to indicate within 2 percent of the regular meter over the entire range above one-third or one-fifth full scale. See paragraphs (b) (1) (i) (iii) and (b) (2) (i), (iii) of this section.

(3) The regular antenna ammeter, common point ammeter, or base current ammeters shall be above (antenna side) the coupling to the remote meters in the antenna circuit so they do not read the current to ground through the remote meter(s).

(4) All remote meters shall meet the same requirements as the regular antenna ammeter with respect to scale accuracy, etc.

(5) Calibration shall be checked against the regular meter at least once a week.

(6) All remote meters shall be provided with shielding or filters as necessary to prevent any feed-back from the antenna to the transmitter.

(7) In the case of shunt excited antennas, the transmission line current meter at the transmitter may be considered as the remote antenna ammeter provided the transmission line is terminated directly into the excitation circuit feed line, which shall employ series tuning only (no shunt circuits of any type shall be employed) and insofar as practicable, the type and scale of the transmission line meter should be the same as those of the excitation circuit feed line meter (meter in slant wire feed line or equivalent).

(8) Remote reading antenna ammeters employing vacuum tube rectifiers or semiconductor devices are acceptable, provided:

(i) The indicating instruments shall meet all the above requirements for linear scale instruments.

(ii) Data are submitted under oath showing the unit has an over-all accuracy of at least 2 percent of the full scale reading.

(iii) The installation, calibration, and checking are in accordance with the requirements of this paragraph.

(9) In the event there is any question as to the method of providing or the accuracy of the remote meter, the burden of proof of satisfactory performance shall be upon the licensee and the manufacturer of the equipment.

(e) Stations determining power by the indirect method may log the transmission line current in lieu of the antenna current provided the instrument meets the above requirements for antenna ammeters, and further provided that the ratio between the transmission line current and the antenna current is entered each time in the log. In case the station is authorized for the same operating power for both day and nighttime operation, this ratio shall be checked at least once daily. Stations which are authorized to operate with nighttime power different from the daytime power shall check the ratio for each power at least once daily.

(f) No instrument, the seal of which has been broken, or the accuracy of which is questionable, shall be employed. Any instrument which was not originally sealed by the manufacturer that has been opened shall not be used until it has been re-

calibrated and sealed in accordance with the following: Repairs and recalibration of instruments shall be made by the manufacturer, by an authorized instrument repair service of the manufacturer or by some other properly qualified and equipped instrument repair service. In either case the instrument must be resealed with the symbol or trade-mark of the repair service and a certificate of calibration supplied therewith.

(g) Since it is usually impractical to measure the actual antenna current of a shunt excited antenna system, the current measured at the input of the excitation circuit feed line is accepted as the antenna current.

(h) Recording instruments may be employed in addition to the indicating instruments to record the antenna current and the direct plate current and direct plate voltage of the last radio stage provided that they do not affect the operation of the circuits or accuracy of the indicating instruments. If the records are to be used in any proceedings before the Commission as representation of operation with respect to plate or antenna current and plate voltage only, the accuracy must be the equivalent of the indicating instruments and the calibration shall be checked at such intervals as to insure the retention of the accuracy.

(i) The function of each instrument shall be clearly and permanently shown on the instrument itself or on the panel immediately adjacent thereto.

§ 3.40 Transmitter; design, construction, and safety of life requirements.

(a) *Design.* The general design of standard broadcast transmitting equipment [main studio microphone (including telephone lines, if used, as to performance only) to antenna output] shall be in accordance with the following specifications. (In cases where telephone lines are not available to give the performance as required in these specifications a relay transmitter may be authorized to supersede the lines.) For the points not specifically covered below, the principles set out shall be followed: The equipment shall be so designed that:

(1) The maximum rated carrier power (determined by § 3.42) is in accordance with the requirements of § 3.41.

(2) The equipment is capable of satisfactory operation at the authorized operating power or the proposed operating power with modulation of at least 85 to 95 percent with no more distortion than given in (3) below.

(3) The total audio frequency distortion from microphone terminals, including microphone amplifier, to antenna output does not exceed 5 per cent harmonics (voltage measurements of arithmetical sum or r. s. s.) when modulated from 0 to 84 percent, and not over 7.5 percent harmonics (voltage measurements of arithmetical sum or r. s. s.) when modulating 85 percent to 95 percent (distortion shall be measured with modulating frequencies of 50, 100, 400, 1000, 5000 and 7500 cycles up to tenth harmonic or 16000 cycles, or any intermediate frequency that readings on these frequencies indicate is desirable).

(4) The audio frequency transmitting characteristics of the equipment from the microphone terminals (including microphone amplifier unless microphone frequency correction is included in which event proper allowance shall be made accordingly) to the antenna output does not depart more than 2 decibels from that at 1,000 cycles between 100 and 5000 cycles.

(5) The carrier shift (current) at any percentage of modulation does not exceed 5 percent.

(6) The carrier hum and extraneous noise (exclusive of microphone and studio noises) level (unweighted r. s. s.) is at least 50 decibels below 100 percent modulation for the frequency band of 150 to 5000 cycles and at least 40 decibels down outside this range.

(7) The transmitter shall be equipped with suitable indicating instruments in accordance with the requirements of § 3.58 and any other instruments necessary for the proper adjustment and operation of the equipment.

(8) Adequate provision is made for varying the transmitter power output between sufficient limits to compensate for excessive variations in line voltage, or other factors which may affect the power output.

(9) The transmitter is equipped with automatic frequency control equipment capable of maintaining the operating frequency within the limit specified by § 3.59.

(i) The maximum temperature variation at the crystal from the normal operating temperature shall not be greater than,

Plus or minus 0.1° C. when an *X* or *Y* cut crystal is employed, or

Plus or minus 1.0° C. when low temperature coefficient crystal is employed.

(ii) Unless otherwise authorized, a thermometer shall be installed in such manner that the temperature at the crystal can be accurately measured within 0.05° C. for *X* or *Y* cut crystal or 0.5° for low temperature coefficient crystal.

(iii) It is preferable that the tank circuit of the oscillator tube be installed in the temperature controlled chamber.

NOTE: Explanations of excessive frequency deviations will not be accepted when temperature variations are in excess of the values specified.

(10) Means are provided for connection and continuous operation of approved modulation monitor and approved frequency monitor.

(i) The radio frequency energy for operation of the approved frequency monitor shall be obtained from a radio-frequency stage prior to the modulated stage unless the monitor is of such design as to permit satisfactory operation when otherwise connected and the monitor circuits shall be such that the carrier is not heterodyned thereby.

(11) Adequate margin is provided in all component parts to avoid overheating at the maximum rated power output.

(12) Any emission appearing on a frequency removed from the carrier by between 15 kc and 30 kc, inclusive, shall be attenuated at least 25 db below the level of the unmodulated carrier. Compliance with the specification will be deemed to show the occupied bandwidth to be 30 kc or less.

(13) Any emission appearing on a frequency removed from the carrier by more than 30 kc and up to and including 75 kc, inclusive, shall be attenuated at least 35 db below the level of the unmodulated carrier.

(14) Any emission appearing on a frequency removed from the carrier by more than 75 kc shall be attenuated at least 43 + 10 log 10 (power in watts) decibels below the level of the unmodulated carrier, or 80 decibels, whichever is the lesser attenuation.

(b) *Construction.* In general, the transmitter shall be constructed either on racks and panels or in totally enclosed frames protected as required by article 810 of the National Electrical Code (Section 8192(a), (b) and (c)), and as set forth in this paragraph and paragraph (c) of this section.

NOTE: The final stages of high power transmitters may be assembled in open frames provided the equipment is enclosed by a protective fence.

(1) Means shall be provided for making all tuning adjustments, requiring voltages in excess of 350 volts to be applied to the circuit, from the front of the panels with all access doors closed.

(2) Proper bleeder resistors or other automatic means shall be installed across all the condenser banks to remove any charge which may remain after the high voltage circuit is opened (in certain instances the plate circuit of the tubes may provide such protection; however, individual approval of such shall be obtained by the manufacturer in case of standard equipment, and the licensee in case of composite equipment).

(3) All plate supply and other high voltage equipment, including transformers, filters, rectifiers and motor generators, shall be protected so as to prevent injury to operating personnel.

(i) Commutator guards shall be provided on all high voltage rotating machinery (coupling guards on motor generators, although desirable, are not required).

(ii) Power equipment and control panels of the transmitter shall meet the above requirements (exposed 220 volt AC switching equipment on the front of the power control panels is not recommended; however, is not prohibited).

(iii) Power equipment located at a broadcast station but not directly associated with the transmitter (not purchased as part of same), such as power distribution panels, control equipment on indoor or outdoor stations and the substations associated

therewith, are not under the jurisdiction of the Commission; therefore, § 3.46 does not apply.

(iv) It is not necessary to protect the equipment in the antenna tuning house and the base of the antenna with screens and interlocks, provided the doors to the tuning house and antenna base are fenced and locked at all times, with the keys in the possession of the operator on duty at the transmitter. Ungrounded fencing or wires should be effectively grounded, either directly or through proper static leaks. Lighting protection for the antenna system is not specifically required but should be installed.

(v) The antenna, antenna lead-in, counterpoise (if used), etc., shall be installed so as not to present a hazard. The antenna may be located close by or at a distance from the transmitter building. A properly designed and terminated transmission line should be used between the transmitter and the antenna when located at a distance.

(4) Metering equipment. (In addition to the following requirements, instruments shall meet the requirements of §§ 3.39 and 3.58.)

(i) All instruments having more than 1,000 volts potential to ground on the movement shall be protected by a cage or cover in addition to the regular case. (Some instruments are designed by the manufacturer to operate safely with voltages in excess of 1,000 volts on the movement. If it can be shown by the manufacturer's rating that the instrument will operate safely at the applied potential, additional protection is not necessary.)

(ii) In case the plate voltmeter is located on the low potential side of the multiplier resistor with one terminal of the instrument at or less than 1,000 volts above ground, no protective case is required. However, it is good practice to protect voltmeters subject to more than 5,000 volts with suitable over-voltage protective devices across the instrument terminals in case the winding opens.

(iii) The antenna ammeters (both regular and remote and any other radio frequency instrument which it is necessary for the operator to read) shall be so installed as to be easily and accurately read without the operator having to risk contact with circuits carrying high potential radio frequency energy.

(c) *Wiring and shielding.* (1) The transmitter panels or units shall be wired in accordance with standard switchboard practice, either with insulated leads properly cabled and supported or with rigid bus bar properly insulated and protected.

(2) Wiring between units of the transmitter, with the exception of circuits carrying radio frequency energy, shall be installed in conduits or approved fiber or metal raceways to protect it from mechanical injury.

(3) Circuits carrying low level radio frequency energy between units shall be either concentric tube, two wire balanced lines, or properly shielded to prevent the pickup of modulated radio frequency energy from the output circuits.

(4) Each stage (including the oscillator) preceding the modulated stage shall be properly shielded and filtered to prevent unintentional feedback from any circuit following the modulated stage (an exception to this requirement may be made in the case of high level modulated transmitters of approved manufacture which have been properly engineered to prevent reaction).

(5) The crystal chamber, together with the conductor or conductors to the oscillator circuit, shall be totally shielded.

(6) The monitors and the radio frequency lines to the transmitter shall be thoroughly shielded.

(d) *Installation.* (1) The installation shall be made in suitable quarters.

(2) Since an operator must be on duty at the transmitter control point during operation, suitable facilities for his welfare and comfort shall be provided at the control point.

(e) [Reserved.]

(f) *Studio equipment.* (1) The studio equipment shall be subject to all the above requirements where applicable except as follows:

(i) If it is properly covered by an underwriter's certificate, it will be considered as satisfying the safety requirements.

(ii) Section 8191 of article 810 of the National Electrical Code shall apply for voltages only when in excess of 500 volts.

(2) No specific requirements are made relative to the design and acoustical treatment. However, the studios and particularly the main studio should be in accordance with the standard practice for the class of station concerned, keeping the noise level as low as reasonably possible.

§ 3.41 **Maximum rated carrier power; tolerances.** The maximum rated carrier power of a transmitter shall be an even power step as recognized by the Commission's plan of allocation (100 watts, 250 watts, 500 watts, 1 kw., 5 kw., 10 kw., 25 kw., 50 kw.) and shall not be less than the authorized power nor shall it be greater than the value specified in the following table.

Class of station	Maximum power authorized to station	Maximum rated carrier power permitted to be installed
		Watts
Class IV	100 watts	250
	250, 500 or 1,000 watts	1,000
Class III	500 or 1,000 watts	1,000
	5,000 watts	5,000
Class II	250, 500, or 1,000 watts	1,000
	5,000 or 10,000 watts	10,000
	25,000 or 50,000 watts	50,000
Class I	10,000 watts	10,000
	25,000 or 50,000 watts	50,000

§ 3.42 **Maximum rated carrier power; how determined.** The maximum rated carrier power of a standard broadcast transmitter shall be determined as the sum of the applicable power ratings of the vacuum tubes employed in the last radio stage.

§ 3.43 **Changes in equipment; authority for.** No licensee or permittee shall 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 shall it change the system of modulation, without authority of the Commission.

§ 3.44 **Other changes in equipment.** Other changes except as provided for in this subpart 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 Commission, but in the next succeeding application for renewal of license such changes which affect the information already on file shall be shown in full.

§ 3.45 **Radiating system.** (a) All applicants for new, additional, or different broadcast facilities and all licensees requesting authority to change the transmitter site of an existing station shall specify a radiating system the efficiency of which complies with the requirements of good engineering practice for the class and power of the station. (See §§ 3.186 and 3.189.)

(b) No broadcast station licensee or permittee shall change the physical height of the transmitting antenna, or supporting structures, or make any changes in the radiating system which will measurably alter the radiation patterns, except upon application to and authority from the Commission.

(c) Should any changes occur which would alter the resistance of the antenna system, the licensee shall immediately make a new determination of the antenna resistance (see § 3.54) and shall submit application for authority to determine power by the direct method on the basis of the new measurements.

(d) The antenna and/or supporting structure shall be painted and illuminated in accordance with the specifications supplied by the Commission pursuant to section 303(q) of the Communications Act of 1934 as amended. (See Part 17 of this chapter; Rules Concerning the Construction Marking and Lighting of Antenna Structures.)

(e) The simultaneous use of a common antenna or antenna structure by more than

one standard broadcast station, or by one or more standard broadcast stations and one or more stations of any other class or service may be authorized provided:

(1) Complete verified engineering data are submitted showing that satisfactory operation of each station will be obtained without adversely affecting the operation of the other station.

(2) The minimum antenna height or field intensity for each standard broadcast station concerned complies with paragraph (a) of this section.

(3) Complete responsibility for maintaining the installation and for painting and illuminating the structure in accordance with the pertinent provisions of Part 17 of this chapter is assumed by one of the licensees.

§ 3.46 Transmitter. (a) The transmitter proper and associated transmitting equipment of each broadcast station shall be designed, constructed, and operated in accordance with good engineering practice in all phases not otherwise specifically included in the regulations in this subpart.

(b) The transmitter shall be wired and shielded in accordance with good engineering practice and shall be provided with safety features in accordance with the specifications of article 810 of the current National Electrical Code as approved by the American Standards Association.

(c) The station equipment shall be so operated, tuned, and adjusted that emissions outside the authorized channel do not cause harmful interference to the reception of other radio stations. Standard broadcast stations employing radio transmitters type accepted after January 1, 1960, shall maintain the bandwidth occupied by their emissions in accordance with the specifications set forth in 3.40(a). Stations employing transmitters installed or type accepted prior to January 1, 1960, shall achieve the highest degree of compliance practicable with their existing equipment. In either case, should harmful interference to the reception of other radio stations occur, the licensee may be required to take such further steps as may be necessary to eliminate the interference.

(d) The audio distortion, audio frequency response, carrier hum, noise level, and other essential phases of the operation which control the external effects shall at all times conform to the requirements of good engineering practice.

§ 3.47 Equipment performance measurements. (a) The licensee of each standard broadcast station shall make the following equipment performance measurements at yearly intervals. One such set shall be made during the four-month period preceding the date of filing application for renewal of station license:

(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. Family of curves should be plotted (one for each percentage above) with DB above and below a reference frequency of 1000 CPS as ordinate and audio frequency as abscissa.

(2) Data and curves showing audio frequency harmonic content for 25, 50, 85, and 100 percent modulation for fundamental frequencies of 50, 100, 400, 1000, 5000, and 75 CPS (either arithmetical or root sum square values up to the tenth harmonic or 16000 CPS). Plot family of curves (one for each percentage above) with percent distortion as ordinate and audio frequency as abscissa.

(3) Data showing percentage carrier shift for 25, 50, 85, and 100 percent modulation with 400 CPS tone.

(4) Carrier hum and extraneous noise generated within the equipment and measured as the level below 100 percent modulation throughout the audio spectrum or by bands.

(5) Measurements or evidence showing that spurious radiations including radio frequency harmonics are suppressed or are not present to a degree capable of causing objectionable interference to other radio services. Field intensity measurements are preferred but observations made with a communications type receiver may be accepted. However, in particular cases involving interference or controversy, the Commission may require actual measurements. Measurements shall be made with the equipment adjusted for normal program operation and shall include all circuits between main studio amplifier input and antenna output including equalizer or cor-

rection circuits normally employed, but without compression if such amplifier is employed.

(b) The data required by paragraph (a) of this section together with a description of instruments and procedure, signed by the engineer making the measurements, shall be kept on file at the transmitter and retained for a period of two years and on request shall be made available during that time to any duly authorized representative of the Federal Communications Commission.

§ 3.48 Acceptability of broadcast transmitters for licensing. (a) In order to facilitate the filing of, and action on applications for station authorizations, transmitters will be accepted for licensing by the Commission under one of the following conditions:

(1) A transmitter may be Type-Accepted upon the request of any manufacturer of transmitters built in quantity by following the type acceptance procedure set forth in Part 2 of this chapter, provided that the data and information submitted indicates that the transmitter meets the requirements of § 3.40. If accepted, such transmitter will be included on the Commission's "Radio Equipment List, Part B, Aural Broadcast Equipment." Applicants specifying transmitters included on such a list need not submit detailed descriptions and diagrams where the correct type number is specified, provided that the equipment proposed is identical with that accepted. Copies of this list are available for inspection at the Commission's office in Washington, D.C., and at each of its field offices.

(2) An application specifying a transmitter not included on the Radio Equipment List, Part B may be accepted upon the request of a prospective licensee submitting with the application for construction permit a complete description of the transmitter, including the circuit diagram, listing of all tubes used, function of each, multiplication in each stage, plate current and voltage applied to each tube, a description of the oscillator circuit together with any devices installed for the purpose of frequency stabilization and the means of varying output power to compensate for power supply voltage variations. However, if this data has been filed with the Commission by a manufacturer in connection with a request for type acceptance, it need not be submitted with the application for construction permit but may be referred to as "on file." Measurement data for type acceptance made in accordance with subparagraph (1) of this paragraph shall be submitted with the license application.

(3) A transmitter shown on an instrument of authorization by manufacturer and type number, or as a composite, and which was in use prior to June 30, 1955, may continue to be used by the licensee, his successors or assignees, provided such transmitter continues to comply with the rules and regulations.

(b) Additional rules with respect to withdrawal of type-acceptance, modification of type-accepted equipment and limitations on the findings upon which type acceptance is based are set forth in Part 2 of this chapter.

§ 3.49 Requirements for approval of frequency monitors. (a) *General requirements.* (1) Any manufacturer desiring to submit a monitor for type approval shall supply the Commission with full specification details (two sworn copies) as well as the test data specified in paragraph (c) of this section. If this information appears to meet the requirements of the rules, shipping instructions will be issued to the manufacturer. The shipping charges to and from the Laboratory at Laurel, Maryland, shall be paid for by the manufacturer. Approval of a monitor will only be given on the basis of the data obtained from the sample monitor submitted to the Commission for test.

(2) In approving a monitor upon the basis of the tests conducted by the Laboratory, the Commission merely recognizes that the type of monitor has the inherent capability of functioning in compliance with the rules, if properly constructed, maintained, and operated. The Commission realizes that the frequency monitor may have limited range over which the visual indicator will determine deviations. Accordingly, it may be necessary that adjunct equipment be used to determine major deviations.

NOTE: In addition to the visual indicator, the range of which may be limited in order to obtain the required accuracy, an aural indicator should also be employed to indicate frequency deviations beyond the range of the visual indicator, particularly where the visual

indicator is so designed that the indication becomes zero when the deviations become considerably greater than the range of the instrument.

(3) Additional rules with respect to withdrawal of type approval, modification of type approval equipment and limitations on the findings upon which type approval is based are set forth in Part 2, Subpart F, of this chapter.

(b) *General specifications.* The general specifications that frequency monitors shall meet before they will be approved by the Commission are as follows:

(1) The unit shall have an accuracy of at least five parts per million under ordinary conditions (temperature, humidity, power supply, and other conditions which may affect its accuracy) encountered in standard broadcast stations throughout the United States.

(2) The range of the indicating device shall be at least from 20 cycles below to 20 cycles above the assigned frequency.

(3) The scale of the indicating device shall be so calibrated as to be accurately read within at least 1 cycle.

(4) The unit shall be equipped with an automatic temperature control chamber (preferably enclosing the tank circuits of the oscillator) such that the maximum temperature variation at the crystal from the normal operating temperature shall not be greater than,

Plus or minus 0.05° C. when *X* or *Y* cut crystal is employed, or

Plus or minus 0.5° C. when low temperature coefficient crystal is employed.

(5) Unless otherwise specifically authorized, the instrument shall be equipped with a thermometer such that the temperature can be accurately measured within 0.025° C. for *X* or *Y* cut crystal or 0.25° C. for low temperature coefficient crystal.

(6) The monitor circuit shall be such that it may be continuously operated and the emitted carrier of the station is not heterodyned thereby.

(7) Means shall be provided for adjustment of the temperature or other means for correction of the indications of the monitor to agree with the external standard.

(c) *Tests to be made by the Laboratory Division of the F. C. C.* The tests to be made at the Laboratory will include the determination of the following:

(1) *Accuracy.* (i) Oscillator frequency, as received.

(ii) Constancy of oscillator frequency, as measured several times in 1 month.

(iii) Accuracy of readings of frequency-difference instrument.

(iv) Functioning of frequency adjustment device.

(v) Effects on frequency of changing tubes and of voltage variations.

(2) *Temperature control stability.* Effect on frequency of variation of room temperature through a range not to exceed 10° to 35° C.

(3) *Sensitivity.* Response of indicating instrument to small changes of frequency.

(4) *General construction.* (i) Inspection to determine ability to stand shipment and service.

(ii) Special tests to determine quality of construction, such as effect of tilting or tipping on frequency.

(5) *Miscellaneous performance.* Various, depending on character of apparatus (e.g., changes after stopping and starting, effect of varying coupling with transmitter, etc.).

(d) The equipment will be operated in a test in the same way and the same conditions under which it will be used in service as specified by the manufacturer. The manufacturer shall supply to the Laboratory Division all instructions or services which will be supplied to the purchaser of the equipment. The equipment, as submitted, shall be adjusted for operation in connection with broadcast stations operating on 1600 kilocycles.

§ 3.50 Requirements for approval of modulation monitors. (a) Any manufacturer desiring to submit a monitor for type approval shall supply the Commission with full specification details (two sworn copies) specified in paragraph (b) of this section. If this information appears to meet the requirements of the rules, shipping instructions will be issued to the manufacturer. The shipping charges to and from the Laboratory at Laurel, Maryland, shall be paid for by the manufacturer. Approval of a monitor

will only be given on the basis of the data obtained from the sample monitor submitted to the Commission for test.

(1) In approving a monitor upon the basis of the tests conducted by the Laboratory, the Commission merely recognizes that the type of monitor has the inherent capability of functioning in compliance with the rules, if properly constructed, maintained, and operated.

(2) Additional rules with respect to withdrawal of type approval, modification of type approval equipment and limitations on the findings upon which type approval is based are set forth in Part 2, Subpart F, of this chapter.

(b) The specifications that the modulation monitor shall meet before it will be approved by the Commission are as follows:

(1) A DC meter for setting the average rectified carrier at a specific value and to indicate changes in carrier intensity during modulation.

(2) A peak indicating light or similar device that can be set at any predetermined value from 50 to 120 percent modulation to indicate on positive peaks, and/or from 50 to 100 percent negative modulation.

(3) A semi-peak indicator with a meter having the characteristics given below shall be used with a circuit such that peaks of modulation of duration between 40 and 90 milliseconds are indicated to 90 percent of full value and the discharge rate adjusted so that the pointer returns from full reading to 10 percent of zero within 500 to 800 milliseconds. A switch shall be provided so that this meter will read either positive or negative modulation and, if desired, in the center position it may read both in a full-wave circuit. The characteristics of the indicating meter are as follows:

(i) The time for one complete oscillation of the pointer shall be 290 to 350 milliseconds. The damping factor shall be between 16 and 200. The useful scale length shall be at least 2.3 inches. The meter shall be calibrated for modulation from 0 to 110 percent and in decibels below 100 percent with 100 percent being 0 DB.

(ii) The accuracy of the reading on percentage of modulation shall be ±2 percent for 100 percent modulation, and ±4 percent of full scale reading at any other percentage of modulation.

(4) The frequency characteristics curve shall not depart from a straight line more than ±½ DB from 30 to 10000 cycles. The amplitude distortion or generation of audio harmonics shall be kept to a minimum.

(5) The modulation meter shall be equipped with appropriate terminals so that an external peak counter can be readily connected.

(6) Modulation will be tested at 115 volts ±5 percent and 60 cycles, and the above accuracies shall be applicable under these conditions.

(7) All specifications not already covered above, and the general design, construction, and operation of these units must be in accordance with good engineering practice.

(c) The modulation monitor may be a part of the frequency monitor.

Technical Operation

§ 3.51 Operating power; how determined. (a) Except as provided in paragraph (b) of this section, the operating power shall be determined by the direct method (the square of the antenna current times the antenna resistance at the point where the current is measured and at the operating frequency).

(b) Operating power shall be determined on a temporary basis by the indirect method: (1) In case of an emergency where the licensed antenna system has been damaged by causes beyond the control of the licensee (see § 3.45), or (2) Pending completion of authorized changes in the antenna system, or (3) If any change is made in the antenna system or any other change is made which may affect the antenna system. (See § 3.45.)

§ 3.52 Operating power; indirect measurement. (a) The operating power determined by indirect measurement from the plate input power of the last radio stage

is the product of the plate voltage (E_p), the total plate current of the last radio stage (I_p), and the proper factor (F) given in paragraph (b) of this section: That is

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

(b) Factor to be used.

Factor (F)	Method of modulation	Maximum rated carrier power	Class of amplifier
0.70	Plate	0.1–1.0 kw	
0.80	Plate	5 kw and over	
0.35	Low Level	0.1 kw and over	B
0.65	Low Level	0.1 kw and over	BC [1]
0.35	Grid	0.1 kw and over	

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

(c) In computing operating power by the indirect method, the factor in paragraph (b) of this section shall apply in all cases, and no distinction will be recognized due to the operating power being less than the maximum rated carrier power.

§ 3.53 [Reserved.]

§ 3.54 **Operating power; direct measurement.** (a) Applications to determine the operating power by the direct method shall be made on FCC Form 302.

(b) The resistance variation method, substitution method and bridge method are acceptable methods of measuring the total antenna resistance.

(c) A determination of the resistance of an omni-directioual antenna shall be made by taking a series of measurements at 5, 10, 15, and 20 kc on each side of the operating frequency. The values measured should be plotted with frequency as abscissa and resistance in ohms as ordinate and a smooth curve drawn. The point on the ordinate where this curve interscets the operating frequency gives the value of the antenna resistance.

(d) Antenna resistance for a directional antenna system shall be measured at the point of common radio frequency input to the directional antenna system. The following conditions shall obtain:

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

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

(3) Suitable radio-frequency bridge or other method shall be employed to determine the resistance and reactance at the point of common radio frequency input.

(4) Resistance and reactance measurements at approximately 5, 10, 15, and 20 kc on each side of the operating frequency shall be made. The values measured shall be plotted and the resistance at the operating frequency determined in the same manner as set forth in paragraph (c) of this section.

(5) A permanently installed antenna ammeter shall be placed in each element of the system as well as at the point of measurement of resistance.

(e) The license for a station of power of 5 kw or under which employs a directional antenna will specify the antenna resistance as 92.5 percent of that determined at the point of common input. The resistance specified for stations of a power over 5 kw will be 95 per cent of that determined at the point of common input.

§ 3.55 **Modulation.** The percentage of modulation shall be maintained as high as possible consistent with good quality of transmission and in no case less than 85 percent on peaks nor more than 100 percent on negative peaks of frequent recurrence during any selection which is transmitted at the highest level of the program under consideration.

§ 3.56 **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 operating 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 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.

§ 3.57 Operating power; maintenance of. (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.

§ 3.58 Indicating instruments. (a) Each standard broadcast station shall be equipped with indicating instruments which conform with the specifications set forth in § 3.39 for measuring the DC plate circuit current and voltage of the last radio frequency amplifier 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 operating 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 § 3.52 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 § 1.332(d) 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.

§ 3.59 Frequency tolerance. The operating frequency of each station shall be maintained within 20 cycles of the assigned frequency.

§ 3.60 Frequency monitor. (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 operating 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 seven days and the results entered in the station 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 § 1.332(d) 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.

§ 3.61 New equipment; restrictions. The Commission will authorize the installation of new transmitting equipment in a broadcast station or changes in the frequency control of an existing transmitter only if such equipment is so designed that there is reasonable assurance that the transmitter is capable of maintaining automatically the assigned frequency within the limits specified in § 3.59.

§ 3.62 Automatic frequency control equipment; authorization required. New automatic frequency control equipment and changes in existing automatic frequency control equipment that may affect the precision of frequency control or the operation of the transmitter shall be installed only upon authorization from the Commission.

§ 3.63 Auxiliary transmitter. Upon showing that a need exists for the use of an auxiliary transmitter in addition to the regular transmitter of a broadcast station, a license therefor may be issued: *Provided,* That:

(a) An auxiliary transmitter may be installed either at the same location as the main transmitter or at another location.

(b) A licensed operator shall be in control whenever an auxiliary transmitter is placed in operation.

(c) The auxiliary transmitter shall be maintained so that it may be placed in operation at any time for any one of the following purposes:

(1) The transmission of the regular programs upon the failure of the main transmitter.

(2) The transmission of the regular programs during maintenance or modification work on the main transmitter necessitating discontinuance of its operation.

(3) CONELRAD tests, drills or operation, provided the auxiliary transmitter is used in connection with a National Defense Emergency Authorization.

(4) Upon request of a duly authorized representative of the Commission.

(d) The auxiliary transmitter shall be tested at least once each week to determine that it is in proper operating condition and that it is adjusted to the licensed or CONELRAD frequency: *Provided, however,* That the test in any week may be omitted if the auxiliary transmitter has been operated during the week pursuant to paragraph (c) of this section and such operation was satisfactory. Tests on the licensed frequency shall be conducted only between 12 midnight and 9 a.m., local standard time. Tests on a CONELRAD frequency, when such tests are not part of an authorized CONELRAD test, shall be made only when the transmitter output is connected to a dummy load. A record shall be kept of the time and result of each test. Such records shall be retained for a period of two years.

(e) The auxiliary transmitter shall be equipped with satisfactory control equipment which will enable the maintenance of the frequency emitted by the station within the limits prescribed by the regulations in this part.

(f) An auxiliary transmitter which is licensed at a geographical location different from that of the main transmitter shall be equipped with a frequency control which will automatically hold the frequency within the limits prescribed by the regulations in this part without any manual adjustment during operation or when it is being put into operation.

(g) The operating power of an auxiliary transmitter may be less than the authorized power, but in no event shall it be greater than such power.

(h) All regulations as to safety requirements and spurious emissions applying to broadcast transmitting equipment shall apply also to an auxiliary transmitter.

§ 3.64 Alternate main transmitters. The licensee of a standard broadcast station may be licensed for alternate main transmitters provided that a technical need for such alternate transmitters is shown, such as licensees maintaining 24-hour schedule and needing alternate operations for maintenance, or where developmental work requires alternate operation, and that the following conditions are met:

(a) Both transmitters are located at the same place.

(b) The transmitters have the same power rating except at stations operating with different daytime and nighttime power when it shall be permissible to employ transmitters of power ratings appropriate to either the licensed daytime or nighttime power.

(c) The external effects from both transmitters are substantially the same as to frequency stability, reliability of operation, radio harmonics and other spurious emissions, audio frequency range and audio harmonic generation in the transmitter.

§ 3.65 Antenna structure, marking and lighting. Where an antenna structure(s) is required to be painted or lighted see § 17.37, *Inspection of tower lights and associated control equipment;* § 17.39, *Cleaning and repainting;* § 17.40, *Time when lights shall be exhibited;* § 17.41, *Spare lamps;* and § 17.42, *Lighting equipment;* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

Remote Control

§ 3.66 Remote control authorization. (a) Application to operate a station by remote control may be made as a part of the application for construction permit for a new station, provided that the proposal is for non-directional operation with a power of 10 kw or less.

(b) Application to operate an authorized station by remote control shall be made on FCC Form 301-A.

(c) An authorization for remote control will be issued only after a satisfactory showing has been made in regard to the following, among others:

(1) The location of the remote control point(s);

(2) The directional antenna system, if such is authorized, is in proper adjustment and is stable;

(3) The transmitter, if the power rating is in excess of 10 kw, is reliable and capable of being operated by remote control;

(4) The station, if authorized to operate with a directional antenna and/or with power in excess of 10 kw, will be equipped so that it can be satisfactorily operated in accordance with Subpart G of this part, on a CONELRAD frequency with a power of 5 kw or not less than 50 percent of the maximum licensed power whichever is the lesser and that the necessary switching from the licensed frequency to the CONELRAD frequency can be accomplished from the remote control position: *Provided, however,* That the power may be less than 50 percent upon certification by the CONELRAD Field Supervisor that such a power will provide satisfactory service under CONELRAD.

§ 3.67 Remote control operation. (a) 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 Commission's rules.

(5) The indications at the remote control point of the antenna current meter on, 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.

(b) All stations, whether operating by remote control or direct control, shall be so equipped, in accordance with § 3.932, so as to be able to follow the prescribed CONELRAD alerting procedure set forth in the CONELRAD Manual for Broadcast Stations.

(c) A station operating with a directional antenna and/or with power in excess of 10 kw shall be so equipped that a shift from the licensed operation to an operation in the CONELRAD system can be accomplished from the remote control position.

§ 3.68 Remote control renewal application. (a) An application for renewal of a remote control authorization may be made on the application for renewal of station license.

(b) Stations employing directional antenna and operated by remote control shall make a skeleton proof of performance each year, consisting of three or four measurements on each radial used in the original application and must submit the results of these measurements, plus the monitoring point readings, with the renewal application.

Operation

§ 3.71 Minimum operating schedule. Except Sundays, the licensee of each standard broadcast station shall maintain a minimum operating schedule of two-thirds of the total hours that it is authorized to operate between 6 a.m. and 6 p.m., local standard time, and two-thirds of the total hours it is authorized to operate between 6 p.m. and midnight, local standard time, except that in an emergency when, due to causes

beyond the control of the licensee, it becomes impossible to continue operating, the station may cease operation for a period of not to exeeed 10 days, provided that the Commission and the Engineer in Charge of the radio district in whieh the station is located shall be notifiecl in writing immediately after the emergency develops.

§ 3.72 **Operation during experimental 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.

§ 3.73 **Specified hours.** If the license of a station specifies the hours of operation, the schedule so specified shall be adhered to except as provided in §§ 3.71 and 3.72.

§ 3.74 **Sharing time.** If the licenses of stations authorized to share time do not specify hours of operation, the licensees shall endeavor to reach an agreement for a definite schedule of periods of time to be used by each. Such agreement shall be in writing and each licensee shall file the same in triplicate original with each application to the Commission for renewal of license. If and when such written agreements are properly filed in conformity with this section, the file mark of the Commission will be affixed thereto, one copy will be retained by the Commission, one copy forwarded to the Engineer in Charge of the radio district in which the station is located, and one copy returned to the licensee to be posted with the station license and considered as a part thereof. If the license specifies a proportionate time division, the agreement shall maintain this proportion. If no proportionate time division is specified in the license, the licensees shall agree upon a division of time. Such division of time shall not include simultaneous operation of the stations unless specifically authorized by the terms of the license.

§ 3.75 **Sharing time; equivalence of day and night hours.** For the purpose of determining the proportionate division of time of the broadcast day for sharing time stations 1 night hour shall be considered the equivalent of 2 day hours.

§ 3.76 **Sharing time; experimental period.** If the license of a station authorized to share time does not specify the hours of operation, the station may be operated for the transmission of regular programs during the experimental period provided an agreement thereto is reached with the other stations with which the broadcast day is shared and further provided such operation is not in conflict with § 3.72. Time-sharing agreements for operation during the experimental period need not be submitted to the Commission.

§ 3.77 **Sharing time; departure from regular schedule.** A departure from the regular operating schedule set forth in a time-sharing agreement will be permitted only in cases where an agreement to that effect is reduced to writing, is signed by the licensees of the stations affected thereby and filed in triplicate by each licensee with the Commission prior to the time of the proposed change. If time is of the essence, the actual departure in operating schedule may precede the actual filing of written agreement, provided appropriate notice is sent to the Commission and the Engineer in Charge of the radio district in which the station is located.

§ 3.78 **Sharing time stations; notification to Commission.** If the licensees of stations authorized to share time are unable to agree on a division of time, the Commission shall be so notified by statement to that effect filed with the applications for renewals of licenses. Upon receipt of such statement the Commission will designate the applications for a hearing and, pending such hearing, the operating schedule previously adhered to shall remain in full force and effect.

§ 3.79 **License to specify sunrise and sunset hours.** If the licensee of a broadcast station is required to commence or cease operation, or to change the mode of operation of the station at the times of sunrise and sunset at any particular location, the controlling times for each month of the year are set forth in the station's instrument of authorization. Uniform sunrise and sunset times are specified for all of the days of each month, based upon the actual times of sunrise and sunset for the fifteenth day of that month adjusted to the nearest quarter hour. In accordance with a standardized procedure described therein, actual sunrise and sunset times are derived by interpolation in the tables of the 1946 American Nautical Almanac, issued by the Nautical Almanac Office of the United States Naval Observatory.

§ 3.80 **Secondary station; filing of operating schedule.** The licensee of a secondary station authorized to operate limited time and which may resume operation at the time the dominant station (or stations) on the same channel ceases operation shall, with each application for renewal of license, file in triplicate a copy of its regular operating schedule, bearing a signed notation by the licensee of the dominant station of its objection or lack of objection thereto. Upon approval of such operating schedule, the Commission will affix its file mark and return one copy to the licensee authorized to operate limited time, which shall be posted with the station license and considered as a part thereof. Departure from said operating schedule will be permitted only in accordance with the procedure set forth in § 3.77.

§ 3.81 **Secondary station; failure to reach agreement.** If the licensee of a secondary station authorized to operate limited time and a dominant station on a channel are unable to agree upon a definite time for resumption of operation by the station authorized limited time, the Commission shall be so notified by the licensee of the station authorized limited time. After receipt of such statement the Commission will designate for hearing the applications of both stations for renewal of license, and pending the hearing the schedule previously adhered to shall remain in full force and effect.

§ 3.82 **Departure from schedule; material violation.** In all cases where a station licensee is required to prepare and file an operating schedule, any deviation or departure from such schedule, except as herein authorized, shall be considered as a violation of a material term of the license.

§ 3.83 **Local standard time.** All references herein to standard time or local standard time refer to local standard time as determined and fixed by the Interstate Commerce Commission.

§3.84 **Daylight saving time.** If local time is changed from standard time to daylight saving time at the location of all stations sharing time on the same channel, the hours of operation of all such stations on that channel shall be understood to refer to daylight saving time, and not standard time, as long as daylight saving time is observed at such locations. This provision shall govern when the time is changed by provision of law or general observance of daylight saving time by the various communities, and when the time of operation of such stations is specified in the license or is mutually agreed upon by the licensees: *Provided, however,* That when the license specifies average time of sunrise and sunset, local standard time shall be observed. In no event shall a station licensed for daytime only operate on regular schedule prior to local sunrise, or shall a station licensed for greater daytime power than nighttime power or for a different radiation pattern for daytime operation than for nighttime operation operate with the daytime power or radiation pattern prior to local sunrise.

§ 3.85 **Changes in time; agreement between licensees.** Where the local time is not changed from standard time to daylight saving time at the location of all stations sharing time on the same channel, the hours of operation of such stations shall be understood to have reference to standard time, and not daylight saving time, unless said licensees mutually agree upon a new schedule which shall be effective only while daylight saving time is observed at the location of some of these stations.

§ 3.86 **Local standard time; license provisions.** The time of operation of any broadcast station which does not share time with other stations on the same channel shall be understood to have reference to local standard time unless modification of such license with respect to hours of operation is authorized by the Commission.

§ 3.87 **Program transmissions prior to local sunrise.** (a) The provisions of §§ 3.6, 3.8, 3.9, 3.10, 3.23, 3.79, and 3.84 shall not prevent the transmission of programs between 4 o'clock a.m., local standard time, and local sunrise, of standard broadcast stations with their authorized daytime facilities: *Provided,* That the provisions of this section shall not extend to:

(1) Stations regularly sharing time during daytime hours either under licenses pursuant to which time-sharing agreements have been entered into or licenses specifying hours of operation, unless time-sharing agreements have been reached covering

such operation prior to local sunrise. Sections 3.74, 3.77, and 3.78 shall be applicable to such agreements.

(2) Any Class II station causing interference, as determined by the standard broadcast Technical Standards of this subpart, by use of its daytime facilities within the 0.5 mv/m 50 percent skywave contour of any Class I station either of the United States or of any country party to the North American Regional Broadcasting Agreement, except (i) where the Class I station is located east of the Class II station in which case operation may begin at local sunrise at the Class I station; (ii) where an agreement has been reached with the Class I station to begin operation prior to local sunrise.

(3) Operation by use of its daytime facilities of any Class II station on any Class I-A channel not assigned to the United States under the North American Regional Broadcasting Agreement.

(4) Class IV stations authorized for operation with daytime power in excess of 250 watts.

(b) Any station operating during such hours receiving notice from the Commission that undue interference is caused shall refrain from such operation during such hours pending fnrther notice from the Commission.

(c) Nothing contained in outstanding instruments of authorization for such stations shall prohibit such operation except as herein provided.

(d) The period 4 a.m. to 6 a.m., local standard time, shall not be included in determining compliance with § 3.71.

§ 3.88 Blanketing interference. The licensee of each broadcast station is required to satisfy all reasonable complaints of blanketing interference within the 1 v/m contour.

§ 3.89 Use of frequency and modulation monitors at auxiliary transmitters. (a) The following shall govern the installation of approved frequency and modulation monitors at auxiliary transmitters:

(1) In case the auxiliary transmitter location is at a site different from that of the main transmitter, an approved frequency monitor shall be installed at the auxiliary transmitter, except when the frequency of the auxiliary transmitter can be monitored by means of the frequency monitor at the main transmitter.

(2) The provision that the frequency monitor may be located at the site of the main transmitter shall not relieve the obligation that the frequency deviation of the auxiliary transmitter shall be maintained within 20 cycles.

(3) Installation of an approved modulation monitor at the location of the auxiliary transmitter, when different from that of the main transmitter, is optional with the licensee. However, when it is necessary to operate the auxiliary transmitter beyond 2 calendar days, a modulation monitor shall be installed and operated at the auxiliary transmitter. The monitor (if taken from the main transmitter) shall be reinstalled at the main transmitter immediately upon resumption of operation of the main transmitter.

(4) In all cases where the auxiliary transmitter and the main transmitter have the same location, the same frequency and modulation monitor may be used for monitoring both transmitters, provided they are so arranged as to be switched readily from one transmitter to the other.

§ 3.90 Emergency weather warnings. Upon receipt of notification of an Emergency Weather Warning of a condition of immediate danger to life and property from the United States Weather Bureau, all standard broadcast stations may, at their option, during authorized hours of operation only, broadcast CONELRAD Attention Signals (two five second carrier breaks and fifteen seconds of 1,000 CPS tone) followed by the Emergency Weather Warning as outlined in CONELRAD Manual BC-3 (Revised), Appendix A. Nothing herein shall be construed as authorizing a daytime only or limited time station to operate during unauthorized hours.

§ 3.91 Discontinuance of operation. The licensee of each station shall notify the Commission in Washington, D.C., and the Engineer in Charge of the radio district where such station is located of permanent discontinuance of operation at least

two days before operation is discontinued. The licensee shall, in addition, immediately forward the station license and other instruments of authorization to the Washington, D.C., office of the Commission for cancellation.

§3.92 Station and operator licenses; posting of. (a) The station license and any other instrument of station anthorization shall be posted in a conspicuons 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.

§ 3.93 Operator requirements. (a) One or more radio operators holding a valid radiotelephone first-class operator license, except as provided in paragraph (b) of this section, shall be in actual charge of the transmitting apparatus and shall be on dnty either at the transmitter location or remote control point.

(b) A station which is authorized for non-directional operation with power of 10 kilowatts or less may be operated by persons holding commercial radio operator license of any class, except an aircraft radiotelephone operator authorization or a temporary limited radiotelegraph second-class operator license, when the equipment is so designed that the stability of the frequency is maintained by the transmitter itself within the limits of tolerance specified, aud none of the operations, except those specified in subparagraphs (1) through (4) of this paragraph, necessary to be performed during the course of normal operation may cause off-frequency operation or result in any unauthorized radiation. (A person holding any class of radio operator licensc or permit who is authorized thereunder to perform limited operation of a standard broadcast station may, when a CONELRAD Radio Alert is called, make adjustments necessary to effect operation on a CONELRAD authorization: *Provided,* That the station's full-time radiotelephone first-class operator shall have previously instructed such person in the adjustments to the transmitter which are necessary to accomplish CONELRAD operation.) Adjustments of transmitting equipment by such operators, except when under the immediate supervision of a radiotelephone first-class operator, shall be limited to the following:

(1) Those necessary to commence or terminate transmitter emissions as a routine matter.

(2) Those external adjustments that may be required as a result of variations of primary power supply.

(3) Those external adjustments which may be necessary to insure modulation within the limits required.

(4) Those adjustments necessary to effect any change in operating power which may be required by the station's instrument of authorization. Should the transmitting apparatus be observed to be operating in a manner inconsistent with the station's instrument of authorization and none of the above adjustments are effective in bringing it into proper operation, a person holding other than a radiotelephone first-class operator license and not acting under the immediate supervision of radiotelephone first-class operator, shall be required to terminate the station's emissions.

(c) The licensee of a station which is operated by one or more operators holding other than a radiotelephone first-class operator license shall have one or more operators holding a radiotelephone first-class operator license in regular full-time employment at the station whose primary duties shall be to effect and insure the proper functioning of the transmitting eqnipment. In the event that the licensee also operates an FM broadcast station in the same community, a regular full-time radiotelephone first-class operator or operators employed in connection with the standard broadcast station may concurrently be employed to satisfy the requirements of § 3.265(c) or § 3.565(c): *Provided,* That the duties of such operator or operators concerning the FM broadcast transmitting equipment shall in nowise interfere with the proper performance of his dnties with respect to the standard broadcast transmitter.

(d) The licensed operator on duty and in charge of a standard broadcast transmitter may, at the discretion of the licensee, 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 rnles and regulations governing such other stations: *Provided, however,* That such duties shall in nowise interfere with the proper operation of the standard broadcast transmitter.

§ 3.94 [Reserved.]

§ 3.95 **Equipment tests.** (a) During the process of construction of a standard broadcast station the permittee, after notifying the Commission and Engineer in Charge of the radio district in which the station is located, may without fnrther authority of the Commission, conduct equipment tests during the experimental period for the purpose of such adjustments and measurements as may be necessary to assure compliance with the terms of the construction permit, the technical provisions of the application therefor, the rules and regulations, and the applicable engineering standards. In addition, the Commission may authorize equipment tests other than during the experimental period if such operation is shown to be desirable to the proper completion of construction and adjustment of the transmitting equipment and antenna system. An informal application for such authority, giving full details regarding the need for such tests, shall be filed with the Commission at least two (2) days (not including Sundays and Saturdays and legal holidays when the offices of the Commission are not open) prior to the date on which it is desired to begin such operation.

(b) The Commission may notify the permittee to conduct no tests or may cancel, suspend, or change the date for the beginning of equipment tests as and when such action may appear to be in the public interest, convenience, and necessity.

(c) Equipment tests may be continued so long as the construction permit shall remain valid and shall be conducted only during the experimental period (12 midnight to local sunrise) unless otherwise specifically authorized.

(d) Inspection of a station will ordinarily be required during the equipment test period and before the commencement of program tests. After construction and after adjustments and measurements have been completed to show compliance with the terms of the construction permit, the technical provisions of the application therefor, the rules and regulations and the applicable engineering standards, the permittee should notify the Engineer in Charge of the radio district in which the station is located that it is ready for inspection.

(e) The authorization for tests embodied in this section shall not be construed as constituting a license to operate but as a necessary part of construction.

§ 3.96 **Program tests.** (a) Upon completion of construction of a standard broadcast station in accordance with the terms of the construction permit, the technical provisions of the application therefor, and the rules and regulations and applicable engineering standards and when an application for station license has been filed showing the station to be in satisfactory operating condition, the permittee may request authority to conduct program tests: *Provided,* That such request shall be filed with the Commission at least ten (10) days prior to the date on which it is desired to begin such operation and that the Engineer in Charge of the radio district in which the station is located is notified. All data necessary to show compliance with the terms and conditions of the construction permit must be filed with the license application. If the station is using a directional antenna, a proof of performance must also be filed as required by § 3.33(b).

(b) Program tests shall not commence until specific Commission authority is received. The Commission reserves the right to change the date of the beginning of such tests or to suspend or revoke the authority for program tests as and when such action may appear to be in the public interest, convenience, and necessity.

(c) Unless sooner suspended or revoked program test authority continues valid during Commission consideration of the application for license and during this period further extension of the construction permit is not required. Program test authority shall be automatically terminated by final determination upon the application for station license.

(d) All operation on program test authority shall be in strict compliance with the rules governing standard broadcast stations and in strict accordance with representations made in the application for license pursuant to which the tests were authorized.

(e) The granting of program test authority shall not be construed as approval by the Commission of the application for station license.

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

Other Operating Requirements

§ 3.111 Logs. The licensee or permittee of each standard broadcast station shall maintain program and operating logs and shall require entries to be made as follows:

(a) In the program log:

(1) An entry of the time each station identification announcement (call letters and location) is made.

(2) An entry briefly describing each program broadcast, such as "music," "drama," "speech," etc., together with the name or title thereof, and the sponsor's name, with the time of the beginning and ending of the complete program. If a mechanical record is used, the entry shall show the exact nature thereof, such as "record," "transcription," etc., and the time it is announced as a mechanical record. If a speech is made by a political candidate, the name and political affiliations of such speaker shall be entered.

(3) An entry showing that each sponsored program broadcast has been announced as sponsored, paid for, or furnished by the sponsor.

(4) An entry showing, for each program of network origin, the name of the network originating the program.

(b) In the operating log:

(1) An entry of the time the station begins to supply power to the antenna, and the time it stops.

(2) An entry of the time the program begins and ends.

(3) An entry of each interruption to the carrier wave, its cause, and duration.

(4) An entry of the following each 30 minutes:

(i) Operating constants of last radio stage (total plate current and plate voltage).

(ii) Antenna current.

(iii) Frequency monitor reading.

(5) Any other entries required by the instrument of authorization.

(6) Log of experimental operation during experimental period. (If regular operation is maintained during this period, the above logs shall be kept.)

(i) A log must be kept of all operation during the experimental period. If the entries required above are not applicable thereto, then the entries shall be made so as to fully describe the operation.

(c) Where an antenna structure(s) is required to be illuminated see § 17.38, *Recording of tower light inspections in the station record,* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 3.112 Logs; retention of. Logs of standard broadcast stations shall be retained by the licensee or permittee for a period of two 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.

NOTE: Application forms for licenses and other authorizations require that certain operating and program data be supplied. It is suggested that these application forms be kept in mind in connection with maintenance of station program and operating records.

§ 3.113 Logs; by whom kept. Each log shall be kept by the person or persons competent to do so, having actual knowledge of the facts required, who shall sign

the log when starting duty and again when going off duty. The logs shall be made available upon request by an authorized representative of the Commission.

§ 3.114 **Log form.** The log shall be kept in an orderly manner, in suitable form, and in such detail that the data required for the particular class of station concerned are readily available. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log.

§ 3.115 **Correction of logs.** No log or portion thereof shall be erased, obliterated, or willfully destroyed within the period of retention provided by the rules. Any necessary correction may be made only by the person originating the entry who shall strike out the erroneous portion, initial the correction made, and indicate the date of correction.

§ 3.116 **Rough logs.** Rough logs may be transcribed into condensed form, but in such case the original log or memoranda and all portions thereof shall be preserved and made a part of the complete log.

§ 3.117 **Station identification.** (a) A licensee of a standard broadcast station shall make station identification announcement (call letters and location) at the beginning and ending of each time of operation and during operation (1) on the hour and (2) either on the half hour or at the quarter hour following the hour and at the quarter hour preceding the next hour: *Provided,*

(b) Such identification announcement need not be made on the hour when to make such announcement would interrupt a single consecutive speech, play, religious service, symphony concert, or operatic production of longer duration than 30 minutes. In such cases the identification announcement shall be made at the beginning of the program, at the first interruption of the entertainment continuity, and at the conclusion of the program.

(c) Such identification announcement need not be made on the half hour or quarter hours when to make such announcement would interrupt a single consecutive speech, play, religious service, symphony concert, or operatic production. In such cases an identification announcement shall be made at the first interruption of the entertainment continuity and at the conclusion of the program: *Provided,* That an announcement within 5 minutes of the times specified in paragraph (a) (2) of this section will satisfy the requirements of identification announcements.

(d) In the case of variety show programs, baseball game broadcasts, or similar programs of longer duration than 30 minutes, the identification announcement shall be made within 5 minutes of the hour and of the times specified in paragraph (a) (2) of this section.

(e) In the case of all other programs the identification announcement shall be made within 2 minutes of the hour and of the times specified in paragraph (a) (2) of this section.

(f) In making the identification announcement the call letters shall be given only on the channel of the station identified thereby, except as otherwise provided in § 3.287 of the Commission's rules governing FM broadcast stations.

§ 3.118 **Mechanical reproductions.** (a) No mechanically reproduced program consisting of a speech, news event, news commentator, forum, panel discussion, or special event in which the element of time is of special significance, or any other program in which the element of time is of special significance and presentation of which would create, either intentionally or otherwise, the impression or belief on the part of the listening audience that the event or program being broadcast is in fact occurring simultaneously with the broadcast, shall be broadcast without an appropriate announcement being made either at the beginning or end of such reproduction or at the beginning or end of the program in which such reproduction is used that it is a mechanical reproduction or a mechanically reproduced program: *Provided, however,* That each such program of one minute or less need not be announced as such.

(b) The exact form of identifying announcement is not prescribed, but the language shall be clear and in terms commonly used and understood. Any other program mechanically reproduced or series of mechanical reproductions, including a mechanical reproduction used for background music, sound effects, station identification, program identification (theme music of short duration) or identification of sponsorship of the

program proper, need not be announced as provided in paragraph (a) of this section, but the licensee shall not attempt affirmatively to create the impression that any program being broadcast by mechanical reproduction consists of live talent.

(c) The requirements of paragraph (a) of this section are waived with respect to network programs, transcribed and rebroadcast at a later hour because of the time zone differentials between the place where the program originates and where it is rebroadcast, this waiver being applicable whether the off-the-line recording is made by the network itself at one of its key stations or by an individual station, but only when the off-the-line recording is for broadcast at an hour not exceeding the time zone differential between the place where the program originates and where it is rebroadcast. Each station which broadcasts network programs at a later hour in accordance with this waiver shall make an appropriate announcement at least once each day between the hours of 10:00 a.m. and 10:00 p.m., stating that some or all of the network programs which are broadcast by that station are delayed broadcasts by means of transcription. This waiver provision also applies during the annual periods in which daylight saving time will be effective with respect to network programs transcribed and rebroadcast one hour later because of the time differential resulting from the adoption of daylight saving time in some areas.

§ 3.119 Sponsored programs; announcement of. (a) In the case of each program for the broadcasting of which money, services, or other valuable consideration is either directly or indirectly paid or promised to, or charged or received by, any radio broadcast station, the station broadcasting such program shall make, or cause to be made, an appropriate announcement that the program is sponsored, paid for, or furnished, either in whole or in part.

(b) In the case of any political program or any program involving the discussion of public controversial issues for which any records, transcriptions, talent, scripts, or other material or services of any kind are furnished, either directly or indirectly, to a station as an inducement to the broadcasting of such program, an announcement shall be made both at the beginning and conclusion of such program on which such material or services are used that such records, transcriptions, talent, scripts, or other material or services have been furnished to such station in connection with the broadcasting of such program: *Provided, however*, That only one such announcement need be made in the case of any such program of 5 minutes' duration or less, which announcement may be made either at the beginning or the conclusion of the program.

(c) The announcement required by this section shall fully and fairly disclose the true identity of the person or persons by whom or in whose behalf such payment is made or promised, or from whom or in whose behalf such services or other valuable consideration is received, or by whom the material or services referred to in paragraph (b) of this section are furnished. Where an agent or other person contracts or otherwise makes arrangements with a station on behalf of another, and such fact is known to the station, the announcement shall disclose the identity of the person or persons in whose behalf such agent is acting instead of the name of such agent.

(d) In the case of any program, other than a program advertising commercial products or services, which is sponsored, paid for or furnished, either in whole or in part, or for which material or services referred to in paragraph (b) of this section are furnished, by a corporation, committee, association or other unincorporated group, the announcement required by this section shall disclose the name of such corporation, committee, association or other unincorporated group. In each such case the station shall require that a list of the chief executive officers or members of the executive committee or of the board of directors of the corporation, committee, association or other unincorporated group shall be made available for public inspection at one of the radio stations carrying the program.

(e) In the case of programs advertising commercial products or services, an announcement stating the sponsor's corporate or trade name or the name of the sponsor's product, shall be deemed sufficient for the purposes of this section and only one such announcement need be made at any time during the course of the program.

§ 3.120 Broadcasts by candidates for public office. (a) *Definitions.* A "legally qualified candidate" means any person who has publicly announced that he is a candidate for nomination by a convention of a political party or for nomination or election

in a primary, special, or general election, municipal, county, State or national, and who meets the qualifications prescribed by the applicable laws to hold the office for which he is a candidate, so that he may be voted for by the electorate directly or by means of delegates or electors, and who:

(1) Has qualified for a place on the ballot or

(2) Is eligible under the applicable law to be voted for by sticker, by writing in his name on the ballot, or other method, and (i) has been duly nominated by a political party which is commonly known and regarded as such, or (ii) makes a substantial showing that he is a bona fide candidate for nomination or office, as the case may be.

(b) *General requirements.* No station licensee is required to permit the use of its facilities by any legally qualified candidate for public office, but if any licensee shall permit any such candidate to use its facilities, it shall afford equal opportunities to all other such candidates for that office to use such facilities: *Provided,* That such licensee shall have no power of censorship over the material broadcast by any such candidate.

(c) *Rates and practices.* (1) The rates, if any, charged all such candidates for the same office shall be uniform and shall not be rebated by any means direct or indirect. A candidate shall, in each case, be charged no more than the rate the station would charge if the candidate were a commercial advertiser whose advertising was directed to promoting its business within the same area as that encompassed by the particular office for which such person is a candidate. All discount privileges otherwise offered by a station to commercial advertisers shall be available upon equal terms to all candidates for public office.

(2) In making time available to candidates for public office no licensee shall make any discrimination between candidates in charges, practices, regulations, facilities, or services for or in connection with the service rendered pursuant to this part, or make or give any preference to any candidate for public office or subject any such candidate to any prejudice or disadvantage; nor shall any licensee make any contract or other agreement which shall have the effect of permitting any legally qualified candidate for any public office to broadcast to the exclusion of other legally qualified candidates for the same public office.

(d) *Records; inspection.* Every licensee shall keep and permit public inspection of a complete record of all requests for broadcast time made by or on behalf of candidates for public office, together with an appropriate notation showing the disposition made by the licensee of such requests, and the charges made, if any, if request is granted. Such records shall be retained for a period of two years.

(e) A request for equal opportunities must be submitted to the licensee within one week of the day on which the prior use occurred.

(f) A candidate requesting such equal opportunities of the licensee, or complaining of non-compliance to the Commission shall have the burden of proving that he and his opponent are legally qualified candidates for the same public office.

§ 3.121 Rebroadcast. (a) The term "rebroadcast" means reception by radio of the program of a radio station, and the simultaneous or subsequent retransmission of such program by a broadcast station.

NOTE 1: As used in § 3.121, program includes any complete program or part thereof, or any signals if other than A-3 emission.

NOTE 2: In case a program is transmitted from its point of origin to a broadcast station entirely by telephone facilities in which a section of such transmission is by radio, the broadcasting of this program is not considered a rebroadcast.

(b) The licensee of a standard broadcast station may, without further authority of the Commission, rebroadcast the program of a United States standard or FM broadcast station, provided the Commission is notified of the call letters of each station rebroadcast and the licensee certifies that express authority has been received from the licensee of the station originating the program.

NOTE: The notice and certification of consent shall be given within 3 days of any single rebroadcast, but in case of the regular practice of rebroadcasting certain programs of a standard broadcast station several times during a license period, notice and certification

of consent shall be given for the ensuing license period with the application for renewal of license, or at the beginning of such rebroadcast practice if begun during a license period.

(c) (1) The licensee of the standard broadcast station located within a state or the District of Columbia may, without further authority of the Commission, rebroadcast on a noncommercial basis a noncommercial program of a United States international broadcast station.

(2) The licensee of a standard broadcast station located in any territory or insular possession of the United States may, without further authority of the Commission, rebroadcast any program of a United States international broadcast station.

(3) In the case of any rebroadcast under the provisions of this paragraph, the Commission shall be notified of the call letters of each station whose programs are rebroadcast and the licensee shall certify that express authority has been received from the licensee of the station originating the program.

(d) No licensee of a standard broadcast station shall rebroadcast the program of any other class of United States radio station without written authority having first been obtained from the Commission upon application accompanied by written consent or certification of consent of the licensee of the station originating the program.

NOTE 1: The broadcasting of a program relayed by a remote pick-up broadcast station (§ 4.401 of this chapter) is not considered a rebroadcast.

NOTE 2: Informal application may be employed.

NOTE 3: By Order No. 82, dated and effective June 24, 1941, until further order of the Commission, § 3.121(d) is suspended only insofar as it requires prior written authority of the Commission for the rebroadcasting of programs originated for that express purpose by United States Government radio stations.

(e) In case of a program rebroadcast by several standard broadcast stations, such as a chain rebroadcast, the person legally responsible for distributing the program or the network facilities may obtain the necessary authorization for the entire rebroadcast both from the Commission and from the person or licensee of the station originating the program.

(f) Attention is directed to section 325(b) of the Communications Act of 1934, which reads as follows:

No person shall be permitted to locate, use, or maintain a radio broadcast studio or other place or apparatus from which or whereby sound waves are converted into electrical energy, or mechanical or physical reproduction of sound waves produced, and caused to be transmitted or delivered to a radio station in a foreign country for the purpose of being broadcast from any radio station there, having a power output of sufficient intensity, and/or being so located geographically that its emissions may be received consistently in the United States, without first obtaining a permit from the Commission upon proper application therefor. (See § 1.327 of this chapter.)

§ 3.122 Lotteries. (a) An application for construction permit, license, renewal of license, or any other authorization for the operation of a broadcast station, will not be granted where the applicant proposes to follow or continue to follow a policy or practice of broadcasting or permitting "the broadcasting of, any advertisement of or information concerning any lottery, gift enterprise, or similar scheme, offering prizes dependent in whole or in part upon lot or chance, or any list of the prizes drawn or awarded by means of any such lottery, gift enterprise, or scheme, whether said list contains any part or all of such prizes." (See 18 U. S. C. 1304.)

(b) The determination whether a particular program comes within the provisions of paragraph (a) of this section depends on the facts of each case. However, the Commission will in any event consider that a program comes within the provisions of paragraph (a) of this section if in connection with such program a prize consisting of money or thing of value is awarded to any person whose selection is dependent in whole or in part upon lot or chance, if as a condition of winning or competing for such prize, such winner or winners are required to furnish any money or thing of value or are required to have in their possession any product sold, manufactured, furnished or distributed by a sponsor of a program broadcast on the station in question.

Licensing Policies

§ 3.131 **Exclusive affiliation of station.** No license shall be granted to a standard broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization under which the station is prevented or hindered from, or penalized for, broadcasting the programs of any other network organization. (The term "network organization" as used herein includes national and regional network organizations. See ch. VII, J, of Report on Chain Broadcasting.)

§ 3.132 **Territorial exclusivity.** No license shall be granted to a standard broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization which prevents or hinders another station serving substantially the same area from broadcasting the network's programs not taken by the former station, or which prevents or hinders another station serving a substantially different area from broadcasting any program of the network organization. This section shall not be construed to prohibit any contract, arrangement, or understanding between a station and a network organization pursuant to which the station is granted the first call in its primary service area upon the programs of the network organization.

§ 3.133 **Term of affiliation.** No license shall be granted to a standard broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization which provides, by original term, provisions for renewal, or otherwise for the affiliation of the station with the network organization for a period longer than 2 years: *Provided*, That a contract, arrangement, or understanding for a period up to 2 years, may be entered into within six months prior to the commencement of such period.

§ 3.134 **Option time.** No license shall be granted to a standard broadcast station which options for network programs any time subject to call on less than 56 days' notice, or more time than a total of 3 hours within each of four segments of the broadcast day, as herein described. The broadcast day is divided into four segments, as follows: 8 a.m. to 1 p.m.; 1 p.m. to 6 p.m.; 6 p.m. to 11 p.m.; 11 p.m. to 8 a.m. (These segments are to be determined for each station in terms of local time at the location of the station but may remain constant throughout the year regardless of shifts from standard to daylight saving time or vice versa.) Such option may not be exclusive as against other network organizations and may not prevent or hinder the station from optioning or selling any or all of the time covered by the option, or other time, to other network organizations.

NOTE 1: As used in this section, an option is any contract, arrangement, or understanding, express or implied, between a station and a network organization which prevents or hinders the station from scheduling programs before the network agrees to utilize the time during which such programs are scheduled, or which requires the station to clear time already scheduled when the network organization seeks to utilize the time.

NOTE 2: All time options permitted under this section must be for specified clock hours, expressed in terms of any time system set forth in the contract agreed upon by the station and network organization. Shifts from daylight saving to standard time or vice versa may or may not shift the specified hours correspondingly as agreed by the station and network organization.

§ 3.135 **Right to reject programs.** No license shall be granted to a standard broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization which (a) with respect to programs offered pursuant to an affiliation contract, prevents or hinders the station from rejecting or refusing network programs which the station reasonably believes to be unsatisfactory or unsuitable; or which (b) with respect to network programs so offered or already contracted for, prevents the station from rejecting or refusing any program which, in its opinion, is contrary to the public interest, or from substituting a program of outstanding local or national importance.

§ 3.136 **Network ownership of stations.** No license shall be granted to a network organization, or to any person directly or indirectly controlled by or under common control with a network organization, for more than one standard broadcast station where one of the stations covers substantially the service area of the other

station, or for any standard broadcast station in any locality where the existing standard broadcast stations are so few or of such unequal desirability (in terms of coverage, power, frequency, or other related matters) that competition would be substantially restrained by such licensing. (The word "control" as used herein is not limited to full control but includes such a measure of control as would substantially affect the availability of the station to other networks.)

NOTE: Effective date of this section with respect to any station may be extended from time to time in order to permit the orderly disposition of properties; and it shall be suspended indefinitely with respect to regional network organizations.

§ 3.137 Dual network operation. No license shall be issued to a standard broadcast station affiliated with a network organization which maintains more than one network; *Provided,* That this section shall not be applicable if such networks are not operated simultaneously, or if there is no substantial overlap in the territory served by the group of stations comprising each such network.

§ 3.138 Control by networks of station rates. No license shall be granted to a standard broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization under which the station is prevented or hindered from, or penalized for, fixing or altering its rates for the sale of broadcast time for other than the network's programs.

§ 3.139 Special rules relating to contracts providing for reservation of time upon sale of a station. No license, renewal of license, assignment of license, or transfer of control of a corporate licensee shall be granted or authorized to a standard broadcast station which has a contract, arrangement or understanding, express or implied, pursuant to which, as consideration or partial consideration for the assignment of license or transfer of control, the assignor of a station license or the transferor of stock, where transfer of a corporate licensee is involved, or the nominee of such assignor or transferor retains any right of reversion of the license or any right to the reassignment of the license in the future, or reserves the right to use the facilities of the station for any period whatsoever.

(1) A maximum limitation of the time subject to reservation so that no more than 12 hours per week shall be subject to reservation, of which no more than 4 hours shall be on any given day.

(2) A clause providing that the licensee reserves the right to reject or refuse programs which he reasonably believes to be unsatisfactory or unsuitable or for which, in his opinion, a program of outstanding local or national importance should be substituted, but provision may be made for the substitution of other radio time for programs so rejected or for the payment at the station card rate for the time made unavailable.

(3) A prohibition against the resale or reassignment of any of the broadcast time reserved by such modified contract.

(4) An express negation of any right with respect to reversion or reassignment of license.

(5) An express provision setting forth a definite expiration date of the contract, arrangement or understanding. Such expiration date shall not extend beyond February 15, 1964, and shall in no event extend beyond the expiration date originally provided for in any such contract, agreement or understanding, in the event that such expiration date is a date prior to February 15, 1964.

(6) An express provision giving to the licensee the right to terminate the contract, arrangement or understanding for substantial cause, including, but not limited to, the assignment of license or the transfer of control of a corporate licensee, consistent disagreement over programs between the parties, or the acquisition of a network affiliation by the licensee, upon the payment of a lump sum or periodic payments, and providing that the amount initially fixed shall thereafter decrease as the amount of time reserved is decreased by performance of the contract. Any such payment should not be so unduly large as to constitute in practice an effective deterrent to the licensee exercising the right of termination. In determining whether the amount is unduly large, the Commission will consider the amount by which consideration in return for

the transfer of the station was decreased by reason of the reservation of time or the present value of the radio time still reserved and unused as of the date of the exercise of the right of termination.

Data and Measurements

§ 3.150 **Data required with applications for directional antenna systems.** (a) The following engineering data shall be submitted with the application for authority to install a directional antenna:

(1) Complete description of the proposed system showing:

(i) Number of elements,

(ii) Type of each element (i.e., guyed or self-supporting, uniform cross section or tapered (specifying base width), grounded or insulated, etc.),

(iii) Complete engineering details of top loading or sectionalizing, if any,

(iv) Height of vertical lead of each element in feet (height above base insulator or base, if grounded),

(v) Overall height in feet of each element above ground,

(vi) Details including sketches of ground system for each element (length and number of radials, dimensions of ground screen, if used, and depth buried) and outlines of property,

(vii) Ratio of fields from elements (identifying elements).

(2) Calculated horizontal (ground) plane field intensity patterns for each mode of operation plotted to the largest scale possible on standard letter-size polar coordinate paper (main engraving approximately 7″ x 10″) using only scale divisions and subdivisions having values of 1, 2, 2.5, or 5 times $10^{n\text{th}}$ and showing:

(i) Inverse field intensity at 1 mile and effective field intensity (RMS).

(ii) Direction true north shall be shown at zero azimuth.

(iii) Direction and distance to each existing station with which interference may be involved. (All directions shall be determined by accurate calculation or from Lambert Conformal Conic Projection Map such as United States Coast and Geodetic Survey Map, No. 3060a, or map of equal accuracy, and all distances shall be determined by accurate calculation or from United States Albers Equal Area Projection Map scale 1/2,500,000 or map of equal accuracy. These may be obtained from the United States Coast and Geodetic Survey and the United States Department of Interior, Geological Survey.)

(iv) Orientation of array with respect to true north and time phasing of fields from elements (specifying degrees leading [+] or lagging [−]) and space phasing of elements (identifying elements). (Space phasing should be given in feet as well as in degrees.)

(v) The location of all the minima in the pattern.

(3) Calculated field intensity vs. azimuth patterns for every 5 degrees of elevation through 60 degrees in those instances where radiation at angles above the horizontal plane is a pertinent factor in station allocation. These patterns may be plotted in polar or rectangular coordinates but shall be submitted one to a page. Minor lobe and null detail occurring between the 5 degree intervals need not be submitted.

(4) Data used in computing the patterns in subparagraphs (2) and (3) of this paragraph including:

(i) Formula used for calculating the horizontal patterns, sample calculations. (Derivation of formula if other than standard is used.)

(ii) All assumptions made and basis therefor, including electrical height, current distribution and efficiency of each element, and ground conductivity.

(iii) Complete tabulation of final calculated data used in plotting patterns, including data for determination of RMS value of pattern.

(5) Values of field intensity less than 10 percent of the effective field intensity of the patterns in subparagraphs (2) and (3) of this paragraph shown on an enlarged scale.

(6) In the event actual inverse distance field intensities expected to be determined in practice (that is, the values determined from actual measurements, particu-

larly in sharp nulls) are different from the calculated values in subparagraphs (2) and (3) of this paragraph, the maximum expected operating values (MEOV) as well as the calculated values shall be shown on both the full patterns and the enlarged sections.

(7) Any additional information required by the application form.

§ 3.151 Field intensity measurements to establish performance of directional antennas. (a) In addition to the information required by the license application form, the following showing must be submitted to indicate that the pattern obtained for each mode of directional operation is essentially the same as that predicted by the application and required by terms of the authorization and that any specific requirements set out are fully met:

(1) Horizontal field intensity pattern(s) showing the inverse field intensity at 1 mile and effective field intensity (RMS) as determined from field intensity measurements taken and analyzed in accordance with § 3.186 in at least the following directions:

(i) Those specified in the instrument of authorization.

(ii) In major lobes. Generally at least three radials are necessary to establish a major lobe; however, additional radials may be required.

(iii) Along sufficient number of other radials to establish the effective field. In the case of a relatively simple directional antenna pattern, approximately five radials in addition to those in subdivisions (i) and (ii) of this subparagraph are sufficient. However, when more complicated patterns are involved, that is, patterns having several or sharp lobes or nulls, measurements shall be taken along as many radials as may be necessary, to definitely establish the pattern(s).

(2) Pattern(s) plotted with direction true north as zero azimuth and showing the orientation of array with respect to true north, time and space phasing of elements, and both calculated and measured parameters. (Specify degrees leading [+] or lagging [−] and space phasing in feet as well as in degrees.)

(3) Pattern(s) plotted to the largest scale possible on standard letter-size polar coordinate paper (main engraving approximately 7″ x 10″) using divisions and subdivisions having values of 1, 2, 2.5, or 5 times 10^{nth} (no other values shall be used). All values of field intensity less than 10 percent of the RMS field intensity of the pattern shown on an enlarged scale.

(4) Complete tabulation of all data used in plotting the above pattern(s).

(5) The 25 and 5 mv/m field intensity contours and the nighttime interference-free contour, when the pattern is for nighttime operation, as well as auy other contours specified by the instrument of authorization, plotted on a map which has the largest practical scale. These contours need not be shown for distances greater than 20 miles from the antenna except that the field intensity contours on the far side of the business and residential areas of the city in which the main studio is located shall be shown. When the station is limited by interference within the 5 mv/m contour the latter contour need not be shown. In the event the 5 mv/m contour includes and extends beyond the city and beyond 20 miles, the highest signal intensity contour that entirely includes the city may be plotted in lieu of the 5 mv/m contour; in the event that the 5 mv/m contour does not include the city, the contour of highest signal intensity encompassing the city shall be plotted in addition to the 5 mv/m contour.

(6) The actual field intensity measured at each monitoring point established in the various directions for which a limiting field was specified in the instrument of authorization together with accurate and detailed description of each monitoring point together with ordinary snapshots, clear and sharp, taken with the field intensity meter in its measuring position and with the camera so located that its field of view takes in as many pertinent landmarks as possible. In addition, the directions for proceeding to each monitoring point together with a rough sketch or map upon which has been indicated the most accessible approaches to the monitoring points should be submitted.

§ 3.152 Field intensity measurements in support of applications or evidence at hearings. In the determination of interference, groundwave field intensity measurements will take precedence over theoretical values, provided such measurements are

properly taken and presented. When measurements of groundwave signal intensity are presented, they shall be sufficiently complete in accordance with § 3.186 to determine the field intensity at 1 mile in the pertinent directions for that station.

NOTE: The antenna resistance measurements required by § 3.186 need not be taken or submitted.

Standard Broadcast Technical Standards

§ 3.181 Introduction. (a) There are presented herein the Technical Standards giving interpretations and further considerations concerning the rules and regulations of the Federal Communications Commission governing standard broadcast stations. While rules and regulations form the basis of good engineering practice, these standards may go beyond the rules and regulations and set up engineering principles for consideration of various allocation problems. These standards have been approved by the Commission and thus are considered as reflecting the opinion of the Commission in all matters involved.

(b) The Technical Standards set forth herein are those deemed necessary for the construction and operation of standard broadcast stations to meet the requirements of technical regulations and for operation in public interest along technical lines not specifically enunciated in the regulations. These standards are based on the best engineering data available from evidence supplied in formal and informal hearings and extensive surveys conducted in the field by the Commission's personnel. Numerous informal conferences have been held with radio engineers, manufacturers of radio equipment and others for the guidance of the Commission in the formulation of these standards.

(c) These standards are complete in themselves and supersede any previous announcements or policies which may have been enunciated by the Commission on engineering matters concerning standard broadcast stations.

(d) While these standards provide for flexibility and set forth the conditions under which they are applicable, it is not expected that material deviation therefrom as to fundamental principles will be recognized unless full information is submitted as to the reasonableness of such departure and the need therefor.

(e) These standards will necessarily change as progress is made in the art, and accordingly it will be necessary to make revisions from time to time. The Commission will accumulate and analyze engineering data available as to the progress of the art so that its standards may be kept current with the developments.

§ 3.182 Engineering standards of allocation. (a) Sections 3.21 to 3.34, inclusive, govern allocation of facilities in the standard broadcast band of 535 to 1605 kc. Section 3.21 establishes three classes of channels in this band, namely, clear channels for the use of high-powered stations, regional channels for the use of medium-powered stations, and local channels for the use of low-powered stations. The classes and power of standard broadcast stations which will be assigned to the various channels are set forth in § 3.22. The classifications of the standard broadcast stations are as follows:

(1) Class I stations are dominant stations operating on clear channels with powers of not less than 10 or more than 50 kw. These stations are designed to render primary and secondary service over an extended area and at relatively long distances, hence have their primary service areas free from objectionable interference from other stations on the same and adjacent channels and secondary service areas free from objectionable interference from stations on the same channels. (The secondary service area of a Class I station is not protected from adjacent channel interference. However, if it is desired to make a determination of the area in which adjacent channel groundwave interference (10 kc removed) to skywave service exists, it may be considered as the area where the ratio of the desired 50% skywave of the Class I station to the undesired groundwave of a station 10 kc removed is 1 to 4.) From an engineering point of view, Class I stations may be divided into two groups and, hereafter, for the purpose of convenience, the two groups of Class I stations will be termed

Class I-A or I-B in accordance with the assignment to channels allocated by § 3.25(a) or (b).

(i) The Class I stations in group I-A are those assigned to the channels allocated by § 3.25(a), on which except to the extent therein provided, duplicate nighttime operation is not permitted, that is, no other station is permitted to operate on a channel with a Class I station of this group within the limits of the continental United States, excluding Alaska (the Class II stations assigned the channels operate limited time or daytime only), and during daytime the Class I station is protected to the 100 uv/m groundwave contour. Protection is given this class of station to the 500 uv/m groundwave contour from adjacent channel stations for both day and nighttime operations. The power of each such Class I station shall not be less than 50 kw.

(ii) The Class I stations in group I-B are those assigned to the channels allocated by § 3.25(b), on which duplicate operation is permitted, that is, other Class I or Class II stations operating unlimited time may be assigned to such channels. During nighttime hours of operation a Class I station of this group is protected to the 500 uv/m 50 percent skywave contour and during daytime hours of operation to the 100 uv/m groundwave contour from stations on the same channel. Protection is given to the 500 uv/m groundwave contour from stations on adjacent channels for both day and nighttime operations. The operating powers of Class I stations on these frequencies shall be not less than 10 kw nor more than 50 kw.

(2) Class II stations are secondary stations which operate on clear channels with powers not less than 0.25 kw or more than 50 kw. These stations are required to use a directional antenna or other means to avoid causing interference within the normally protected service areas of Class I stations or other Class II stations. These stations normally render primary service only, the area of which depends on the geographical location, power, and frequency. This may be relatively large but is limited by and subject to such interference as may be received from Class I stations. However, it is recommended that Class II stations be so located that the interference received from other stations will not limit the service area to greater than the 2500 uv/m groundwave contour nighttime and 500 uv/m groundwave contour daytime, which are the values for the mutual protection of this class of stations with other stations of the same class.

(3) Class III stations operate on regional channels and normally render primary service to the larger cities and the rural area contiguous thereto, and are subdivided into two classes:

(i) Class III-A stations which operate with powers not less than 1 kw or more than 5 kw are normally protected to the 2500 uv/m groundwave contour nighttime and the 500 uv/m groundwave contour daytime.

(ii) Class III-B stations which operate with powers not less than 0.5 kw, or more than 1 kw nighttime and 5 kw daytime are normally protected to the 4000 uv/m groundwave contour nighttime and 500 uv/m groundwave contour daytime.

(4) Class IV stations operate on local channels normally rendering primary service only to a city or town and the suburban or rural areas contiguous thereto with powers not less than 100 watts, nor more than 250 watts nighttime and 1 kilowatt daytime. The stations are normally protected to the 0.5 mv/m groundwave contour daytime. On local channels the separation required for the daytime protection shall also determine the nighttime separation. Where directional antennas are employed in the daytime by Class IV stations utilizing power in excess of 250 watts, the separations required shall in no case be less than those necessary to afford protection, assuming nondirectional operation with 100 watts or 250 watts, whichever is the nighttime power of the station. In no case will 250 watts nighttime operation be authorized to a station unable to operate omnidirectionally at 250 watts in the daytime. The actual nighttime limitation will be calculated.

NOTE: The following approximate method may be used. It is based on the assumption of 0.25 wavelength antenna height and 88 mv/m at one mile effective field for 250 watts power, using the 10% skywave field intensity curve of Figure 2 of § 3.190. Zones defined by circles of various radii specified below are drawn about the desired station and the interfering 10% skywave signal from each station in a given zone is considered to be the value

tabulated below. The effective interfering 10% skywave signal is taken to be the RSS value of all signals originating within these zones. (Stations beyond 500 miles are not considered.)

Zone	Inner radius	Outer radius	10 percent skywave signal (mv/m)
A	...	60	0.10
B	60	80	0.12
C	80	100	0.14
D	100	250	0.16
E	250	350	0.14
F	350	450	0.12
G	450	500	0.10

Where the power of the interfering station is not 250 watts, the 10% skywave signal should be adjusted by the square root of the ratio of the power to 250 watts.

(b) The class of any station is determined by the channel assignment, the power, and the field intensity contour to which it renders service free of interference from other stations as determined by these standards. No station will be permitted to change to a class normally protected to a contour of less intensity than the contour to which the station actually renders interference-free service. Any station of a class normally protected to a contour of less intensity than that to which the station actually renders interference-free service, will be automatically reclassified according to the class normally protected, the minimum consistent with its power and channel assignment. Likewise, any station to which the interference is reduced so that service is rendered to a contour normally protected for a higher class will be automatically changed to that class if consistent with its power and channel assignment.

(c) When it is shown that primary service is rendered by any station, beyond the normally protected contour, and when primary service to approximately 90% of the population (population served with adequate signal) of the area between the normally protected contour and the contour to which such station actually serves, is not supplied by any other station or stations carrying the same general program service, the contour to which protection may be afforded in such cases will be determined from the individual merits of the case under consideration.

(d) When a station is already limited by interference from other stations to a contour of higher value than that normally protected for its class, this contour shall be the established standard for such station with respect to interference from all other stations.

(e) The several classes of broadcast stations have in general three service areas; namely, primary, secondary, and intermittent service areas. (See § 3.11 for the definitions of primary, secondary, and intermittent service areas.) Class I stations render service to all three service areas. Class II stations render service to a primary area but the secondary and intermittent service areas may be materially limited or destroyed due to interference from other stations depending on the station assignments involved. Class III and IV stations usually have only primary service areas as interference from other stations generally prevents any secondary service and may limit the intermittent service area. However, complete intermittent service may be obtained in many cases depending on the station assignments involved.

(f) The signals necessary to render primary service to different types of service areas are as follows:

Area:	*Field intensity groundwave* [1]
City business or factory areas	10 to 50 mv/m
City residential areas	2 to 10 mv/m
Rural—all areas during winter or northern areas during summer	0.1 to 0.5 mv/m
Rural—southern areas during summer	0.25 to 1.0 mv/m

[1] See § 3.184 for curves showing distance to various groundwave field intensity contours for different frequency and ground conductivities and §3.183.

All these values are based on an absence of objectionable fading, either in changing intensity or selective fading, the usual noise level in the areas, and an absence of limiting interference from other broadcast stations. The values apply both day and night but generally fading or interference from other stations limits the primary service at night in all rural areas to higher values of field intensity than the values given. The Commission will authorize a directive antenna for a Class IV station for daytime operation only with power in excess of 250 watts. In computing the degrees of protection which such antenna will afford, the radiation produced by this antenna shall be assumed to be no less, in any direction, than that which would result from nondirectional operation, utilizing a single element of the directional array, with 100 watts or 250 watts, whichever is the nighttime power of the station.

NOTE: Standards have not been established for interference from atmospherics or man-made electric noise as no uniform method of measuring noise or static has been established. In any individual case objectionable interference from any source, except other broadcast signals, may be determined by comparing the actual noise interference reproduced during reception of a desired broadcast signal to the degree of interference that would be caused by another broadcast signal within 20 cycles of the desired signal and having a carrier ratio of 20 to 1 with both signals modulated 100 percent on peaks of usual programs. Standards of noise measurements and interference ratio for noise are now being studied.

(g) In determining the population of the primary service area, it may be considered that the following signals are satisfactory to overcome man-made noise in towns of the population given.

Population:	*Field intensity groundwave*
Up to 2,500	0.5 mv/m
2,500 to 10,000	2.0 mv/m
10,000 and up	Values given in paragraph (f) of this section

These values are subject to wide variations in individual areas and especial attention must be given to interference from other stations. The values are not considered satisfactory in any case for service to the city in which the main studio of the station is located. The values in paragraph (f) of this section shall apply except as individual consideration may determine.

(h) All classes of broadcast stations have primary service areas subject to limitation by fading and noise, and interference from other stations to the contours set out for each class of station.

(i) Secondary service is delivered in the areas where the sky wave for 50 percent or more of the time has a field intensity of 500 uv/m or greater. (The secondary service area of a Class I-A station should be considered as having this limit only for determination of service in comparison with other stations.) It is not considered that satisfactory secondary service can be rendered to cities unless the skywave approaches in value the groundwave required for primary service. The secondary service is necessarily subject to some interference and extensive fading whereas the primary service area of a station is subject to no objectionable interference or fading. Class I stations only are assigned on the basis of rendering secondary service.

NOTE: Standards have not been established for objectionable fading as such standards would necessarily depend on the receiver characteristics which have been changed considerably in this regard during the last several years. Selective fading causing audio distortion and the signal fading below the noise level are the objectionable characteristics of fading on modern design receivers. The AVC circuits in the better designed modern receivers in general maintain the audio output sufficiently constant to be satisfactory during most fading.

(j) The intermittent service is rendered by the groundwave and begins at the outer boundary of the primary service area and extends to the value of signal where it may be considered as having no further service value. This may be down to only a few microvolts in certain areas and up to several millivolts in other areas of high noise level, interference from other stations, or objectionable fading at night. The

intermittent service area may vary widely from day to night and generally varies from time to time as the name implies. Only Class I stations are assigned for protection from interference from other stations into the intermittent service area.

(k) Section 3.23 provides that the several classes of broadcast stations may be licensed to operate unlimited time, limited time, daytime, sharing time, and specified hours, with full explanation given in the section.

(l) Section 3.24 sets out the general requirements for obtaining an increase in facilities of a licensed station and for a new station. Section 3.24(b) concerns the matter of interference that may be caused by a new assignment or increase in facilities of an existing assignment.

(m) [Reserved.]

(n) [Reserved.]

(o) Objectionable interference from another broadcast station is the degree of interference produced when, at a specified field intensity contour with respect to the desired station, the field intensity of an undesired station (or the root-sum-square value of field intensities of two or more stations on the same frequency) exceeds for ten (10) percent or more of the time the values set forth in these standards. (The secondary service area of a Class I-A station should be considered as having this limit only for determination of service in comparison with other stations.)

(1) With respect to the root-sum-square values of interfering field intensities referred to herein, except in the case of Class IV stations on local channels, calculation is accomplished by considering the signals in order of decreasing magnitude, adding the squares of the values and extracting the square root of the sum, excluding those signals which are less than 50% of the RSS value of the higher signals already included.

(2) The RSS value will not be considered to be increased when a new interfering signal is added which is less than 50% of the RSS value of the interference from existing stations, and which at the same time is not greater than the smallest signal included in the RSS value of interference from existing stations.

(3) It is recognized that application of the above "50% exclusion" method of calculating the RSS interference may result in some cases in anomalies wherein the addition of a new interfering signal or the increase in value of an existing interfering signal will cause the exclusion of a previously included signal and may cause a decrease in the calculated RSS value of interference. In order to provide the Commission with more realistic information regarding gains and losses in service (as a basis for determination of the relative merits of a proposed operation) the following alternate method for calculating the proposed RSS values of interference will be employed wherever applicable.

(4) In the cases where it is proposed to add a new interfering signal which is not less than 50% of the RSS value of interference from existing stations or which is greater than the smallest signal already included to obtain this RSS value, the RSS limitation after addition of the new signal shall be calculated without excluding any signal previously included. Similarly, in cases where it is proposed to increase the value of one of the existing interfering signals which has been included in the RSS value, the RSS limitation after the increase shall be calculated without excluding the interference from any source previously included.

(5) If the new or increased signal proposed in such cases is ultimately authorized, the RSS values of interference to other stations affected will thereafter be calculated by the "50% exclusion" method without regard to this alternate method of calculation.

(6) Examples of RSS interference calculations:

(i) Existing interferences:

Station No. 1—1.0 mv/m.
Station No. 2—0.60 mv/m.
Station No. 3—0.59 mv/m.
Station No. 4—0.58 mv/m.

The RSS value from Nos. 1, 2 and 3 is 1.31 mv/m: therefore interference from No. 4 is excluded for it is less than 50% of 1.31 mv/m.

(ii) Station A receives interference from:

Station No. 1—1.0 mv/m.
Station No. 2—0.60 mv/m.
Station No. 3—0.59 mv/m.

It is proposed to add a new limitation—0.68 mv/m. This is more than 50% of 1.31 mv/m, the RSS value of Nos. 1, 2 and 3. The RSS value of Station No. 1 and of the proposed station would be 1.21 mv/m which is more than twice as large as the limitation from Station No. 2 or No. 3. However, under the above provision the new signal and the three existing interferences are nevertheless calculated for purposes of comparative studies, resulting in an RSS value of 1.47 mv/m. However, if the proposed station is ultimately authorized, only No. 1 and the new signal are included in all subsequent calculations for the reason that Nos. 2 and 3 are less than 50% of 1.21 mv/m, the RSS value of the new signal and No. 1.

(iii) Station A receives interference from:

Station No. 1—1.0 mv/m.
Station No. 2—0.60 mv/m.
Station No. 3—0.59 mv/m.

No. 1 proposes to increase the limitation it imposes on Station A to 1.21 mv/m. Although the limitations from stations Nos. 2 and 3 are less than 50% of the 1.21 mv/m limitation, under the above provision they are nevertheless included for comparative studies, and the RSS limitation is calculated to be 1.47 mv/m. However, if the increase proposed by Station No. 1 is authorized, the RSS value then calculated is 1.21 mv/m because Stations Nos. 2 and 3 are excluded in view of the fact that the limitations they impose are less than 50% of 1.21 mv/m.

(p) Objectionable interference from a station on the same channel shall be considered to exist to a station when, at the field intensity contour specified in paragraph (v) of this section with respect to the class to which the station belongs, the field intensity of an interfering station (or the root-sum-square value of the field intensities of two or more interfering stations) operating on the same channel, exceeds for ten (10) percent or more of the time the value of the permissible interfering signal set forth opposite such class in paragraph (v) of this section.

(q) Objectionable interference from a station on an adjacent channel shall be considered to exist to a station when, at the normally protected contour of a desired station, the field intensity of the ground wave of an undesired station operating on an adjacent channel (or the root-sum-square value of the field intensities of two or more such undesired stations operating on the same adjacent channel) exceeds a value specified in paragraph (w) of this section.

(r) For the purpose of estimating the coverage and the interfering effects of stations in the absence of field intensity measurements, use shall be made of Figure 8 of § 3.190 which describes the estimated effective field for one kilowatt power input of simple vertical omnidirectional antennas of various heights with ground systems of at least 120 one-quarter wavelength radials. Certain approximations, based on the curve or other appropriate theory, may be made when other than such antennas and ground systems are employed, but in any event the effective field to be employed shall not be less than given in the following:

Class of station:	*Effective field*
I	225 mv/m
II and III	175 mv/m
IV	150 mv/m

In case a directional antenna is employed, the interfering signal of a broadcasting station will vary in different directions, being greater than the above values in certain directions and less in others, depending upon the design and adjustment of the directional antenna system. To determine the interference in any direction the measured or calculated radiated field (unabsorbed field intensity at 1 mile from the array)

must be used in conjunction with the appropriate propagation curves. (See § 3.185 for further discussion and solution of a typical directional antenna case.)

(s) The existence or absence of objectionable groundwave interference from stations on the same or adjacent channels shall be determined by actual measurements made according to the method hereinafter described, or, in the absence of such measurements, by reference to the propagation curves of § 3.184. The existence or absence of objectionable interference due to skywave propagation shall be determined by reference to the appropriate propagation curves in Figure 1 or Figure 2 of § 3.190.

(t) In computing the fifty (50) percent skywave field intensity values and the ten (10) percent skywave field intensity values of a station on a clear channel, use shall be made of the appropriate graph set forth in Figure 1 of § 3.190 entitled "Average Skywave Field Intensity" (corresponding to the second hour after sunset at the recording station). These graphs are drawn for a radiated field of 100 mv/m at 1 mile in the horizontal plane from a 0.311 wavelength antenna. In computing the ten (10) percent skywave field intensity of a regional channel station, use shall be made of the appropriate curve in Figure 2 of § 3.190 entitled "10 percent Skywave Signal Range." This graph is drawn for a radiated field of 100 mv/m at 1 mile at the vertical angle pertinent to transmission by one reflection. This curve supersedes the ten (10) percent skywave curve of Figure 1 of § 3.190, only for regional and local channels at the present time. Adoption of revised skywave curves for use on clear channels will await the outcome of the Clear Channel Hearing (Docket No. 6741).

(u) The distance to any specified groundwave field intensity contour for any frequency may be determined from the appropriate curves in § 3.184 entitled "Ground Wave Field Intensity vs. Distance."

(v) Protected service contours and permissible interference signals for broadcast stations are as follows:

Class of station	Class of channel used	Permissible power	Signal intensity contour of area protected from objectionable interference [1]		Permissible interfering signal on same channel [2]	
			Day [3]	Night	Day [3]	Night
I-A	Clear	50 kw	SC 100 uv/m. AC 500 uv/m.	Not duplicated [7]	5 uv/m	Not duplicated.
I-B	Clear	10 kw. to 50 kw	SC 100 uv/m. AC 500 uv/m.	500 uv/m. (50% skywave).	5 uv/m	25 uv/m.
II	Clear	0.25 kw. to 50 kw.	500 uv/m	2500 uv/m [5] (groundwave)	25 uv/m	125 uv/m.
III-A	Regional	1 kw. to 5 kw.	500 uv/m	2500 uv/m (groundwave)	25 uv/m	125 uv/m.
III-B	Regional	0.5 to 1 kw. night, and 5 kw. day.	500 uv/m	4000 uv/m (groundwave)	25 uv/m	200 uv/m.
IV	Local	0.1 kw. to 0.25 kw. night and 0.1 to 1 kw. day	500 uv/m	Not prescribed [6]	25 uv/m	Not prescribed.[6]

[1] When a station is already limited by interference from other stations to a contour of higher value than that normally protected for its class, this contour shall be the established standard for such station with respect to interference from all other stations.

[2] For adjacent channels see paragraph (w) of this section.

[3] Groundwave.

[4] Skywave field intensity for 10 percent or more of the time.

[5] These values are with respect to interference from all stations except Class I-B, which stations may cause interference to a field intensity contour of higher value. However, it is recommended that Class II stations be so located that the interference received from Class I-B stations will not exceed these values. If the Class II stations are limited by Class I-B stations to higher values, then such values shall be the established standard with respect to protection from all other stations.

[6] See paragraph (a)(4) of this section.

[7] On the frequency 770 kc, two Class I stations may be assigned.

SC = same channel.

AC = Adjacent channel.

(w) The following table is to be used for determining the minimum ratio of the field intensity of a desired to an undesired signal for interference-free service. In the case of a desired groundwave signal interfered with by two or more skywave signals on the same frequency, the RSS value of the latter is used. From the table, it is apparent that in many cases stations operating on channels 10 and 20 kilocycles apart may be operated with antenna systems side by side or otherwise in proximity

Frequency separation of desired to undesired signals—	Desired groundwave to—		Desired 50 percent skywave to undesired 10 percent skywave
	Undesired groundwave	Undesired 10 percent skywave	
0 kc	20:1	20:1	20:1
10 kc	1:1	1:5	(1)
20 kc	1:30	....	....

[1] The secondary service area of a Class I station is not protected from adjacent channel interference. However, if it is desired to make a determination of the area in which adjacent channel groundwave interference (10 kc. removed) to skywave service exists, it may be considered as the area where the ratio of the desired 50 percent skywave of the Class I station to the undesired groundwave of a station 10 kc. removed is 1 to 4.

without any indications of interference if the interference is defined only in terms of permissible ratios listed in this paragraph. As a practical matter, serious interference problems may arise when two or more stations with the same general service area are operated on channels 10, 20 and 30 kilocycles apart.

(x) Two stations, one with a frequency twice that of the other, should not be assigned in the same groundwave service area unless special precautions are taken to avoid interference from the second harmonic of the lower frequency. In selecting a frequency, consideration should be given to the fact that occasionally the frequency assignment of two stations in the same area may bear such a relation to the intermediate frequency of some broadcast receivers as to cause so-called "image" interference. However, since this can usually be rectified by readjustment of the intermediate frequency of such receivers, the Commission in general will not take this kind of interference into consideration in allocation problems.

(y) Two stations operating with synchronized carriers and carrying the identical program will have their groundwave service subject to some distortion in areas where the signals from the two stations are of comparable intensity. For the purpose of estimating coverage of such stations areas in which the signal ratio is between 1 to 2 and 2 to 1 will not be considered as having satisfactory service.

NOTE: Two stations are considered to be operated synchronously when the carriers are maintained within one-fifth of a cycle per second of each other and they transmit identical programs.

§ 3.183 **Groundwave signals.** (a) Interference that may be caused by a proposed assignment or an existing assignment during daytime should be determined, when possible, by measurements on the frequency involved or on another frequency over the same terrain and by means of the curves in § 3.184 entitled "Ground Wave Field Intensity versus Distance."

(b) In determining interference based upon field intensity measurements, it is necessary to do the following: First, establish the outer boundary of the protected service area of the desired station in the direction of the station that may cause interference to it. Second, at this boundary, measure the interfering signal from the undesired station. The ratio of the desired to the undesired signal given in § 3.182(w) should be applied to the measured signals and if the required ratio is observed, no objectionable interference is foreseen. When measurements of both the desired and undesired stations are made in one area to determine the point where objectionable interference from groundwave signals occur or to establish other pertinent contours, several measurements of each station shall be made within a few miles of this point or contour. The effective field of the antennas in the pertinent directions of the stations must be established and all measurements must be made in accordance with § 3.186.

(c) In all cases where measurements taken in accordance with the requirements are not available, the groundwave intensity must be determined by means of the

pertinent map of ground conductivity and the groundwave curves of field intensity versus distance. The conductivity of a given terrain may be determined by measurements of any broadcast signal traversing the terrain involved. Figures M3 and R3 of § 3.190 show the conductivity throughout the United States by general areas of reasonably uniform conductivity. When it is clear that only one conductivity value is involved, Figure R3 of § 3.190, which is a replica of Figure M3 and contained in these standards, may be used; in all other situations Figure M3 must be employed. It is recognized that in areas of limited size or over a particular path, the conductivity may vary widely from the values given; therefore, these maps are to be used only when accurate and acceptable measurements have not been made. (For determinations of interference and service requiring a knowledge of ground conductivities in Canada and Mexico, Appendix H to the North American Regional Broadcasting Agreement, Washington, D.C., 1950, may be used. Where different conductivities appear in the maps of the several countries on different sides of the border not explained by geophysical cleavages, such cleavages are to be considered as real. A uniform ground conductivity of 10 millimhos per meter may be assumed for Cuba.)

NOTE: Figure M3 which is incorporated in these Standards by reference, was derived by indicating ground conductivity values in the United States on the United States Albers equal area projection map (based on standard parallels 29½° and 45½°; North American datum; scale 1/2,500,000). Figure M3, consisting of two sections, an eastern and a western half, may be obtained from the Superintendent of Documents, Washington, D.C.

(d) Example of determining interference by the graphs in § 3.184:

It is desired to find whether objectionable interference exists between a 5 kw Class III station on 990 kc and a 1 kw Class III station on 1000 kc, the stations being separated by 130 miles; both stations use nondirectional antennas having such height as to produce an effective field for 1 kw of 175 mv/m. (See §3.185 in case of use of directional antennas.) The conductivity at each station and of the intervening terrain is determined as 6 mmhos/m. The protection to Class III stations during daytime is to the 500 uv/m contour. The distance to the 500 uv/m groundwave contour of the 1 kw station is determined by the use of the appropriate curve in § 3.184, Graph 12. Since the curve is plotted for 100 mv/m at a mile, to find the distance to the 500 uv/m contour of the 1 kw station, it is necessary to determine the distance to the 285 uv/m contour $\left(\frac{100 \times 500}{175} = 285\right)$. From the appropriate curve, the estimated radius of the service area for the desired station is found to be 39.5 miles. Subtracting this distance from the distance between the two stations leaves 90.5 miles for the interfering signal to travel. From the above curve it is found that the signal from the 5 kw station at this distance would be 158 uv/m. Since a one to one ratio applies for stations separated by 10 kc, the undesired signal at that point can have a value up to 500 uv/m without objectionable interference. If the undesired signal had been found to be greater than 500 uv/m, then objectionable interference would exist. For other channel separations, the appropriate ratio of desired to undesired signal should be used.

(e) Where a signal traverses a path over which different conductivities exist, the distance to a particular groundwave field intensity contour shall be determined by the use of the equivalent distance method. Reasonably accurate results may be expected in determining field intensities at a distance from the antenna by application of the equivalent distance method when the unattenuated field of the antenna, the various ground conductivities and the location of discontinuities are known. This method considers a wave to be propagated across a given conductivity according to the curve for a homogeneous earth of that conductivity. When the wave crosses from a region of one conductivity into a region of a second conductivity, the equivalent distance of the receiving point from the transmitter changes abruptly but the field intensity does not. From a point just inside the second region the transmitter appears to be at that distance where, on the curve for a homogeneous earth of the second conductivity, the field intensity equals the value that occurred just across the boundary in the first region. Thus the equivalent distance from the receiving point to the transmitter may be either greater or less than the actual distance. An imaginary transmitter is considered to exist at that equivalent distance. This technique is not

intended to be used as a means of evaluating unattenuated field or ground conductivity by the analysis of measured data. The method to be employed for such determinations is set out in § 3.186.

(f) An example of the use of the equivalent distance method follows:

It is desired to determine the distance to the 0.5 mv/m and 0.025 mv/m contours of a station on a frequency of 1000 kc with an inverse distance field of 100 mv/m at one mile being radiated over a path having a conductivity of 10 mmhos/m for a distance of 15 miles, 5 mmhos/m for the next 20 miles and 15 mmhos/m thereafter. By the use of the appropriate curves in § 3.184--Graph 12, it is seen that at a distance of 15 miles on the curve for 10 mmhos/m the field is 3.45 mv/m. The equivalent distance to this field intensity for a conductivity of 5 mmhos/m is 11 miles. Continuing on the propagation curve for the second conductivity, the 0.5 mv/m contour is encountered at a distance of 27.9 miles from the imaginary transmitter. Since the imaginary transmitter was 4 miles nearer (15 − 11 miles) to the 0.5 mv/m contour, the distance from the contour to the actual transmitter is 31.9 miles (27.9 + 4 miles). The distance to the 0.025 mv/m contour is determined by continuing on the propagation curve for the second conductivity to a distance of 31 miles (11 + 20 miles), at which point the field is read to be 0.39 mv/m. At this point the conductivity changes to 15 mmhos/m and from the curve relating to that conductivity, the equivalent distance is determined to be 58 miles—27 miles more distant than would obtain had a conductivity of 5 mmhos/m prevailed. Using the curve representing the conductivity of 15 mmhos/m the 0.025 mv/m contour is determined to be at an equivalent distance of 172 miles. Since the imaginary transmitter was considered to be 4 miles closer at the first boundary and 27 miles farther at the second boundary, the net effect is to consider the imaginary transmitter 23 miles (27 − 4 miles) more distant than the actual transmitter; thus the actual distance to the 0.025 mv/m contour is determined to be 149 miles (172 − 23 miles).

§ 3.184 Groundwave field intensity charts. (a) Graphs 1–19A show the computed values of groundwave field intensity as a function of the distance from the transmitting antenna. The groundwave field intensity is here considered to be that part of the vertical component of the electric field received on the ground which has not been reflected from the ionosphere nor the troposphere. These 20 charts were computed for 20 different frequencies, a dielectric constant of the ground equal to 15 for land and 80 for sea water (referred to air as unity) and for the ground conductivities (expressed in mmhos/m) given on the curves. The curves show the variation of the groundwave field intensity with distance to be expected for transmission from a short vertical antenna at the surface of a uniformly conducting spherical earth with the ground constants shown on the curves; the curves are for an antenna power and efficiency such that the inverse distance field is 100 mv/m at 1 mile. The curves are valid at distances large compared to the dimensions of the antenna for other than short vertical antennas.

(b) The inverse distance field (100 mv/m divided by the distance in miles) corresponds to the groundwave field intensity to be expected from an antenna with the same radiation efficiency when it is located over a perfectly conducting earth. To determine the value of the groundwave field intensity corresponding to a value of inverse distance field other than 100 mv/m at 1 mile, simply multiply the field intensity as given on these charts by the desired value of inverse distance field at 1 mile divided by 100; for example, to determine the groundwave field intensity for a station with an inverse distance field of 1700 mv/m at 1 mile, simply multiply the values given on the charts by 17. The value of the inverse distance field to be used for a particular antenna depends upon the power input to the antenna, the nature of the ground in the neighborhood of the antenna, and the geometry of the antenna. For methods of calculating the interrelations between these variables and the inverse distance field, see "The Propagation of Radio Waves over the Surface of the Earth and in the Upper Atmosphere," Part II, by Mr. K. A. Norton, Proc. I.R.E., Vol. 25, September 1937, pp. 1203–1236.

(c) At sufficiently short distances (say less than 35 miles), such that the curvature of the earth does not introduce an additional attenuation of the waves, the graphs were computed by means of the plane earth formulas given in the paper, "The Propagation of Radio Waves over the Surface of the Earth and in the Upper At-

mosphere," Part I, by Mr. K. A. Norton, Proc. I.R.E., Vol. 24, October 1936, pp. 1367–1387. At larger distances the additional attenuation of the waves which is introduced by the effect of the curvature of the earth was introduced by the methods outlined in the papers, "The Diffraction of Electromagnetic Waves from an Electrical Point Source round a Finitely Conducting Sphere, with Applications to Radiotelegraphy and the Theory of the Rainbow," by Balth van der Pol and H. Bremmer, Part I, Phil. Mag., Vol. 24, p. 141, July 1937, Part II, Phil. Mag., Vol. 24, p. 825, Suppl., November 1937, "Ergebnisse einer Theorie ueber die Fortpflanzung elektron magnetischer Wellen ueber eine Kugel endlicher Leitfahigkeit," by Balth van der Pol and H. Bremmer, Hochfrequenztechnik und Elektroakustik, Band 51, Heft 6, June 1938, "Further Note on the Propagation of Radio Waves over a Finitely Conducting Spherical Earth," by Balth van der Pol and H. Bremmer, Phil. Mag., Vol. 27, p. 261, March 1939. In order to allow for the refraction of the radio waves in the lower atmosphere due to the variation of the dielectric constant of the air with height above the earth, a radius of the earth equal to 4/3 the actual radius was used in the computations for the effect of the earth's curvature in the manner suggested by C. R. Burrows, "Radio Propagation over Spherical Earth," Proc. I.R.E., May 1935; i.e., the distance corresponding to a given value of attenuation due to the curvature of the earth in the absence of air refraction was multiplied by the factor $(4/3)^{2/3} = 1.21$. The amount of this refraction varies from day to day and from season to season, depending on the air mass conditions in the lower atmosphere. If k denotes the ratio between the equivalent radius of the earth and the true radius, the following table gives the values of k for several typical air masses encountered in the United States.

Air mass type	k	
	Summer	Winter
Tropical Gulf—T_r	1.53	1.43
Polar Continental—P_c	1.31	1.25
Superior—S	1.25	1.25
Average	1.33	

It is clear from this table that the use of the average value of $k = 4/3$ is justified in obtaining a single correction for the systematic effects of atmospheric refraction.

(d) Provided the value of the dielectric constant is near 15, the curves of Graphs 1–19A may be compared with experimental data to determine the appropriate values of the ground conductivity and of the inverse distance field intensity at 1 mile. This is accomplished simply by plotting the measured fields on transparent log-log graph paper similar to that used for Graphs 1–19A and superimposing this chart over the graph corresponding to the frequency involved. The log-log graph sheet is then shifted vertically until the best fit is obtained with one of the curves on the graph; the intersection of the inverse distance line on the graph with the 1-mile abscissa on the chart determines the inverse distance field intensity at 1 mile. For other values of dielectric constant, the following procedure may be used for a determination of the dielectric constant of the ground, conductivity of the ground and the inverse distance field intensity at 1 mile. Graph 20 gives the relative values of groundwave field intensity over a plane earth as a function of the numerical distance p and phase angle b. On graph paper with coordinates similar to those of Graph 20, plot the measured values of field intensity as ordinates versus the corresponding distances from the antenna expressed in miles as abscissae. The data should be plotted only for distances greater than one wavelength (or, when this is greater, five times the vertical height of the antenna in the case of a single element, i.e., nondirectional antenna or 10 times the spacing between the elements of a directional antenna) and for distances less than $50/f_{mc}^{1/3}$ miles (i.e., 50 miles at 1 mc). Then, using a light box, place the sheet with the data plotted on it over the sheet with the curves of Graph 20 and shift the data sheet vertically and horizontally (making sure that the

vertical lines on both sheets are parallel) until the best fit with the data is obtained with one of the curves on Graph 20. When the two sheets are properly lined up, the value of the field intensity corresponding to the intersection of the inverse distance line of Graph 20 with the 1 mile abscissa on the data sheet is the inverse distance field intensity at 1 mile, and the values of the numerical distance at 1 mile, p_1, and of b are also determined. Knowing the values of b and p_1 (the numerical distance at 1 mile), we may substitute in the following approximate formulas to determine the appropriate values of the ground conductivity and dielectric constant.

$$x \cong \frac{\pi}{p} \cdot (R/\lambda)_1 \cdot \cos b \tag{1}$$

$(R/\lambda)_1$ = number of wavelengths in 1 mile.

$$\sigma_{emu} = \frac{x f_{mc}}{17.9731} \cdot 10^{-14} \tag{2}$$

σ_{emu} = conductivity of the ground expressed in electromagnetic units.

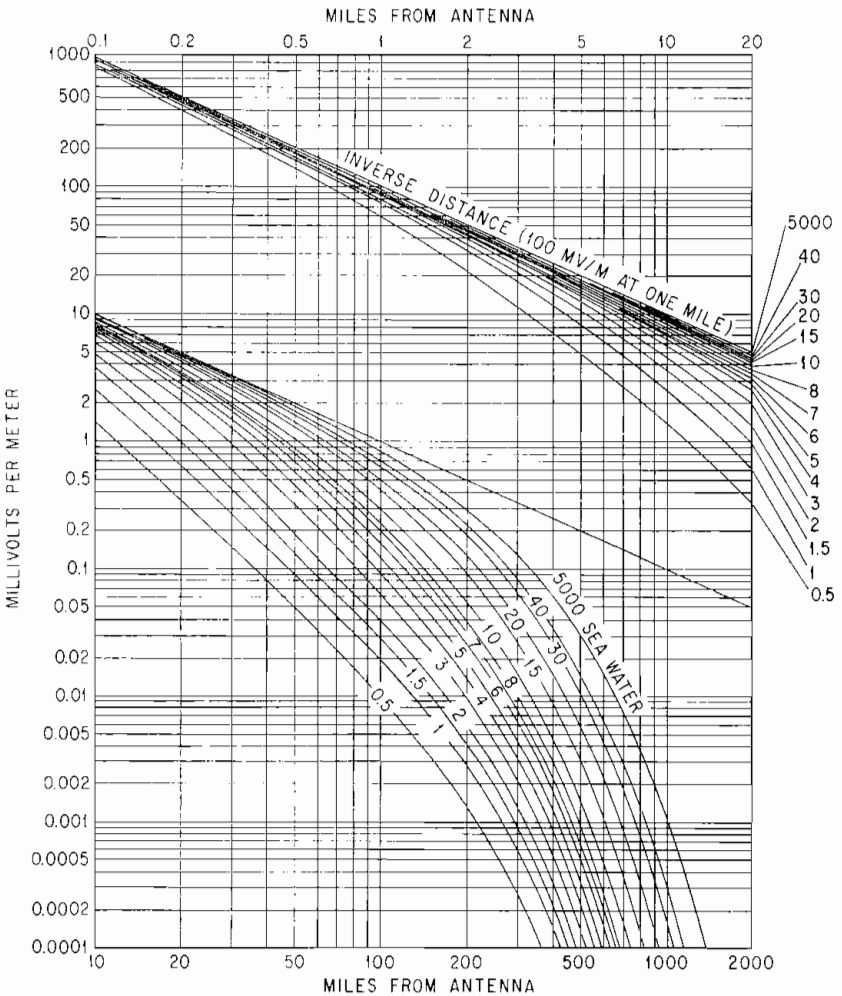
f_{mc} = frequency expressed in megacycles.

$$\epsilon \cong x \tan b - 1 \tag{3}$$

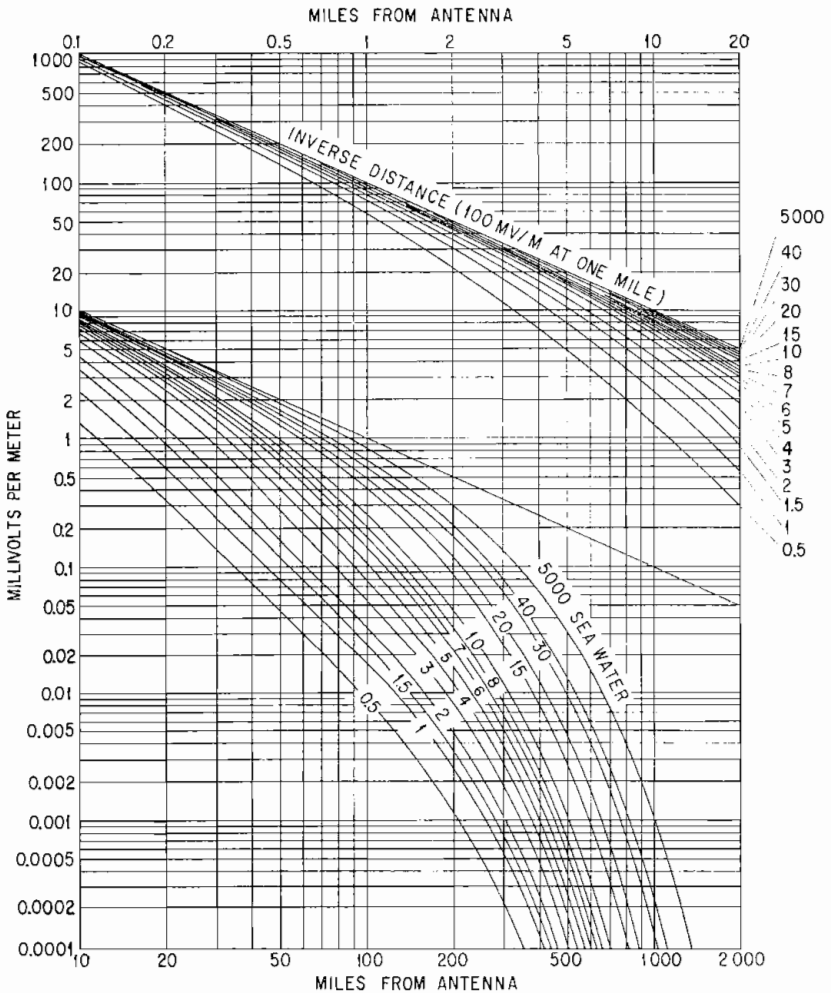
ϵ = dielectric constant of the ground referred to air as unity.

First solve for x by substituting the known values of p_1, $(R/\lambda)_1$, and cos b in equation (1). Equation (2) may then be solved for σ and equation (3) for ϵ. At distances greater than $50/f_{mc}^{1/3}$ miles the curves of Graph 20 do not give the correct relative values of field intensity since the curvature of the earth weakens the field more rapidly than these plane earth curves would indicate. Thus, no attempt should be made to fit experimental data to these curves at the larger distances.

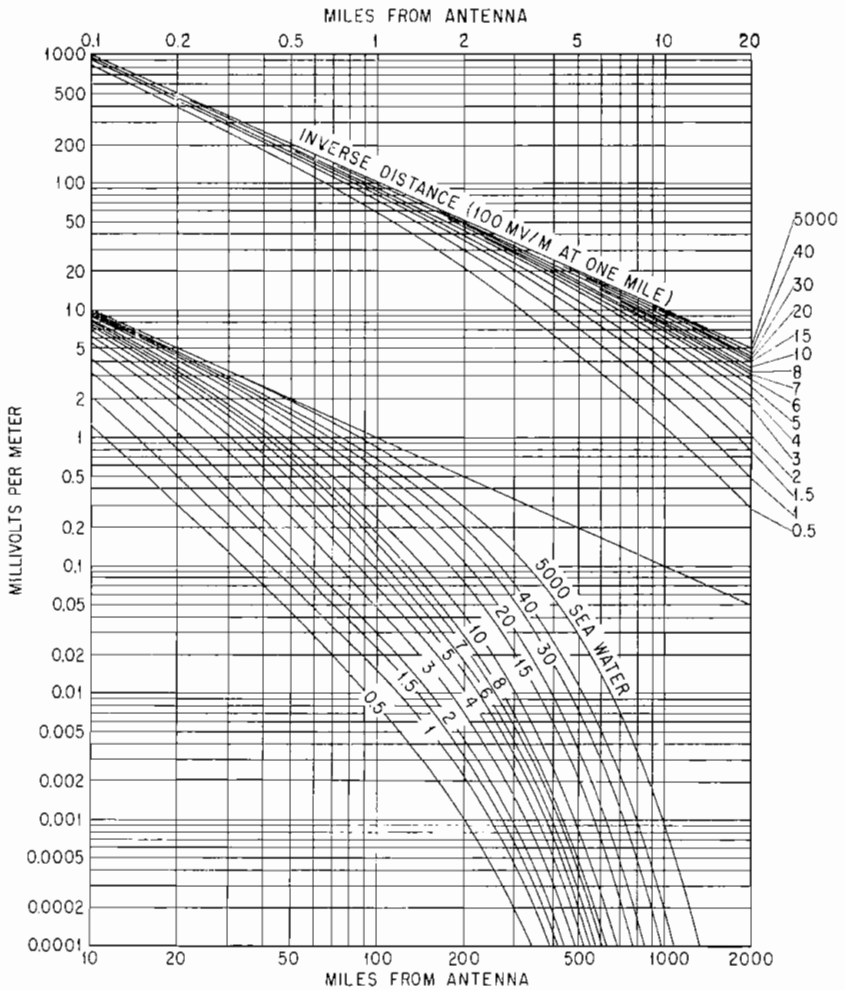
(e) At sufficiently short distances (say less than 35 miles at broadcast frequencies), such that the curvature of the earth does not introduce an additional attenuation of the waves, the curves of Graph 20 may be used for determining the ground wave field intensity for transmitting and receiving antennas at the surface of the earth for any radiated power, frequency, or set of ground constants in the following manner: First, lay off the straight inverse distance line corresponding to the power radiated on transparent log-log graph paper similar to that of Graph 20, labelling the ordinates of the chart in terms of field intensity, and the abscissae in terms of distance. Next, by means of the formulas given on Graph 20, calculate the value of the numerical distance, p, at 1 mile, and the value of b. Then superimpose the log-log chart over Graph 20, shifting it vertically until the inverse distance lines on both charts coincide and shifting it horizontally until the numerical distance at 1 mile on Graph 20 coincides with 1 mile on the log-log graph paper. The curve of Graph 20 corresponding to the calculated value of b is then traced on the log-log graph paper giving the field intensity versus distance in miles.



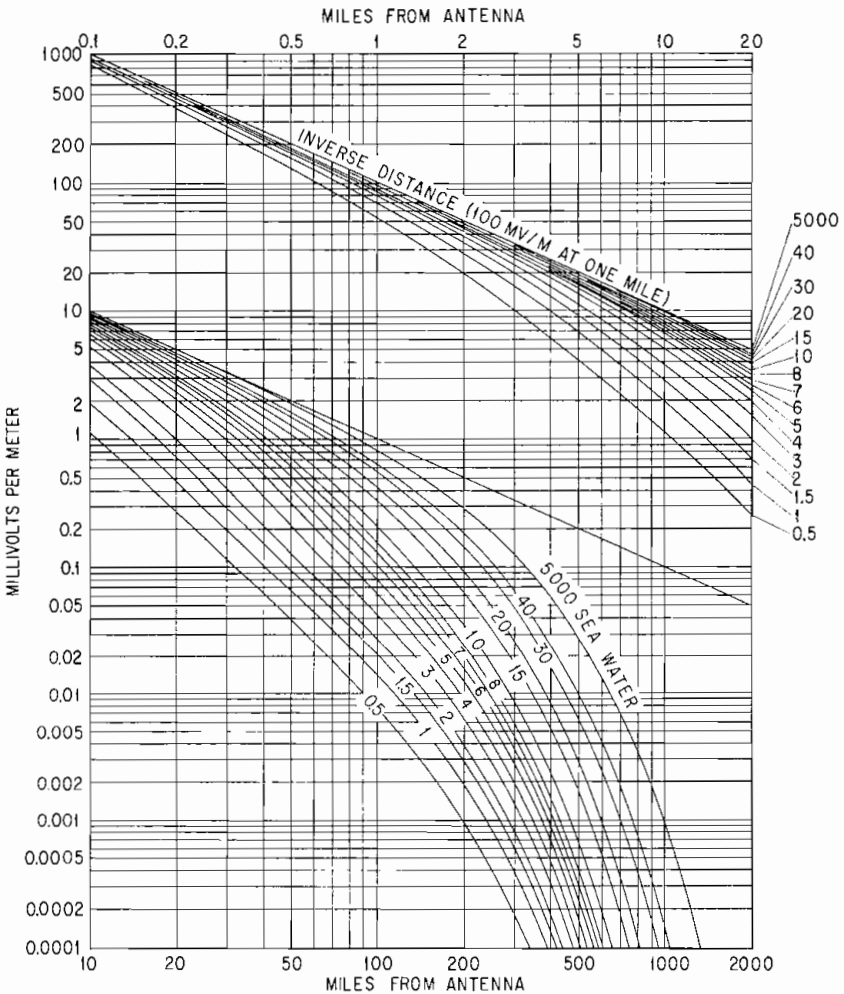
GRAPH 1. Groundwave field intensity vs. distance, 540–560 kc. Computed for 550 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



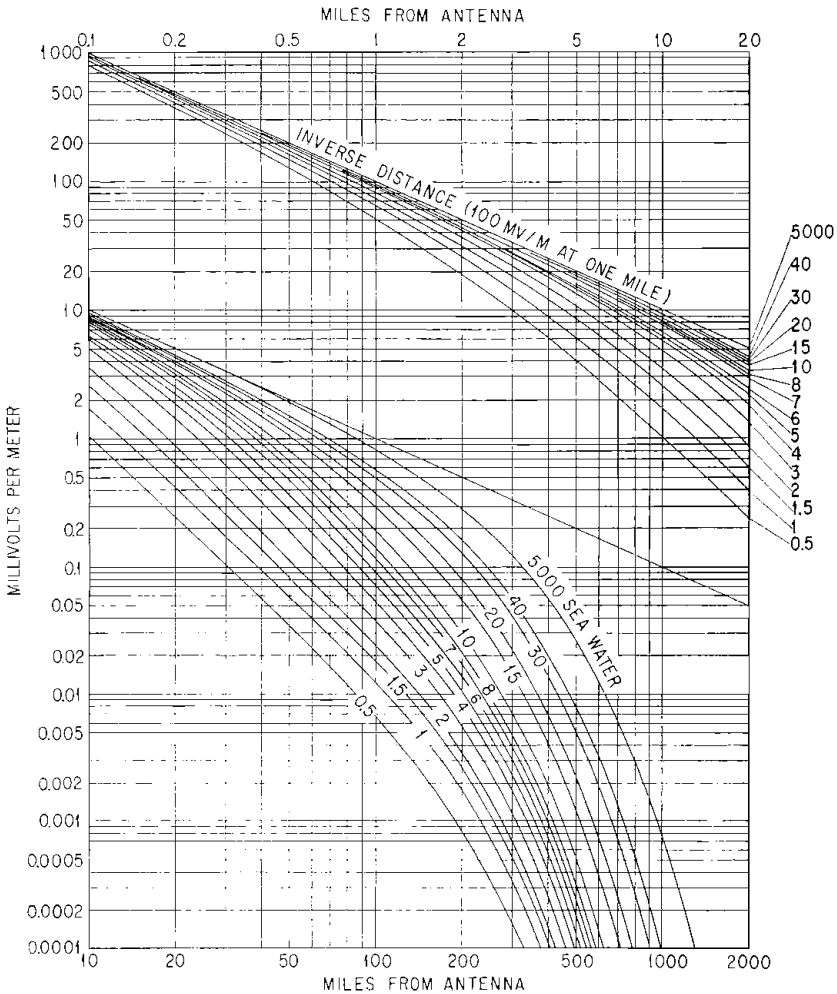
GRAPH 2. Groundwave field intensity vs. distance, 570–590 kc. Computed for 580 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



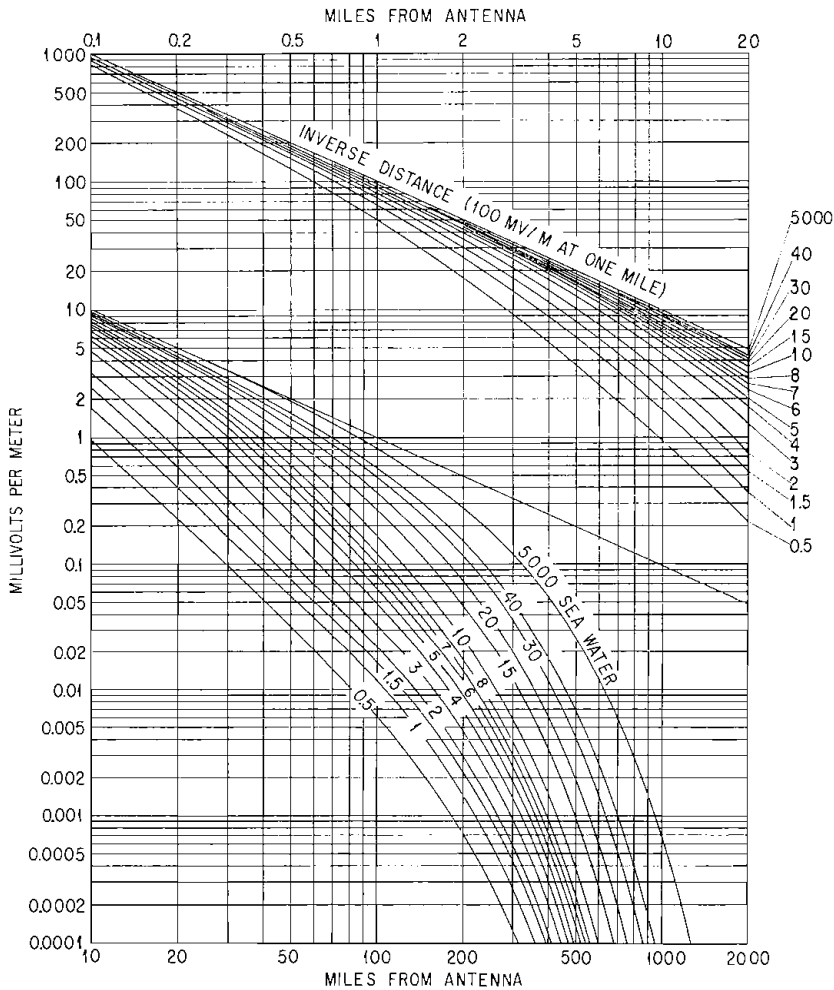
GRAPH 3. Groundwave field intensity vs. distance, 600–620 kc. Computed for 610 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



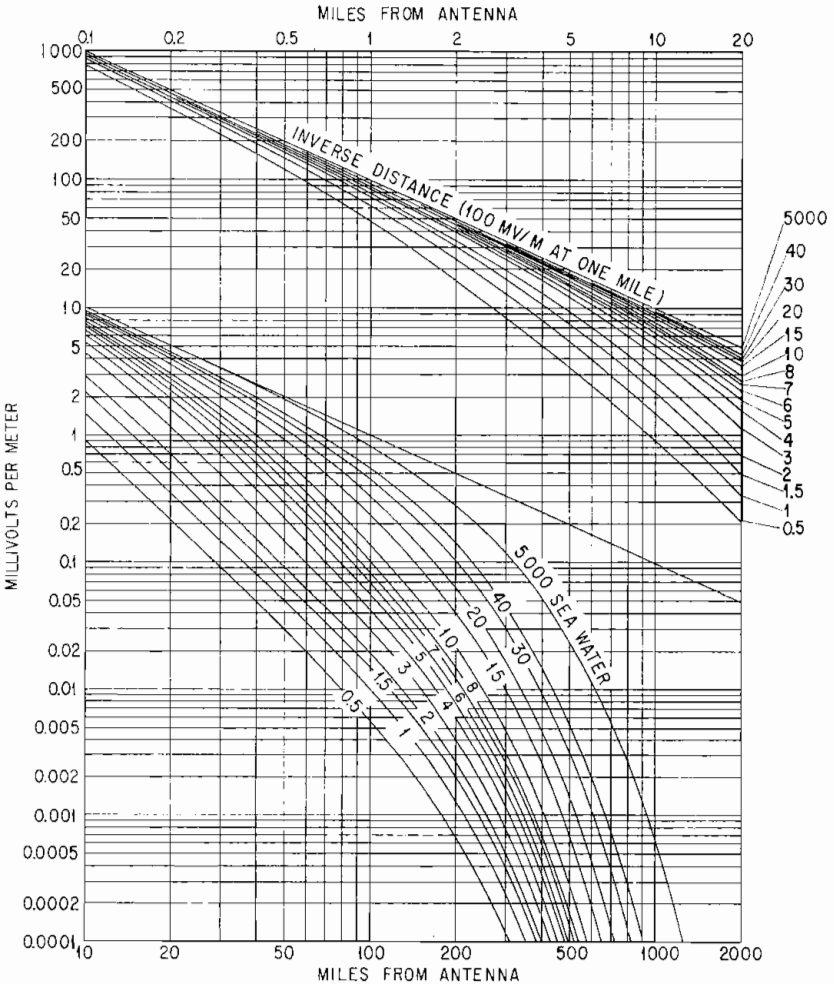
GRAPH 4. Groundwave field intensity vs. distance, 630-650 kc. Computed for 640 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



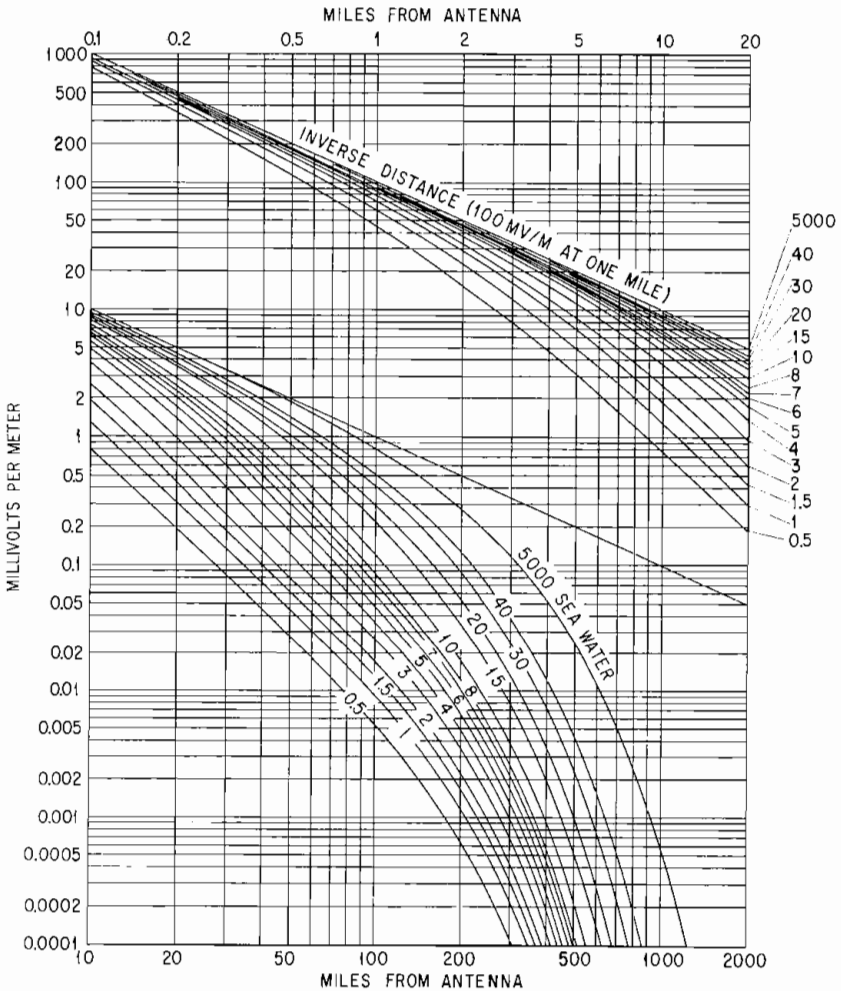
GRAPH 5. Groundwave field intensity vs. distance, 660–680 kc. Computed for 670 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



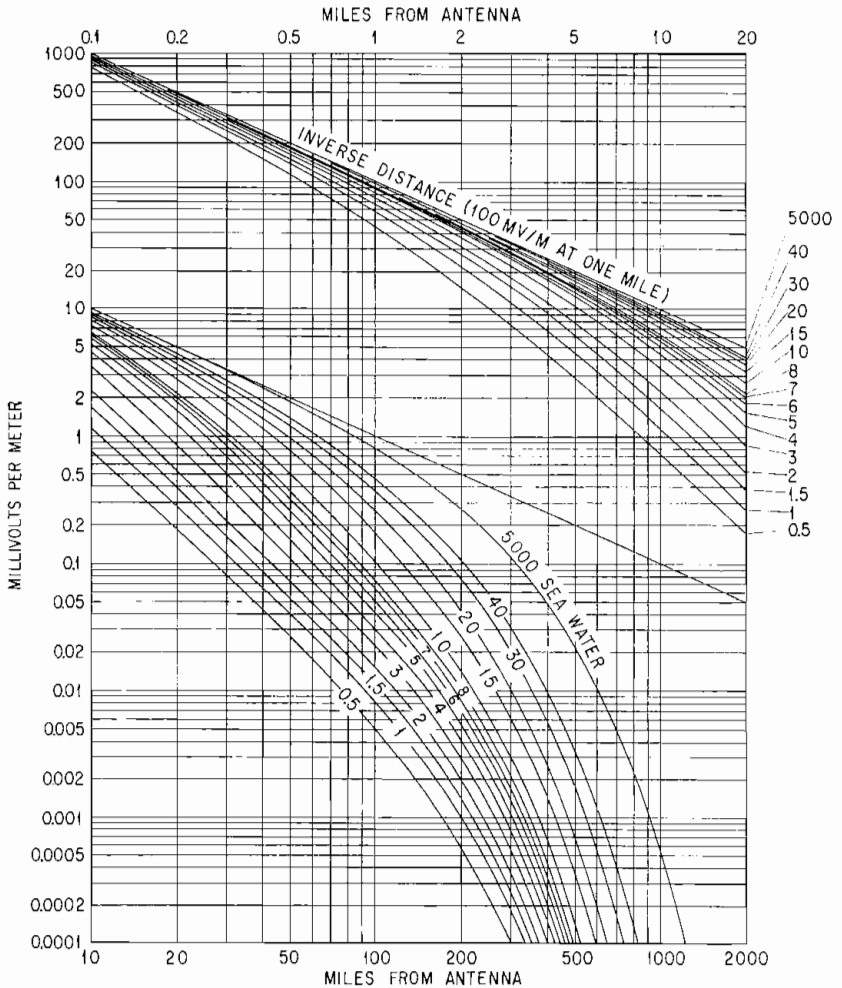
GRAPH 6. Groundwave field intensity vs. distance, 690–710 kc. Computed for 700 kc. $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



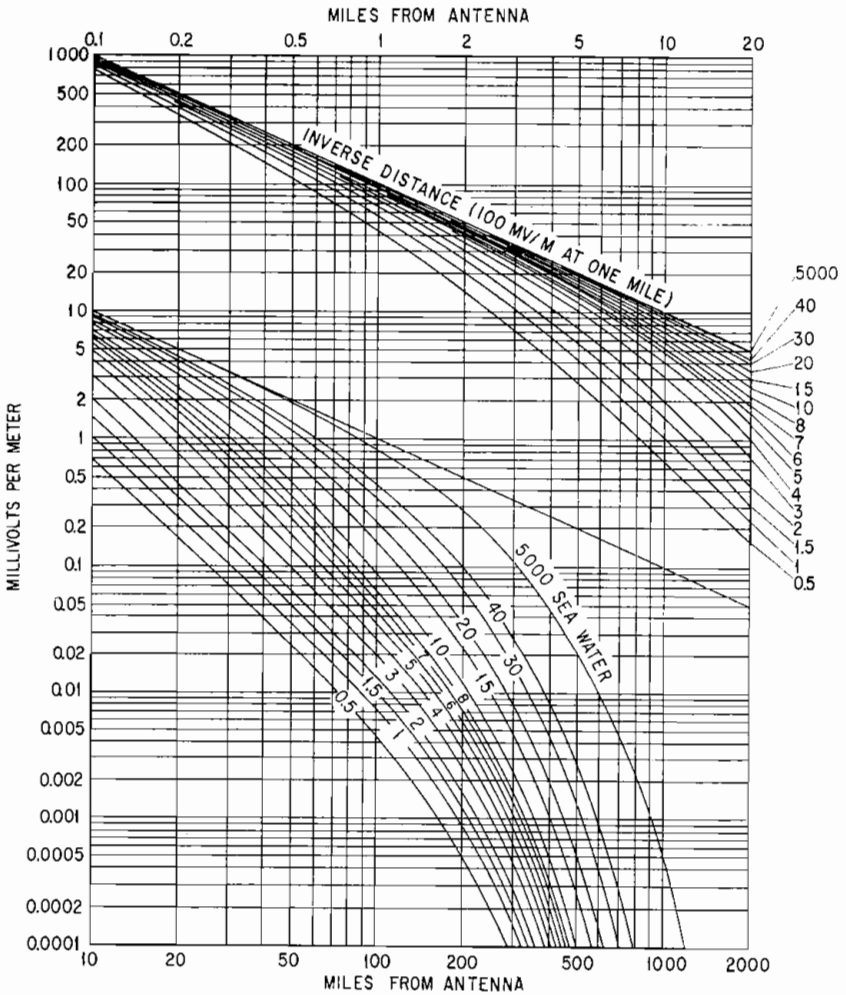
GRAPH 7. Groundwave field intensity vs. distance, 720–760 kc. Computed for 740 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



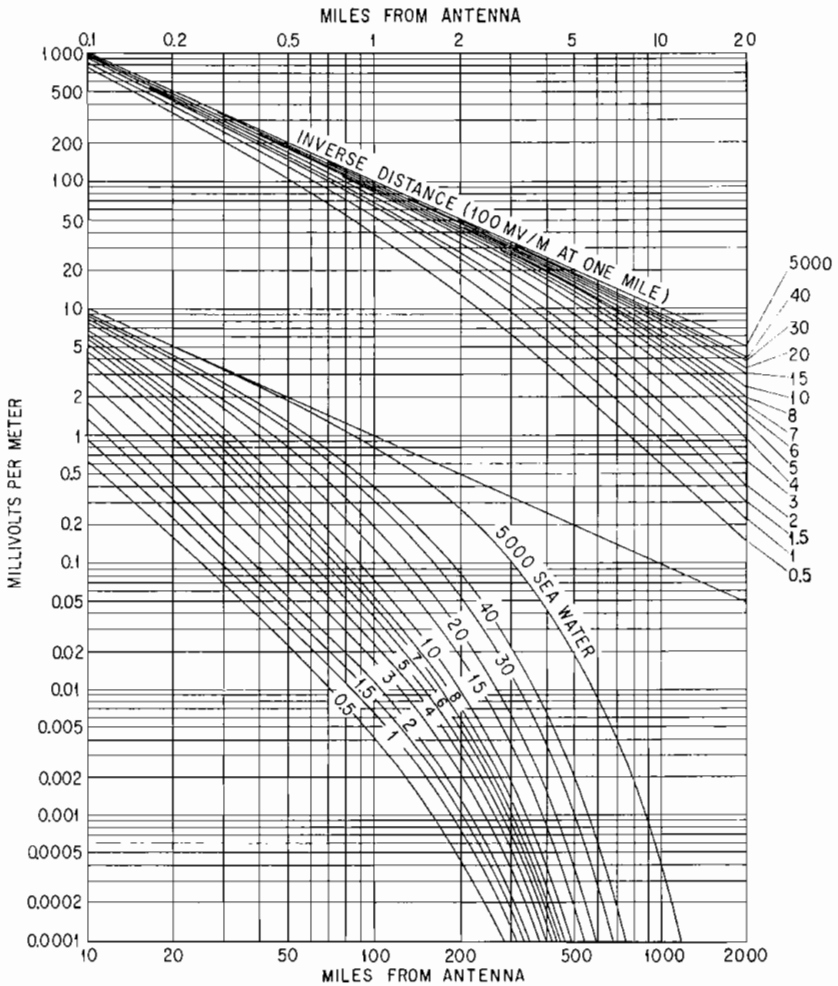
GRAPH 8. Groundwave field intensity vs. distance, 770–810 kc. Computed for 790 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



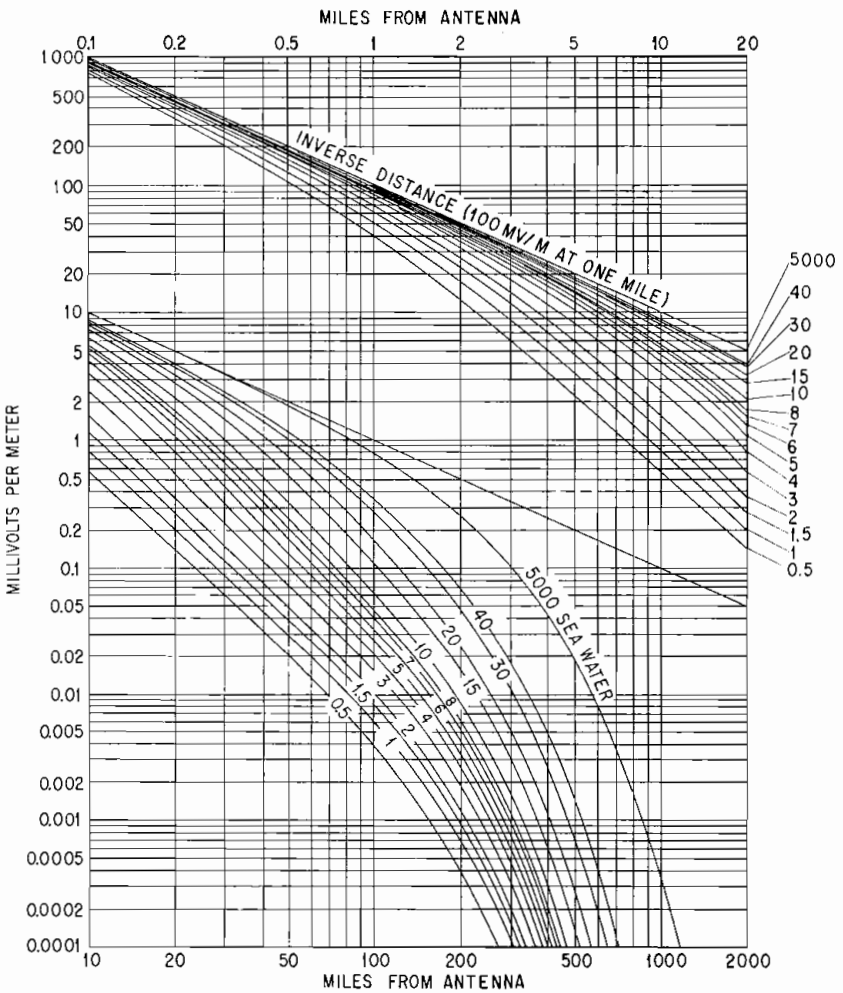
GRAPH 9. Groundwave field intensity vs. distance, 820–860 kc. Computed for 840 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



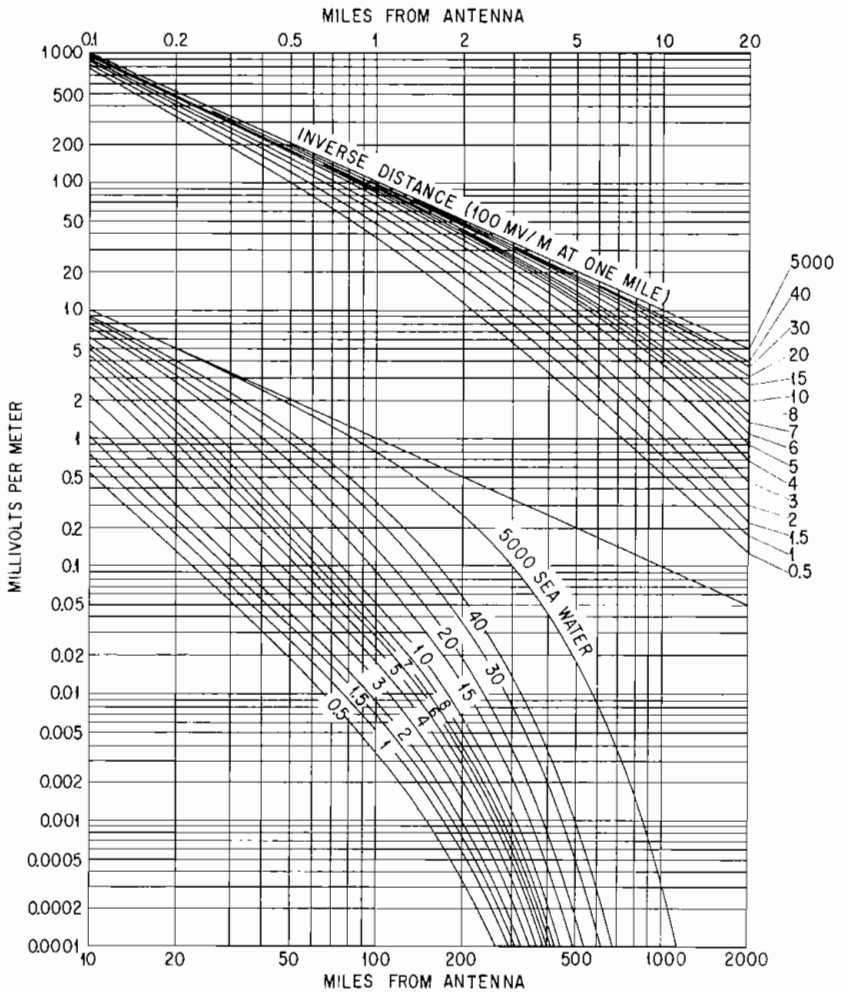
GRAPH 10. Groundwave field intensity vs. distance, 870–910 kc. Computed for 890 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



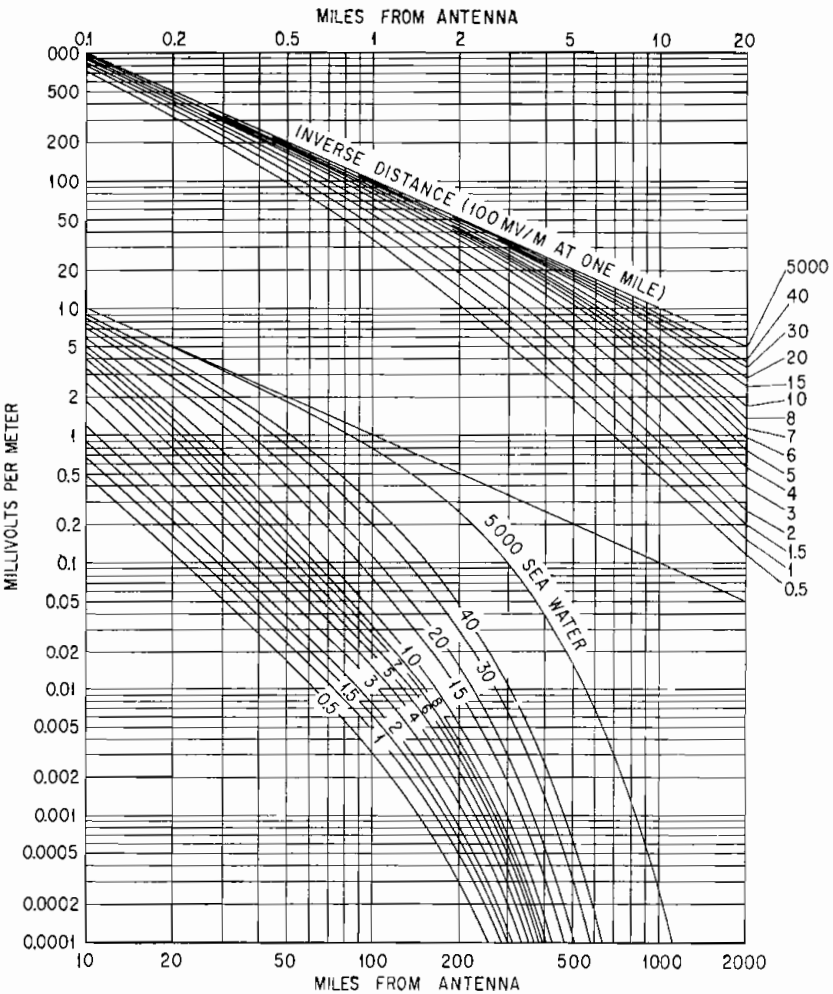
GRAPH 11. Groundwave field intensity vs. distance, 920–960 kc. Computed for 940 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



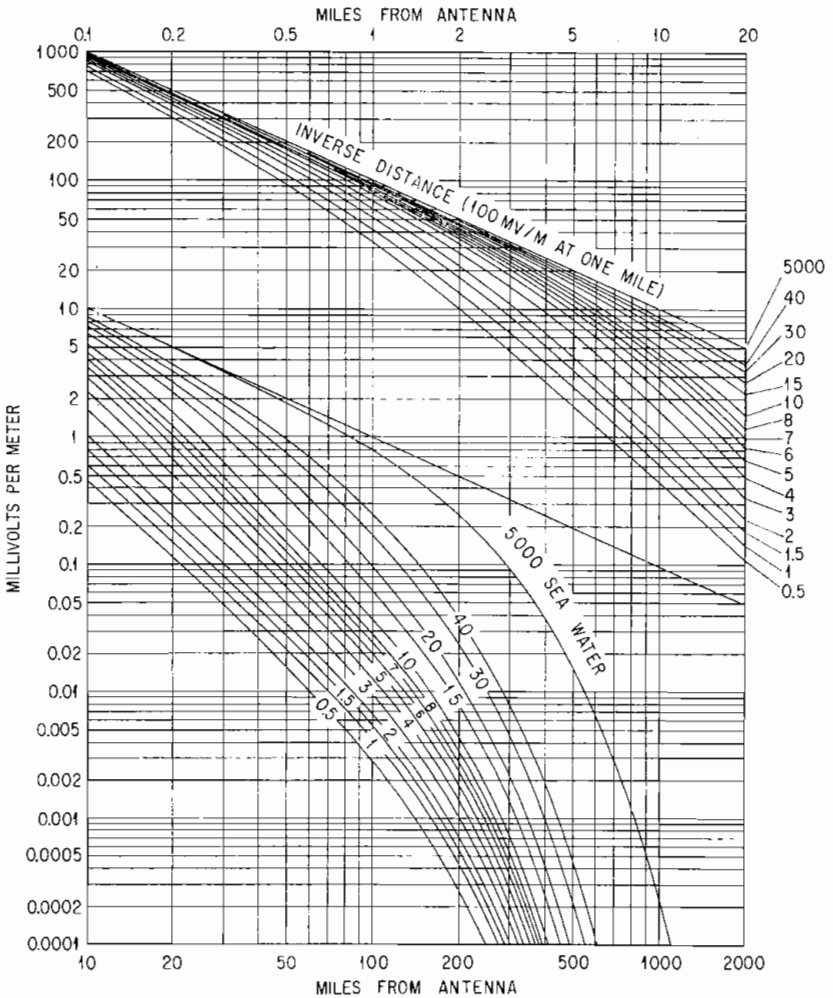
GRAPH 12. Groundwave field intensity vs. distance, 970–1030 kc. Computed for 1000 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



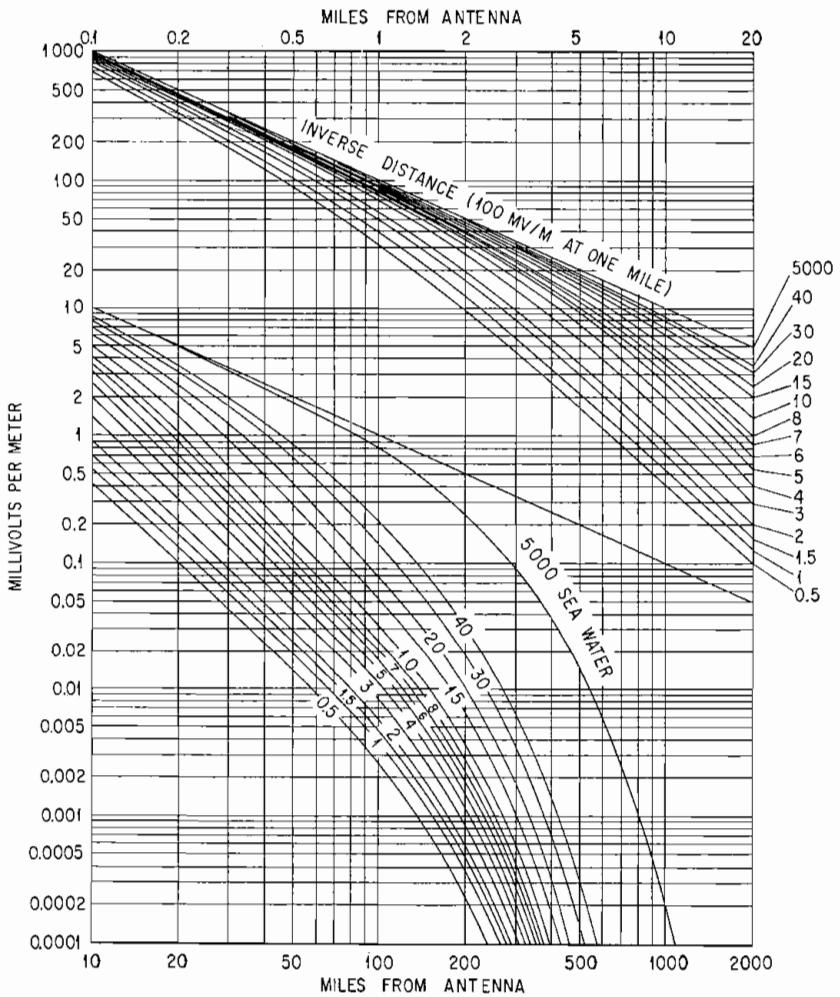
GRAPH 13. Groundwave field intensity vs. distance, 1040–1100 kc. Computed for 1070 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



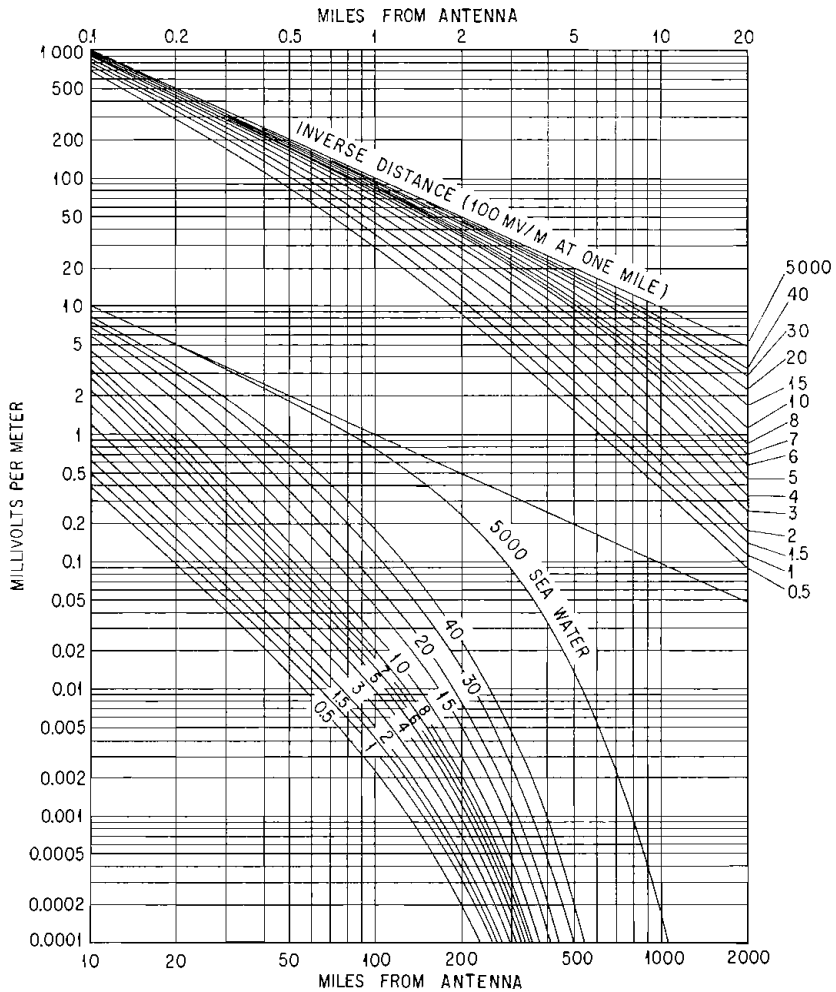
GRAPH 14. Groundwave field intensity vs. distance, 1110–1170 kc. Computed for 1140 kc, ϵ = 15, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



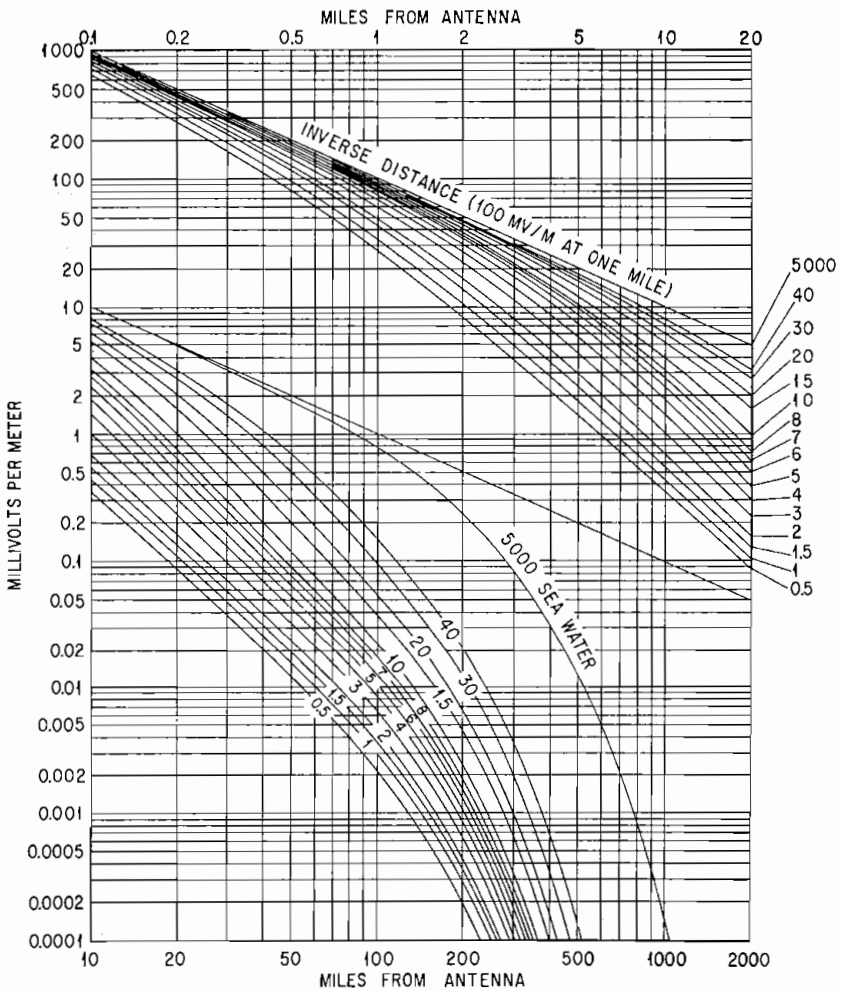
GRAPH 15. Groundwave field intensity vs. distance, 1180–1240 kc. Computed for 1210 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



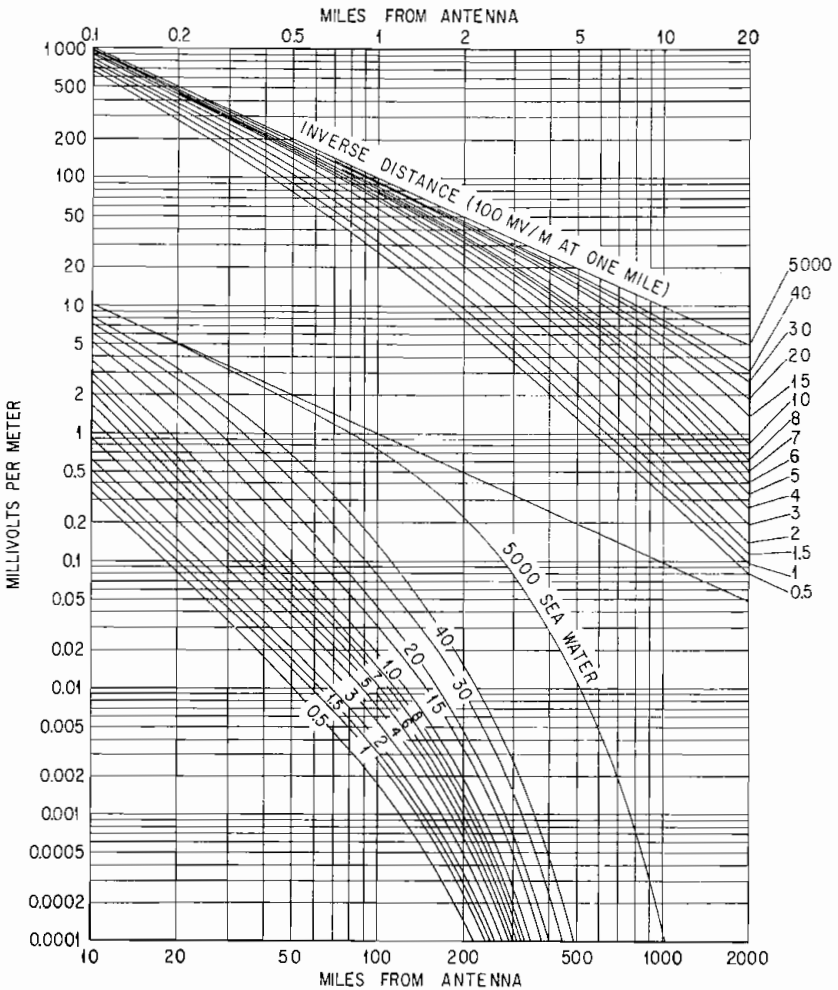
GRAPH 16. Groundwave field intensity vs. distance, 1250–1330 kc. Computed for 1290 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



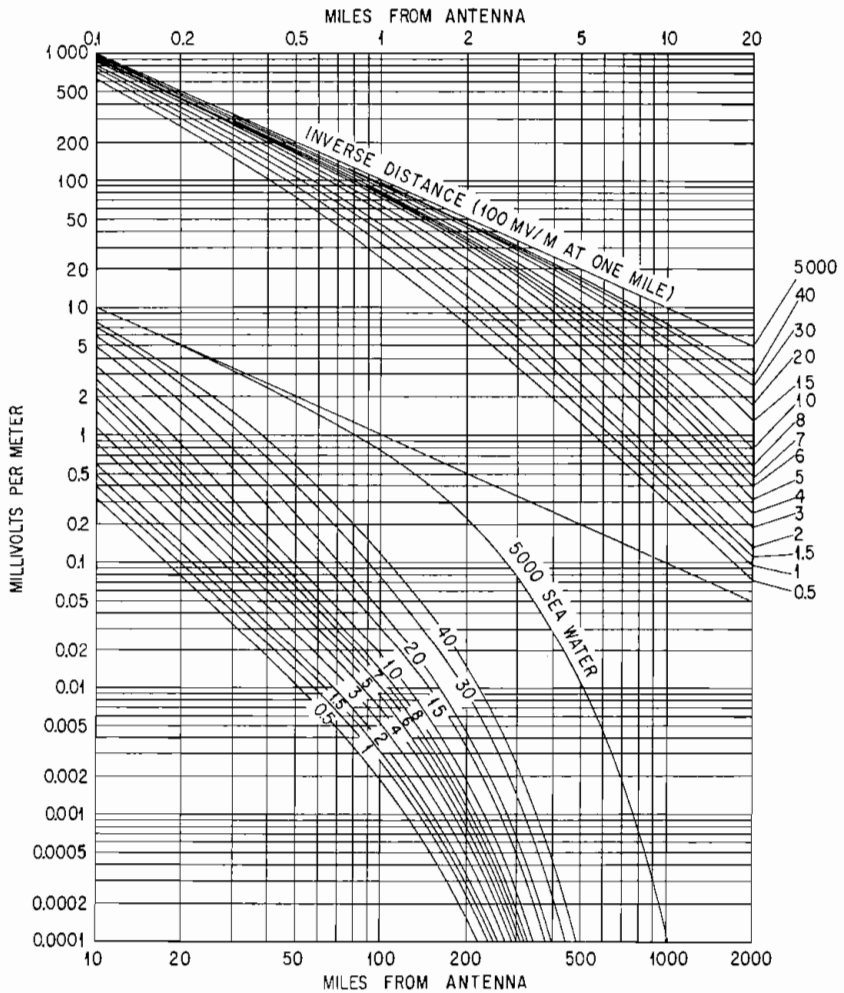
GRAPH 17. Groundwave field intensity vs. distance, 1340–1420 kc. Computed for 1380 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



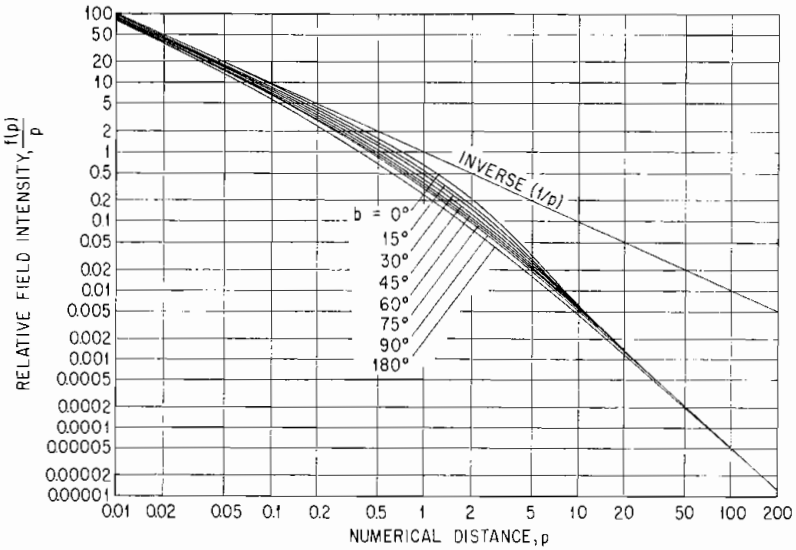
GRAPH 18. Groundwave field intensity vs. distance, 1430–1510 kc. Computed for 1470 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



GRAPH 19. Groundwave field intensity vs. distance, 1520–1600 kc. Computed for 1560 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



GRAPH 19A. Groundwave field intensity vs. distance, 1560–1640 kc. Computed for 1600 kc, $\epsilon = 15$, and the ground conductivities expressed in mmhos/m for which the curves are labeled.



GRAPH 20. Groundwave field intensity vs. numerical distance over a plane earth.

$$p = \frac{\pi}{x}\frac{R}{\lambda}\frac{\cos^2 b''}{\cos b'} \cong \frac{\pi}{x}\frac{R}{\lambda}\cos b$$
$$b = 2\,b'' - b' \cong \tan^{-1}\frac{\epsilon + 1}{x}$$

} vertical polarization.

$$p = \pi\frac{R}{\lambda}\frac{x}{\cos b'}$$
$$b = 180° - b'$$

} horizontal polarization.

$$x = \frac{1.79731 \cdot 10^{15}\sigma\text{emu}}{f_{\text{mc}}}$$

$$\tan b'' = \frac{\epsilon}{x}$$

$$\tan b' = \frac{\epsilon - 1}{x}$$

$\frac{R}{\lambda}$ = distance expressed in wavelengths.

σ = ground conductivity expressed in mmhos/m.

f = frequency expressed in megacycles.

ϵ = dielectric constant of the ground referred to air as unity.

§ 3.185 **Computation of interfering signal from a directional antenna.** (a) In case of an antenna directional in the horizontal plane, the groundwave interference can be readily computed from the calculated horizontal pattern by determining the vectors toward the service area of the station to be protected and applying these values to the groundwave curves set out in § 3.183.

(b) For signals from stations operating on clear channels, in case of determining skywave interference from an antenna with a vertical pattern different from that on which Figure 1 of § 3.190 is predicated (the basis of the night mileage separation tables), it is necessary to compare the appropriate vectors in the vertical plane.

(c) The skywave curves entitled "Average Skywave Field Intensity" (corresponding to the second hour after sunset at the recording station) as shown in Figure 1 of § 3.190 are based on antenna systems having height of 0.311 wave length (112°) and producing a vertical pattern as shown in Figure 5 of § 3.190. A nondirectional antenna system, as well as a directional antenna system having vertical patterns other than essentially the same as shown, must be converted to the pattern of a 0.311 wave length antenna having the same field intensity at the critical angle as does the pattern of the antenna involved.

(d) Example of the use of skywave curves:

Figure 6 of § 3.190 is a graph entitled "Variation with Distance of Two Important Parameters in the Theory of Skywave Propagation." The curve for θ showing the angle above the horizon at which radiation occurs plotted against distance, must be used for this purpose. For instance, assuming the station with which interference may be expected is located at a distance of 450 miles from a proposed station, the critical angle of radiation as determined from this curve is approximately 15°. Therefore, if the vertical pattern of the proposed station in the direction of the other station is such that at 15° above the horizon the radiation is 1.3 times that from an antenna having a vertical patteru as shown in Figure 5 of § 3.190 and producing the same field intensity at 1 mile iu the horizontal plane, the interfering signal would be 1.3 times that determined from Figure 1 of § 3.190 for an antenna having the same field intensity in the horizontal plane. That is, if the field intensity iu the horizontal plane of the proposed station is 124 mv/m the interfering field intensity exceeded 10 percent of the time at the other station would be

$$140 \times 1.30 \times \frac{124}{100} \text{ or } 225 \text{ uv/m}$$

and would cause interference to the 4.5 mv/m groundwave contour of the existing station.

(e) For signals from stations on regional and local channels, in computing the 10% skywave (interference) field intensity values of Class III and Class IV stations, Fig. 2 of § 3.190 is to be used in place of Figure 1 of § 3.190. (Certain simplifying assumptions may be made in the case of Class IV stations on local channels: See note to § 3.182(a)(4).) Since Figure 2 of § 3.190 is predicated upon a radiated field of 100 mv/m at one mile in the pertinent direction, no comparison with the vertical pattern of a 0.311 wavelength antenna is to be made. Instead the appropriate radiated field in the vertical plane corresponding to the distance to the receiving station, divided by 100, is multiplied into the value of 10% skywave field intensity determined from Figure 2 of § 3.190. There are two new factors to be considered, however, namely the variation of received field with latitude of the path and the variation of pertinent vertical angle due to variations of ionosphere height and ionosphere scattering.

(f) Figure 2 of § 3.190, "10% Skywave Signal Range Chart," shows the 10% skywave signal as a function of the latitude of the transmission path and the distance from a transmitting antenna with a radiated field of 100 mv/m at the pertinent angle for the distance. The latitude of the transmission path is defined as the geographic latitude of the midpoint between the transmitter and the receiver. Latitude 35° should be used in case the midpoint of the path lies below 35° North and latitude 50° should be nsed in case the midpoint of the path lies above 50° North.

(g) Figure 6-A of § 3.190, entitled "Angles of Departure vs. Transmission Range,"

is to be used in determining the angles in the vertical pattern of the antenna of an interfering station to be considered as pertinent to transmission by one reflection. Corresponding to any given distance, the curves 4 and 5 indicate the upper and lower angles within which the radiated field is to be considered. The maximum value of field intensity occurring between these angles will be used to determine the multiplying factor for the 10% skywave field intensity determined from Figure 2 of § 3.190. (Curves 2 and 3 are considered to represent the variation due to the variation of the effective height of the E-layer while curves 4 and 5 extend the range of pertinent angles to include a factor which allows for scattering. The dotted lines are included for information only.)

(h) In the case of non-directional vertical antennas, the vertical distribution of relative fields for several heights, assuming sinusoidal distribution of current along the antenna, is shown in Figure 5 of § 3.190. In the case of directional antennas the vertical pattern in the great circle direction toward the point of reception in question must first be calculated. Then for the distance to the points, the upper and lower pertinent angles are determined from Figure 6-A of § 3.190. The ratio of the largest value of radiated field occurring between these angles, to 100 mv/m (for which Figure 2 of § 3.190 is drawn) is then used as the multiplying factor for the value of the field read from the curves of Figure 2 of § 3.190. Note that while the accuracy of the curves is not as well established by measurements for distances less than 250 miles as for distances in excess of 250 miles, the curves represent the most accurate data available today. Pending accumulation of additional data to establish firm standards for skywave calculations in this range, the curves may be used. In cases where the radiation in the vertical plane, in the pertinent azimuth, contains a large lobe at a higher angle than the pertinent angle for one reflection the method of calculating interference will not be restricted to that described above, but each such case will be considered on the basis of the best knowledge available.

(i) Example, suppose it is desired to determine the amount of interference to a Class III station at Portland, Oregon, caused by another Class III station at Los Angeles, California, which is radiating a signal of 560 mv/m unattennated at one mile in the great circle direction of Portland, using a 0.5 wavelength antenna. The distance is 825 miles. From Figure 6-A of § 3.190 the upper and lower pertinent angles are 7° and 3.5°, and from Figure 5 of § 3.190 the maximum radiation within these angles is 99% of the horizontal radiation or 554 mv/m at 1 mile. The latitude of the path is 39.8° N and from Figure 2 of § 3.190, the 10% skywave field at 825 miles is 0.050 mv/m for 100 mv/m radiated. Multiplying by $^{554}/_{100}$ to adjust the value to the actual radiation gives 0.277 mv/m. At 20 to 1 ratio the limitation to the Portland station is to the 5.5 mv/m contour.

(j) When the distance is large, more than one reflection may be involved and due consideration must be given each appropriate vector in the vertical pattern, as well as the constants of the earth where reflection takes place between the transmitting station and the service area to which interference may be caused.

§ 3.186 Field intensity measurements in allocation; establishment of effective field at one mile. (a) Section 3.45 provides that certain minimum field intensities are acceptable in lieu of the required minimum physical vertical heights of the antennas proper. Also in other allocation problems, it is necessary to determine the effective field at 1 mile. The following requirements shall govern the taking and submission of data on the field intensity produced:

(1) Beginning as near to the antenna as possible without including the induction field and to provide for the fact that a broadcast antenna not being a point source of radiation (not less than one wave length or 5 times the vertical height in the case of a single element, i.e., nondirectional antenna or 10 times the spacing between the elements of a directional antenna), measurements shall be made on eight or more radials, at intervals of approximately one-tenth mile up to 2 miles from the antenna, at intervals of approximately one-half mile from 2 miles to 6 miles from the antenna, at intervals of approximately 2 miles from 6 miles to 15 or 20 miles from the antenna, and a few additional measurements if needed at greater distances from the antenna. Where the antenna is rurally located and unobstructed measurements can be made, there shall be as many as 18 or 20 measurements on each radial. However, where the

antenna is located in a city where unobstructed measurements are difficult to make, measurements shall be made on each radial at as many unobstructed locations as possible, even though the intervals are considerably less than stated above, particularly within 2 miles of the antenna. In cases where it is not possible to obtain accurate measurements at the closer distances (even out to 5 or 6 miles due to the character of the intervening terrain), the measurements at greater distances should be made at closer intervals. (It is suggested that "wave tilt" measurements may be made to determine and compare locations for taking field intensity measurements, particularly to determine that there are no abrupt changes in ground conductivity or that reflected waves are not causing abnormal intensities.)

(2) The data required by subparagraph (1) of this paragraph should be plotted for each radial in accordance with either of the two methods set forth below:

(i) Using log-log coordinate paper, plot field intensities as ordinate and distance as abscissa.

(ii) Using semi-log coordinate paper, plot field intensity times distance as ordinate on the log scale and distance as abscissa on the linear scale.

(3) However, regardless of which of the methods in subparagraph (2) of this paragraph is employed, the proper curve to be drawn through the points plotted shall be determined by comparison with the curves in § 3.184 as follows: Place the sheet on which the actual points have been plotted over the appropriate Graph in § 3.184, hold to the light if necessary and adjust until the curve most closely matching the points is found. This curve should then be drawn on the sheet on which the points were plotted, together with the inverse distance curve corresponding to that curve. The field at 1 mile for the radial concerned shall be the ordinate on the inverse distance curve at 1 mile.

(4) When all radials have been analyzed in accordance with subparagraph (3) of this paragraph, a curve shall be plotted on polar coordinate paper from the fields obtained, which gives the inverse distance field pattern at 1 mile. The radius of a circle, the area of which is equal to the area bounded by this pattern, is the effective field. (See § 3.14.)

(5) While making the field intensity survey, the output power of the station shall be maintained at the licensed power as determined by the direct method. To do this it is necessary to determine accurately the total antenna resistance (the resistance variation method, the substitution method or bridge method is acceptable) and to measure the antenna current by means of an ammeter of acceptable accuracy. (See §§ 3.39 and 3.54.)

(b) Complete data taken in conjunction with the field intensity measurements shall be submitted to the Commission in affidavit form including the following:

(1) Tabulation by number of each point of measurement to agree with the map required in (2) below and the field intensity meter reading, the attenuation constant, the field intensity (E), the distance from the antenna (D) and the product of the field intensity and distance (ED) (if data for each radial are plotted on semi-logarithmic paper, see above) for each point of measurement.

(2) Map showing each point of measurement numbered to agree with tabulation required above.

(3) Description of method used to take field intensity measurements.

(4) The family of theoretical curves used in determining the curve for each radial properly identified by conductivity and dielectric constants.

(5) The curves drawn for each radial and the field intensity pattern.

(6) Antenna resistance measurement:

(i) Antenna resistance at operating frequency.

(ii) Description of method employed.

(iii) Tabulation of complete data.

(iv) Curve showing antenna resistance versus frequency.

(7) Antenna current or currents maintained during field intensity measurements.

(8) Description, accuracy, date, and by whom each instrument was last calibrated.

(9) Name, address, and qualifications of the engineer making the measurements.

(10) Any other pertinent information.

§ 3.187 **Limitation on daytime radiation.** (a) No authorization for new or changed Class II facilities will be granted if the proposed Class II station would radiate during two hours following local sunrise and two hours preceding local sunset, in any direction toward the 0.1 mv/m groundwave contour of a co-channel United States Class I station, values in excess of those obtained as provided in paragraph (b) of this section.

(b) To obtain the maximum permissible radiation for a Class II station on a given frequency (f_{kc}) from 640 kc through 990 kc, multiply the radiation value obtained for the given distance and azimuth from the 500 kc chart (Figure 9 of § 3.190) by the appropriate interpolation factor shown in the K_{500} column of paragraph (c) of this section; and multiply the radiation value obtained for the given distance and azimuth from the 1000 kc chart (Figure 10 of § 3.190) by the appropriate interpolation factor shown in the K_{1000} column of paragraph (c) of this section. Add the two products thus obtained; the result is the maximum radiation value applicable to the Class II station in the pertinent directions. For frequencies from 1010 kc to 1580 kc, obtain in a similar manner the proper radiation values from the 1000 kc and 1600 kc charts (Figures 10 and 11 of § 3.190), multiply each of these values by the appropriate interpolation factor in the K'_{1600} and K'_{1600} columns in paragraph (c) of this section, and add the products.

(c) Interpolation factors

(1) Frequencies below 1000 kc

f_{kc}	K_{500}	K_{1000}
640	0.720	0.280
650	0.700	0.300
660	0.680	0.320
670	0.660	0.340
680	0.640	0.360
690	0.620	0.380
700	0.600	0.400
710	0.580	0.420
720	0.560	0.440
730	0.540	0.460
740	0.520	0.480
750	0.500	0.500
760	0.480	0.520
770	0.460	0.540
780	0.440	0.560
800	0.400	0.600
810	0.380	0.620
820	0.360	0.640
830	0.340	0.660
840	0.320	0.680
850	0.300	0.700
860	0.280	0.720
870	0.260	0.740
880	0.240	0.760
890	0.220	0.780
900	0.200	0.800
940	0.120	0.880
990	0.020	0.980

(2) Frequencies above 1000 kc

f'_{kc}	K'_{1000}	K'_{1600}
1010	0.983	0.017
1020	0.967	0.033
1030	0.950	0.050
1040	0.933	0.067
1050	0.917	0.083
1060	0.900	0.100
1070	0.883	0.117
1080	0.867	0.133
1090	0.850	0.150
1100	0.833	0.167
1110	0.817	0.183
1120	0.800	0.200
1130	0.783	0.217
1140	0.767	0.233
1160	0.733	0.267
1170	0.717	0.283
1180	0.700	0.300
1190	0.683	0.317
1200	0.667	0.333
1210	0.650	0.350
1220	0.633	0.367
1500	0.167	0.833
1510	0.150	0.850
1520	0.133	0.867
1530	0.117	0.883
1540	0.100	0.900
1550	0.083	0.917
1560	0.067	0.933
1570	0.050	0.950
1580	0.033	0.967

§ 3.188 **Location of transmitters.** (a) The four primary objectives to be obtained in the selection of a site for a transmitter of a broadcast station are as follows:

(1) To serve adequately the center of population in which the studio is located and to give maximum coverage to adjacent areas.

(2) To cause and experience minimum interference to and from other stations.

(3) To present a minimum hazard to air navigation consistent with objectives (1) and (2).

(4) To fulfill certain other requirements given below.

(b) The site selected should meet the following conditions:

(1) A minimum field intensity of 25 to 50 mv/m will be obtained over the business or factory areas of the city.

(2) A minimum field intensity of 5 to 10 mv/m will be obtained over the most distant residential section.

(3) The absorptiou of the signal is the minimum for any obtainable sites in the area. As a guide in this respect the absorption of the signals from other stations in that area should be followed, as well as the results of tests on other sites.

(4) The population within the blanket contour does not exceed that specified by § 3.24(g).

(c) In selecting a site in the center of a city it is usually necessary to place the radiating system on the top of a building. This building should be large enough to permit the installation of a satisfactory ground and/or counterpoise system. Great care must be taken to avoid selecting a building surrounded by taller buildings or where any nearby building higher than the antenna is located in the direction which it is desired to serve. Such a building will tend to cast "radio shadows" which may materially reduce the coverage of the station in that direction. Irrespective of the height of surrounding buildings, the building on which the antenna is located should not have height of approximately one-quarter wavelength. A study of antenna systems located on buildings tends to indicate that where the building is approximately a quarter wavelength in height, the efficiency of radiation may be materially reduced.

(d) Particular attention must be given to avoiding cross-modulation. In this connection, attention is invited to the fact that it has been found very unsatisfactory to locate broadcast stations so that high signal intensities occur in areas with overhead electric power or telephone distribution systems and sections where the wiring and plumbing are old or improperly installed. These areas are usually found in the older or poorer sections of a city. These conditions give rise to cross-modulation interference due to the nonlinear conductivity characteristics of contacts betweeu wiring, plumbing, or other conductors. This type of interference is independent of the selectivity characteristics of the receiver and normally can be eliminated only by correction of the condition causing the interference. Cross-modulation teuds to increase with frequency and in some areas it has been found impossible to eliminate all sources of cross-modulation, resulting in an unsatisfactory condition for both licensee and listeners. The Commission will not authorize, (1) new stations, (2) increased facilities to existing stations, or (3) auxiliary transmitters, for use with other than the authorized antenna system of the main transmitter, located in such areas or utilizing roof-top antennas, when the operating power would be in excess of 500 watts.

(e) If it is determined that a site should be selected removed from the city, there are several general conditions to be followed in determining the exact site. Three maps should be given consideration if available:

(1) Map of the density of populatiou and number of people by sections in the area. (See Bureau of Census series P–D and H–E available from Superintendent of Documents, Washington 25, D.C.)

(2) Geographical contour map with contour intervals of 20 to 50 feet.

(3) Map showing the type, nature and depth of the soil in the area with special reference to the condition of the moisture throughout the year.

From these maps a site should be selected with a minimum number of intervening hills between it and the center of the city. In general, because of ground conditions, it is better to select a site in a low area rather than on top of a hill, and the only condition under which a site on top of a hill should be selected is that it is only possible by this means to avoid a substantial number of hills, between the site and the center of a city with the resulting radio shadows. If a site is to be selected to serve a city which is on a general sloping area, it is generally better to select a site below the city than above the city.

(f) If a compromise must be made between probable radio shadows from intervening hills and locating the transmitter on top of a hill, it is generally better to compromise in favor of the low area, where an efficient radiating system may be installed which will more than compensate for losses due to shadows being caused by the hills, if not too numerous or too high. Several transmitters have been located on

top of hills, but so far as data has been supplied not a single installation has given superior efficiency of propagation and coverage.

(g) The ideal location of a broadcast transmitter is in a low area of marshy or "crawfishy" soil or area which is damp the maximum percentage of time and from which a clear view over the entire center of population may be had and the tall buildings in the business section of the city would cast a shadow across the minimum residential area.

(h) The type and condition of the soil or earth immediately around a site is very important. Important, to an equal extent, is the soil or earth between the site and the principal area to be served. Sandy soil is considered the worst type, with glacial deposits and mineral-ore areas next. Alluvial, marshy areas and salt-water bogs have been found to have the least absorption of the signal. One is fortunate to have available such an area and, if not available, the next best condition must be selected.

(i) Figure M3 (see Note to § 3.183(c)) and Figure R3 of § 3.190 indicate effective conductivity values in the United States, and are to be used for determining the extent of broadcast station coverage when adequate field intensity measurements over the path in question are not available. Since the values specified are only for general areas and since conductivity values over particular paths may vary widely from those shown, caution must be exercised in using the maps for selection of a satisfactory transmitter site. Where the submission of field intensity measurements is deemed necessary or advisable, the Commission, in its discretion, may require an applicant for new or changed broadcast facilities to submit such data in support of its application.

(j) In general, broadcast transmitters operating with approximately the same power can be grouped in the same approximate area and thereby reduce the interference between them. If the city is of irregular shape, it is often possible to take advantage of this in selecting a suitable location that will give a maximum coverage. The maps giving the density of population will be a key to this. The map giving the elevation by contours will be a key to the obstructing hills between the site and city. The map of the soil conditions will assist in determining the efficiency of the radiating system that may be erected and the absorption of the signal encountered in the surrounding area.

(k) Another factor to be considered is the relation of the site to airports and airways. Procedures and standards with respect to the Commission's consideration of proposed antenna structures which will serve as a guide to persons intending to apply for radio station licenses are contained in Part 17 of this chapter (Rules Concerning the Construction, Marking and Lighting of Antenna Structures).

(l) In finally selecting the site, consideration must be given to the required space for erecting an efficient radiating system, including the ground or counterpoise. It is the general practice to use direct grounds consisting of a radial buried wire system. If the area is such that it is not possible to get such ground system in soil that remains moist throughout the year, it probably will be found better to erect a counterpoise. (Such a site should be selected only as a last resort.) It, like the antenna itself, must of course be designed properly for the operating frequency and other local conditions.

(m) While an experienced engineer can sometimes select a satisfactory site for a 100-watt station by inspection, it is necessary for a higher power station to make a field-intensity survey to determine that the site selected will be entirely satisfactory. There are several facts that cannot be determined by inspection that make a survey very desirable for all locations removed from the city. Often two or more sites may be selected that appear to be of equal promise. It is only by means of field-intensity surveys taken with a transmitter at the different sites or from measurements on the signal of nearby stations traversing the terrain involved that the most desirable site can be determined. There are many factors regarding site efficiency that cannot be determined by any other method. When making the final selection of a site, the need for a field-intensity survey to establish the exact conditions cannot be stressed too strongly. The selection of a proper site for a broadcast station is an important engineering problem and can only be done properly by experienced radio engineers.

§ 3.189 Minimum antenna heights or field intensity requirements. (a) Section 3.45 requires that all applicants for new, additional, or different broadcast facilities and all licensees requesting authority to move the transmitter of an existing station,

shall specify a radiating system, the efficiency of which complies with the requirements of good engineering practice for the class and power of the station.

(b) The specifications deemed necessary to meet the requirements of good engineering practice at the present state of the art are set out in detail below.

(1) The licensee of a standard broadcast station requesting a change in power, time of operation, frequency, or transmitter location must also request authority to install a new antenna system or to make changes in the existing antenna system which will meet the minimum height requirements, or submit evidence that the present antenna system meets the minimum requirements with respect to field intensity, before favorable consideration will be given thereto. (See § 3.186.) In the event it is proposed to make substantial changes in an existing antenna system, the changes shall be such as to meet the minimum height requirements or will be permitted subject to the submission of field intensity measurements showing that it meets the minimum requirements with respect to effective field intensity.

(2) These minimum actual physical vertical heights of antennas permitted to be installed are shown by curves A, B, and C of Figure 7 of § 3.190 as follows:

(i) Class IV stations, 150 feet or a minimum effective field intensity of 150 mv/m for 1 kilowatt (100 watts 47.5 mv/m, and 250 watts 75 mv/m). (This height applies to a Class IV station on a local channel only. In the case of a Class IV station assigned to a regional channel Curve A shall apply.)

(ii) Class II and III stations, or a minimum effective field intensity of 175 mv/m for 1 kilowatt.

(iii) Class I stations, or a minimum effective field intensity of 225 mv/m for 1 kilowatt.

(3) The heights given on the graph for the antenna apply regardless of whether the antenna is located on the ground or on a building. Except for the reduction of shadows, locating the antenna on a building does not necessarily increase the efficiency and where the height of the building is in the order of a quarter wave the efficiency may be materially reduced.

(4) To obtain the maximum efficiency of which any antenna is capable a good ground system must be employed (a counterpoise may be substituted under certain conditions).

(5) At the present development of the art, it is considered that where a vertical radiator is employed with its base on the ground, the ground system should consist of buried radial wires at least one-fourth wave length long. There should be as many of these radials evenly spaced as practicable and in no event less than 90. (120 radials of 0.35 to 0.4 of a wave length in length and spaced 3° is considered an excellent ground system and in case of high base voltage, a base screen of suitable dimensions should be employed.)

(6) It should be borne in mind that the above specifications are the minimum and where possible better antenna and ground systems should be installed.

(7) In case it is contended that the required antenna efficiency can be obtained with an antenna of height or ground system less than the minimum specified, a complete field intensity survey must be supplied to the Commission showing that the field intensity at a mile without absorption fulfills the minimum requirements. (See § 3.186.) This field survey must be made by a qualified engineer using equipment of acceptable accuracy.

(8) The main element or elements of a directional antenna system shall meet the above minimum requirements with respect to height or effective field intensity. No directional antenna system will be approved which is so designed that the effective field of the array is less than the minimum prescribed for the class of station concerned, or in case of a Class I station less than 90 percent of the groundwave field which would be obtained from a perfect antenna of the height specified by Figure 7 of § 3.190 for operation on frequencies below 1000 kilocycles, and in the case of a Class II or III station less than 90 percent of the groundwave field which would be obtained from a perfect antenna of the height specified by Figure 7 of § 3.190 for operation on frequencies below 750 kilocycles.

(9) Before any changes are made in the antenna system, it is necessary to submit full details to the Commission for approval. These data may be submitted by letter.

§ 3.190 Engineering charts. [See Figure 1 to 11.]

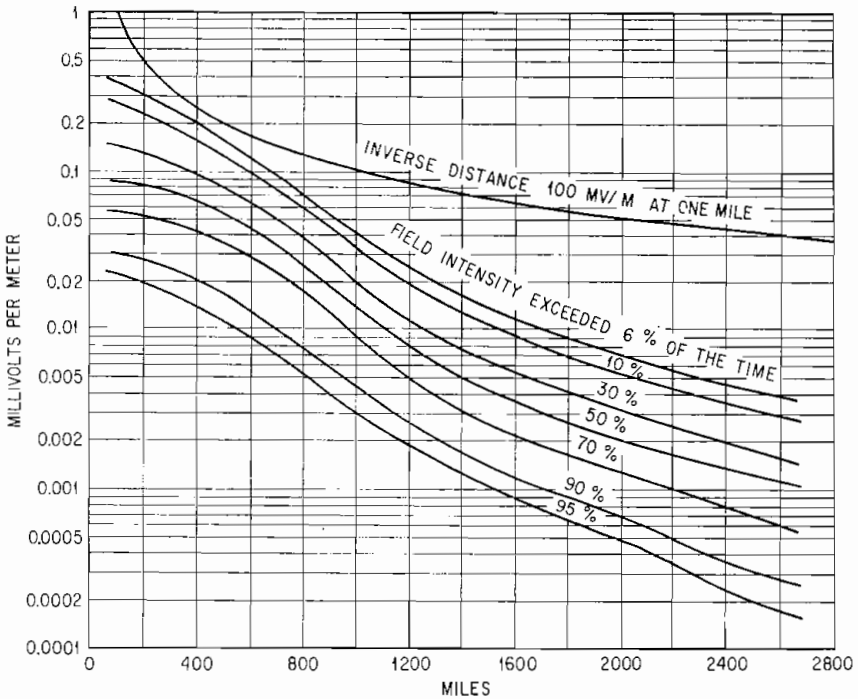


FIGURE 1. Average skywave field intensity (corresponding to the second hour after sunset at the recording station). These curves are not considered to be sufficiently accurate for practical use for distances less than approximately 250 miles.

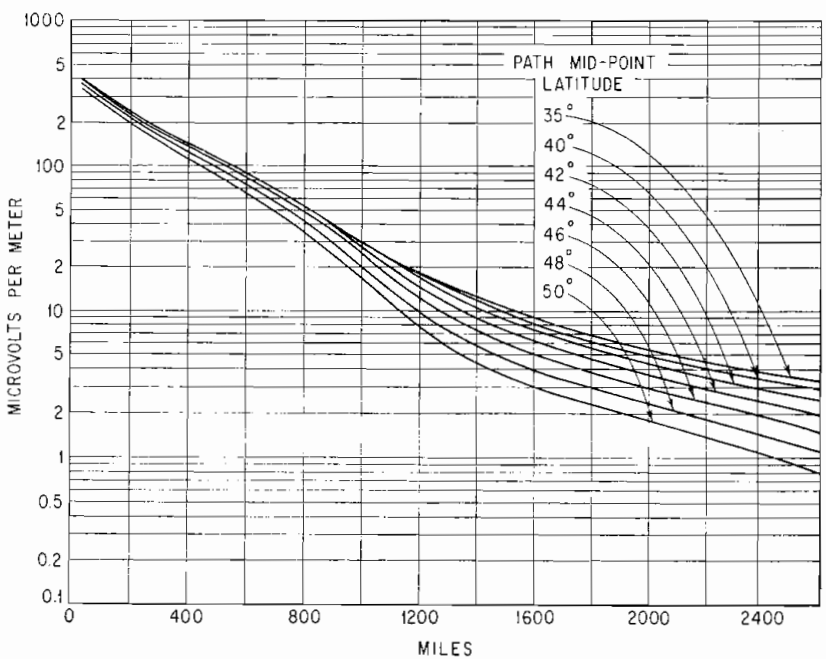


FIGURE 2. 10% skywave signal range, 540 kc to 1600 kc. Hourly median fields for 10% of the year based on 1944 propagation. Resultant skywave fields from an antenna of height $H = 0.311\ \lambda$ radiating 100 mv/m at the angle θ pertinent to transmission by one reflection.

NUMBERS ON MAP REPRESENT ESTIMATED EFFECTIVE GROUND CONDUCTIVITY IN MILLIMHOS PER METER

CONDUCTIVITY OF SEAWATER IS NOT SHOWN ON MAP BUT IS ASSUMED TO BE 5000 MILLIMHOS PER METER

FIGURE 3. Estimated effective ground conductivity in the United States.

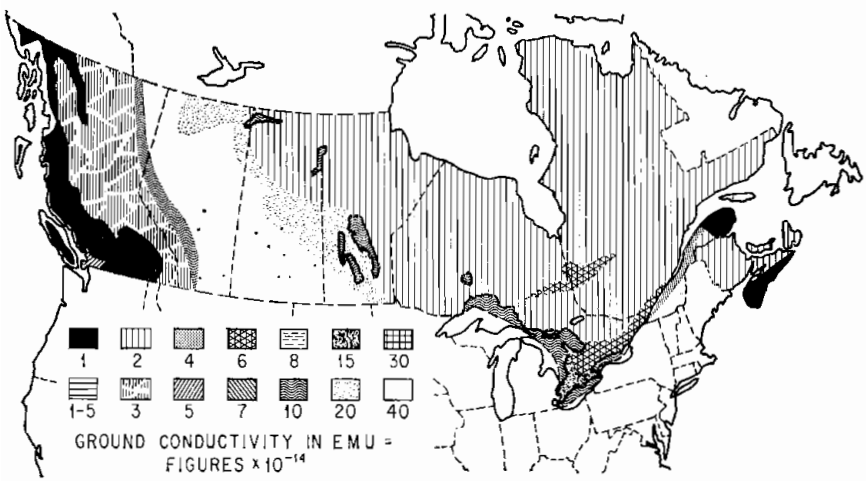


FIGURE 4. Ground conductivity in Canada. Compiled by Radio Division, Department of Transport.

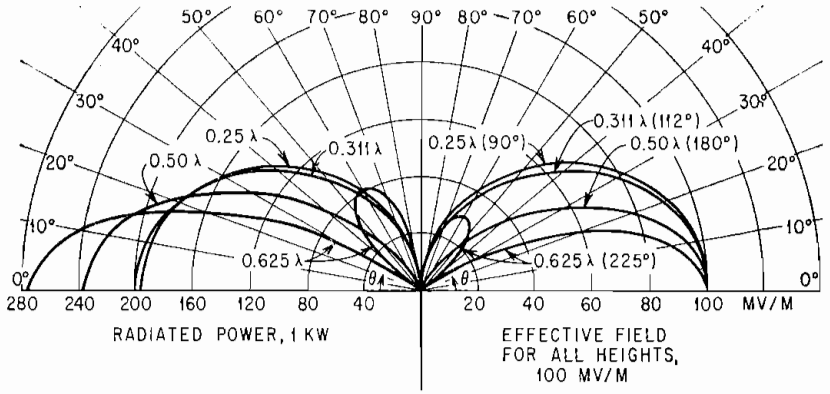


FIGURE 5. Vertical radiation patterns for different heights of vertical wire antennas (sinusoidal current distribution).

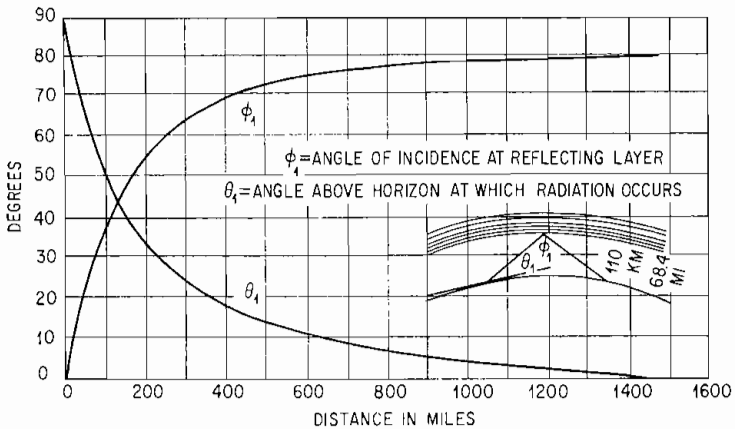


FIGURE 6. Variation with distance of two important parameters in the theory of skywave propagation.

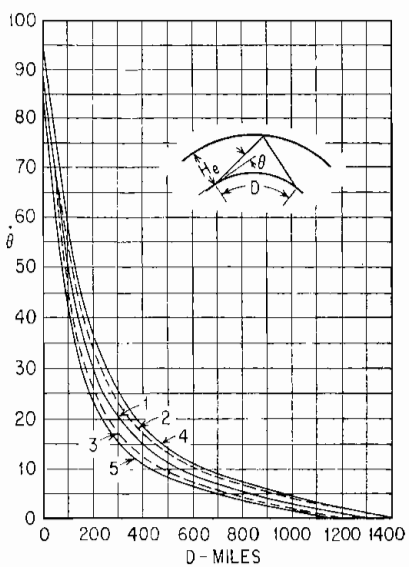


FIGURE 6A. Angles of departure vs. transmission range.

1. θ for 1000 kc average H_θ.
2. θ for 1000 kc maximum H_θ.
3. θ for 1000 kc minimum H_θ.

4 and 5 contain also an estimated correction for deviation from mid-point reflection.

For use in band 540–1600 kc.

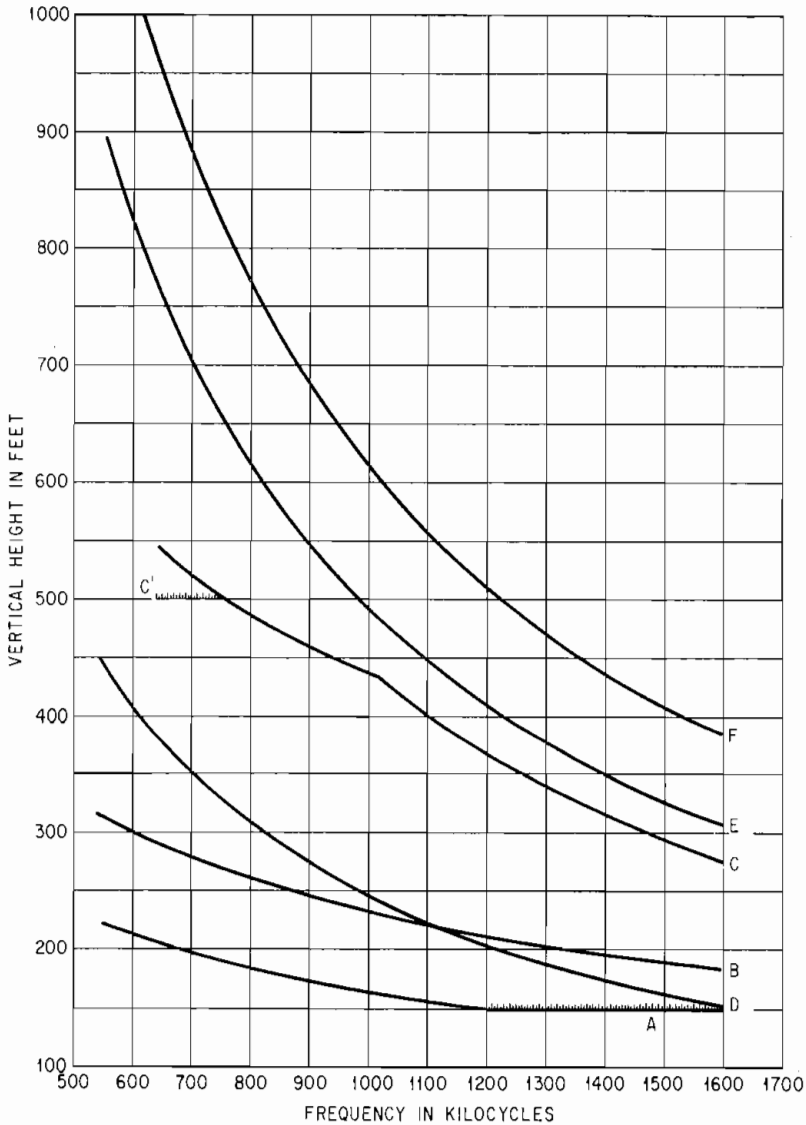


FIGURE 7. Antennas for standard broadcast stations. Minimum vertical height of antennas permitted to be installed (*A*, *B*, and *C*).

A. Class IV stations, or a minimum effective field intensity of 150 mv/m for 1 kw. (100 watts, 47.5 mv/m, and 250 watts, 75 mv/m).

B. Class II and III stations, or a minimum effective field intensity of 175 mv/m for 1 kw.

C. Class I stations, or a minimum effective field intensity of 225 mv/m for 1 kw.

C'. Where it is shown that the Federal Aviation Agency will not approve an antenna having height in excess of 500 feet at any location within the metropolitan area concerned, a height of 500 feet will be accepted.

D. 0.25 wavelength.

E. 0.50 wavelength.

F. 0.625 wavelength.

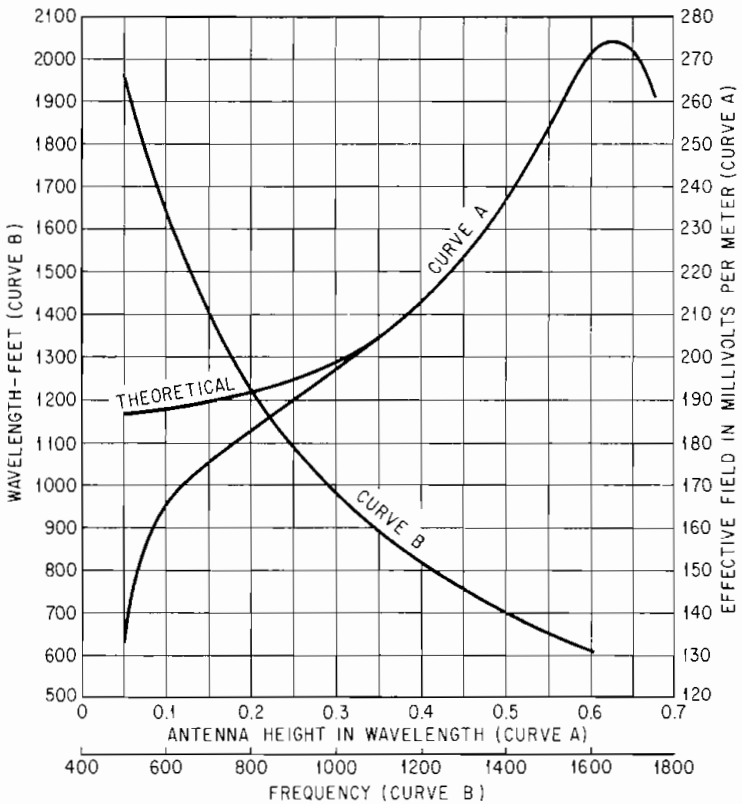


FIGURE 8. Effective field at one mile for one kilowatt (curve A). Use for simple omnidirectional vertical antenna with ground system of at least 120 radials ¼ λ.

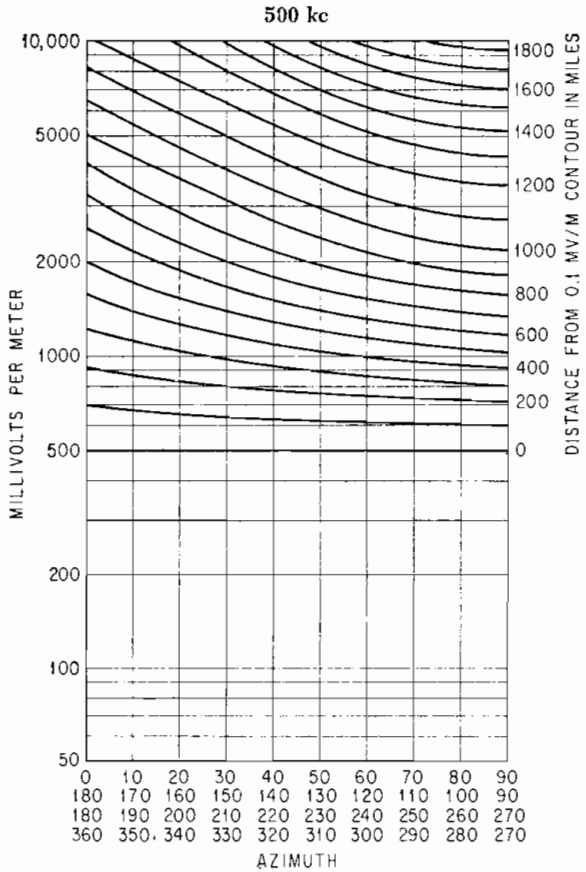


FIGURE 9. Permissible daytime radiation for Class II stations.

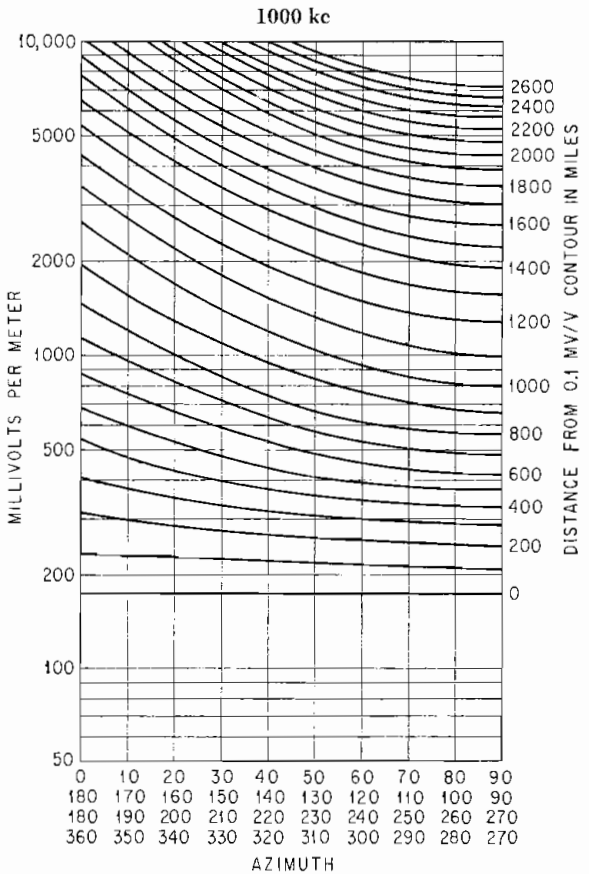


FIGURE 10. Permissible daytime radiation for Class II stations.

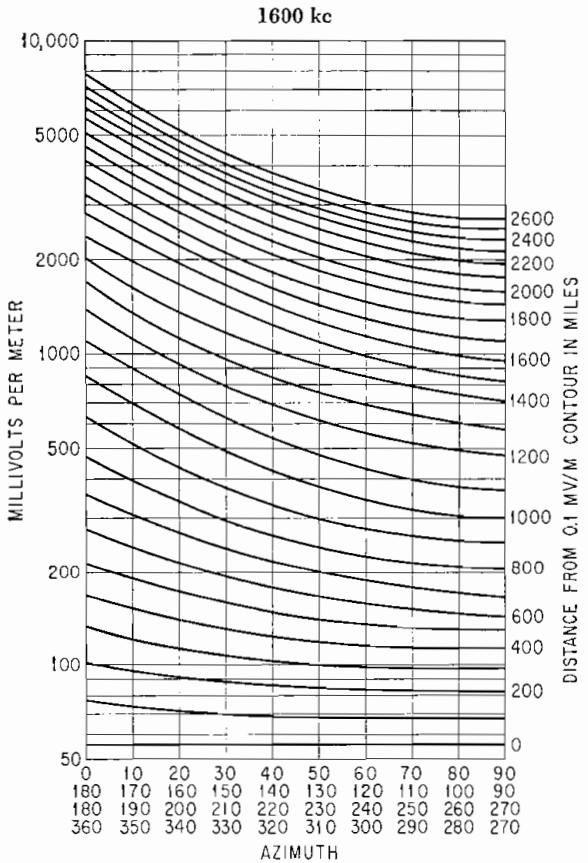


FIGURE 11. Permissible daytime radiation for Class II stations.

SUBPART B—FM BROADCAST STATIONS

Classification of FM Broadcast Stations and Allocation of Frequencies

§ 3.201 **Numerical designation of FM broadcast channels.** For convenience, the frequencies available for FM broadcasting (including those assigned to noncommercial educational broadcasting) are given numerical designations which are shown in the table below:

Frequency (Mc):	*Channel No.*	Frequency (Mc):	*Channel No.*	Frequency (Mc):	*Channel No.*
88.1	201	94.9	235	101.5	268
88.3	202	95.1	236	101.7	269
88.5	203	95.3	237	101.9	270
88.7	204	95.5	238	102.1	271
88.9	205	95.7	239	102.3	272
89.1	206	95.9	240	102.5	273
89.3	207	96.1	241	102.7	274
89.5	208	96.3	242	102.9	275
89.7	209	96.5	243	103.1	276
89.9	210	96.7	244	103.3	277
90.1	211	96.9	245	103.5	278
90.3	212	97.1	246	103.7	279
90.5	213	97.3	247	103.9	280
90.7	214	97.5	248	104.1	281
90.9	215	97.7	249	104.3	282
91.1	216	97.9	250	104.5	283
91.3	217	98.1	251	104.7	284
91.5	218	98.3	252	104.9	285
91.7	219	98.5	253	105.1	286
91.9	220	98.7	254	105.3	287
92.1	221	98.9	255	105.5	288
92.3	222	99.1	256	105.7	289
92.5	223	99.3	257	105.9	290
92.7	224	99.5	258	106.1	291
92.9	225	99.7	259	106.3	292
93.1	226	99.9	260	106.5	293
93.3	227	100.1	261	106.7	294
93.5	228	100.3	262	106.9	295
93.7	229	100.5	263	107.1	296
93.9	230	100.7	264	107.3	297
94.1	231	100.9	265	107.5	298
94.3	232	101.1	266	107.7	299
94.5	233	101.3	267	107.9	300
94.7	234				

§ 3.202 **Areas of the United States.** For the purpose of allocation the United States is divided into two areas. The first area—area I—includes southern New Hampshire; all of Massachusetts, Rhode Island, and Connecticut; southeastern New York as far north as Albany-Troy-Schenectady; all of New Jersey, Delaware, and the District of Columbia; Maryland as far west as Hagerstown; and eastern Pennsylvania as far west as Harrisburg. The second area—area II—comprehends the remainder of the United States not included in area I.

NOTE: In some of the territory contiguous to area I, the demand for frequencies requires that applications be given careful study and consideration to insure an equitable distribution of facilities throughout the region. This region includes the remainder of Maryland, Pennsylvania, and New York (except the northeastern corner) not included in area I; Virginia, West Virginia, North Carolina, South Carolina, Ohio, and Indiana; southern Michigan as far north as Saginaw; eastern Illinois as far west as Rockford-Decatur; and southeastern Wisconsin as far north as Sheboygan. Other regions may be added as required.

§ 3.203 **Class A stations.** (a) A Class A station is a station which operates on a Class A channel and is designed to render service primarily to a community or to a city or town other than the principal city of an area, and the surrounding rural area. The coverage of a Class A station shall be not more than the equivalent of 1 kilowatt effective radiated power and antenna height of 250 feet above average terrain, as determined by the methods prescribed in the Technical Standards of this subpart. (For the purpose of determining equivalent coverage, the 1 mv/m contour should be used.) A Class A station will not be licensed with more than 1 kilowatt effective radiated power. The power rating of the transmitter used for a Class A station shall be not less than 250 watts nor more than 1 kilowatt. The signal intensity requirements of § 3.311 shall determine the minimum coverage of a Class A station. Class A stations will normally be protected to the 1 mv/m contour; however, assignments will be made in a manner to insure, insofar as possible, a maximum of service to all listeners, whether urban or rural, giving consideration to the minimum signal capable of providing service.

(b) The following frequencies, except as provided in paragraphs (c) and (d) of this section, are designated as Class A channels and are assigned for use by Class A stations:

Frequency (Mc):	*Channel No.*	Frequency (Mc):	*Channel No.*	Frequency (Mc):	*Channel No.*
92.1	221	97.7	249	103.1	276
92.7	224	98.3	252	103.9	280
93.5	228	99.3	257	104.9	285
94.3	232	100.1	261	105.5	288
95.3	237	100.9	265	106.3	292
95.9	240	101.7	269	107.1	296
96.7	244	102.3	272		

These channels are available for assignment (1) in cities which are not the central city or cities of a metropolitan district, and (2) in central cities of metropolitan districts which have fewer than six Class B stations.

(c) In Hawaii, the frequency band 98–108 Mc is allocated for nonbroadcast use. The frequencies 98.1 through 107.9 Mc, inclusive (Channels 251 through 300 inclusive) will not be assigned in Hawaii for use by FM broadcast stations.

(d) In Alaska the frequency band 88–100 Mc is allocated to Government radio services and the non-Government fixed service only. The frequencies 88.1 Mc through 99.9 Mc (Channels 201 through 260 inclusive) will not be assigned in Alaska for use by FM broadcast stations.

§ 3.204 **Class B stations.** (a) A Class B station is a station which operates on a Class B channel and is designed to render service primarily to a metropolitan district or principal city and the surrounding rural area, or to rural areas removed from large centers of population. The service area of a Class B station will not be protected beyond the 1 mv/m contour; however, Class B assignments will be made in a manner to insure, insofar as possible, a maximum of service to all listeners, whether urban or rural, giving consideration to the minimum signal capable of providing service. Standard power ratings of transmitters used for Class B stations shall be 1 kw or greater. The signal intensity requirements of § 3.311 shall determine the minimum coverage of a Class B station. In the following subparagraphs antenna height above average terrain and effective radiated power are to be determined by the methods prescribed in the Technical Standards of this subpart.

(1) The coverage of a Class B station in Area 1 shall be not more than the equivalent of 20 kilowatts effective radiated power and antenna height of 500 feet above average terrain. (For the purpose of determining equivalent coverage, the 1 mv/m contour should be used.) A Class B station in Area I will not be licensed with an effective radiated power greater than 20 kilowatts.

(2) The coverage of a Class B station in Area II shall normally be not more than the equivalent of 20 kilowatts effective radiated power and antenna height of 500 feet above average terrain. (For the purpose of determining equivalent coverage, the 1 mv/m contour should be used.) The use of greater power and antenna height will be

encouraged in those portions of Area II where such use would not result in undue interference to stations already authorized or to probable assignments insofar as can be determined at the time of the grant. In such case, the power, antenna height, and area will be determined on the merits of each application with particular attention being given to rural areas which would not otherwise receive service.

(b) The following frequencies, except as provided in paragraphs (c) and (d) of this section, are designated as Class B channels and are assigned for use by Class B stations:

Frequency (Mc):	*Channel No.*	Frequency (Mc):	*Channel No.*	Frequency (Mc):	*Channel No.*
92.3	222	97.5	248	102.9	275
92.5	223	97.9	250	103.3	277
92.9	225	98.1	251	103.5	278
93.1	226	98.5	253	103.7	279
93.3	227	98.7	254	104.1	281
93.7	229	98.9	255	104.3	282
93.9	230	99.1	256	104.5	283
94.1	231	99.5	258	104.7	284
94.5	233	99.7	259	105.1	286
94.7	234	99.9	260	105.3	287
94.9	235	100.3	262	105.7	289
95.1	236	100.5	263	105.9	290
95.5	238	100.7	264	106.1	291
95.7	239	101.1	266	106.5	293
96.1	241	101.3	267	106.7	294
96.3	242	101.5	268	106.9	295
96.5	243	101.9	270	107.3	297
96.9	245	102.1	271	107.5	298
97.1	246	102.5	273	107.7	299
97.3	247	102.7	274	107.9	300

(c) In Hawaii the frequency band 98–108 Mc is allocated for nonbroadcast use. The frequencies 98.1 through 107.9 Mc inclusive (Channels 251 through 300, inclusive) will not be assigned in Hawaii for use by FM broadcast stations.

(d) In Alaska the frequency band 88–100 Mc is allocated exclusively to Government radio services and the non-Government fixed service. The frequencies 88.1 Mc through 99.9 Mc (Channels 201 through 260 inclusive) will not be assigned in Alaska for use by FM broadcast stations.

§ 3.205 **Station location and program origination.** (a) Except as provided in paragraph (b) of this section, each FM broadcast station will be licensed to serve primarily a particular city, town, or other political subdivision which will be specified in the station license and the station will be considered to be located in such place. Each station shall maintain a studio, which will be known as the main studio, in the place where the station is located provided that the main studio may be located at the transmitter site whether or not the transmitter site is in the place where the station is located. A majority (computed on the basis of duration and not number) of a station's programs or in the case of a station affiliated with a network, two-thirds of such station's non-network programs, whichever is smaller, shall originate from the main studio or from other studios or remote points situated in the place where the station is located.

(b) Stations will be licensed to serve more than one city, town, or other political subdivision, only where a satisfactory showing is made that each such place meets all the requirements of the rules and Technical Standards of this subpart with respect to the location of main studios; that the station can and will originate a substantial number of local live programs from each such place; and that the requirements as to origination of programs contained in paragraph (a) of this section would place an unreasonable burden on the station if it were licensed to serve only one city, town or other political subdivision. A station licensed to serve more than one place shall be considered to be located in and shall maintain main studios in each such place. With respect to such station the requirements as to origination of programs contained in

paragraph (a) of this section shall be satisfied by the origination of programs from any or all of the main studios or from other studios and remote points situated in any or all of the places in which the main studios are located.

(c) The transmitter of each FM broadcast station shall be so located that satisfactory service is delivered to the city where the main studio is located, in accordance with the Technical Standards of this subpart: *Provided, however,* Upon special showing of need, authorization may be granted to locate the transmitter so that adequate service is not rendered to this city, but in no event shall this city be beyond the 50 uv/m contour.

Administrative Procedure

§ 3.214 **Cross reference.** See Sections 1.300 to 1.364, subpart D of Part 1 of this chapter, for general requirements as to applications, filing of applications and descriptions of application forms, other forms and information to be filed with the Commission, the manner in which applications are processed, and provisions applying to action on applications.

§ 3.215 **Notification of filing of applications.** In order to minimize harmful interference at the National Radio Astronomy Observatory site located at Green Bank, Pocahontas County, West Virginia, and at the Naval Radio Research Observatory at Sugar Grove, Pendleton County, West Virginia, an applicant for authority to construct a new FM broadcast station or for authority to make changes in the frequency, power, antenna height, or antenna directivity of an existing station within the area bounded by 39°15′ N on the north, 78°30′ W on the east, 37°30′ N on the south and 80°30′ W on the west shall, at the time of filing such application with the Commission, simultaneously notify the Director, National Radio Astronomy Observatory, P.O. Box #2, Green Bank, West Virginia, in writing, of the technical particulars of the proposed station. Such notification shall include the geographical coordinates of the antenna, antenna height, antenna directivity if any, proposed frequency, type of emission, and power. In addition, the applicant shall indicate in his application to the Commission the date notification was made to the Observatory. After receipt of such applications, the Commission will allow a period of twenty (20) days for comments or objections in response to the notifications indicated. If an objection to the proposed operation is received during the twenty day period from the National Radio Astronomy Observatory for itself or on behalf of the Naval Radio Research Observatory, the Commission will consider all aspects of the problem and take whatever action is deemed appropriate.

§ 3.216 **Equipment tests.** (a) During the process of construction of an FM broadcast station, the permittee, after notifying the Commission and Engineer in Charge of the radio district in which the station is located, may without fnrther authority of the Commission, conduct equipment tests for the purpose of such adjustments and measurements as may be necessary to assure compliance with the terms of the construction permit, the tcchnical provisions of the application therefor, the rules and regnlations, and the applicable engineering standards.

(b) The Commission may notfy the permittee to conduct no tests or may cancel, suspend, or change the date for the beginning of equipment tests as and when such action may appear to be in the public interest, convenience, and necessity.

(c) Equipment tests may be continued so long as the construction permit shall remain valid.

(d) Inspection of a station will ordinarily be required during the equipment test period and before the commencement of the program test. After construction and after adjustments and measurements have been completed to show compliance with the terms of the construction permit, the technical provisions of the application therefor, the rules and regulations and the applicable engineering standards, the permittee should notify the Engineer in Charge of the radio district in which the station is located that it is ready for inspection.

(e) The authorization for tests embodied in this section shall not be construed as constituting a license to operate but as a necessary part of construction.

§ 3.217 **Program tests.** (a) Upon completion of construction of an FM broadcast station in accordance with the terms of the construction permit, the technical pro-

visions of the application therefor, and the rules and regulations and the applicable engineering standards, and when an application for station license has been filed showing the station to be in satisfactory operating condition, the permittee may request authority to conduct program tests: *Provided,* That such request shall be filed with the Commission at least ten (10) days prior to the date on which it is desired to begin such operation and that the Engineer in Charge of the radio district in which the station is located is notified. (All data necessary to show compliance with the terms and conditions of the construction permit must be filed with the license application.)

(b) Program tests shall not commence until specific Commission authority is received. The Commission reserves the right to change the date of the beginning of such tests or to suspend or revoke the authority for program tests as and when such action may appear to be in the public interest, convenience, and necessity.

(c) Unless sooner suspended or revoked program test authority continues valid during Commission consideration of the application for license and during this period further extension of the construction permit is not required. Program test authority shall be automatically terminated by final determination upon the application for station license.

(d) All operation under program test authority shall be in strict compliance with the rules governing FM broadcast stations and in strict accordance with representations made in the application for license pursuant to which the tests were authorized.

(e) The granting of program test authority shall not be construed as approval by the Commission of the application for station license.

§ 3.218 Normal license period. (a) All FM broadcast station licenses will be issued for a normal license period of three years. Licenses will be issued to expire at the hour of 3:00 a.m., e.s.t. in accordance with the following schedule and at three-year intervals thereafter.

(1) For stations located in Delaware and Pennsylvania, August 1, 1957.

(2) For stations located in Maryland, District of Columbia, Virginia, West Virginia, October 1, 1957.

(3) For stations located in North Carolina, South Carolina, December 1, 1957.

(4) For stations located in Florida, Puerto Rico and Virgin Islands, February 1, 1958.

(5) For stations located in Alabama and Georgia, April 1, 1958.

(6) For stations located in Arkansas, Louisiana and Mississippi, June 1, 1958.

(7) For stations located in Tennessee, Kentucky and Indiana, August 1, 1958.

(8) For stations located in Ohio and Michigan, October 1, 1958.

(9) For stations located in Illinois and Wisconsin, December 1, 1958.

(10) For stations located in Iowa and Missouri, February 1, 1956.

(11) For stations located in Minnesota, North Dakota, South Dakota, Montana and Colorado, April 1, 1956.

(12) For stations located in Kansas, Oklahoma, Nebraska, June 1, 1956.

(13) For stations located in Texas, August 1, 1956.

(14) For stations located in Wyoming, Nevada, Arizona, Utah, New Mexico and Idaho, October 1, 1956.

(15) For stations located in California, December 1, 1956.

(16) For stations located in Washington, Oregon, Alaska and Hawaii, February 1, 1957.

(17) For stations located in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont, April 1, 1957.

(18) For stations located in New Jersey and New York, June 1, 1957.

Licensing Policies

§ 3.231 Exclusive affiliation of station. No license shall be granted to an FM broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization under which the station is prevented or hindered from, or penalized for, broadcasting the programs of any other network organization.

(The term "network organization" as used herein includes national and regional network organizations. See ch. VII, J, of Report on Chain Broadcasting.)

§ 3.232 **Territorial exclusivity.** No license shall be granted to an FM broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization which prevents or hinders another broadcast station serving substantially the same area from broadcasting the network's programs not taken by the former station, or which prevents or hinders another broadcast station serving a substantially different area from broadcasting any program of the network organization. This section shall not be construed to prohibit any contract, arrangement, or understanding between a station and a network organization pursuant to which the station is granted the first call in its primary service area upon the programs of the network organization.

§ 3.233 **Term of affiliation.** No license shall be granted to an FM broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization which provides, by original terms, provisions for renewal, or otherwise for the affiliation of the station with the network organization for a period longer than 2 years: *Provided,* That a contract, arrangement, or understanding for a period up to 2 years, may be entered into within 6 months prior to the commencement of such period.

§ 3.234 **Option time.** No license shall be granted to an FM broadcast station which options for network programs any time subject to call on less than 56 days' notice, or more time than a total of 3 hours within each of four segments of the broadcast day, as herein described. The broadcast day is divided into four segments, as follows: 8 a.m. to 1 p.m.; 1 p.m. to 6 p.m.; 6 p.m. to 11 p.m.; 11 p.m. to 8 a.m. (These segments are to be determined for each station in terms of local time at the location of the station but may remain constant throughout the year regardless of shifts from standard to daylight saving time or vice versa.) Such options may not be exclusive as against other network organizations and may not prevent or hinder the station from optioning or selling any or all of the time covered by the option, or other time, to other network organizations.

NOTE 1: As used in this section, an option is any contract, arrangement, or understanding, express or implied, between a station and a network organization which prevents or hinders the station from scheduling programs before the network agrees to utilize the time during which such programs are scheduled, or which requires the station to clear time already scheduled when the network organization seeks to utilize the time.

NOTE 2: All time options permitted under this section must be specified clock hours, expressed in terms of any time system set forth in the contract agreed upon by the station and network organization. Shifts from daylight saving to standard time or vice versa may or may not shift the specified hours correspondingly as agreed by the station and network organization.

§ 3.235 **Right to reject programs.** No license shall be granted to an FM broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization which (a), with respect to programs offered pursuant to an affiliation contract, prevents or hinders the station from rejecting or refusing network programs which the station reasonably believes to be unsatisfactory or unsuitable; or which (b), with respect to network programs so offered or already contracted for prevents the station from rejecting or refusing any program which, in its opinion, is contrary to the public interest, or from substituting a program of outstanding local or national importance.

§ 3.236 **Network ownership of stations.** No license shall be granted to a network organization, or to any person directly or indirectly controlled by or under common control of a network organization, for an FM broadcast station in any locality where the existing FM broadcast stations are so few or of such unequal desirability (in terms of coverage, power, frequency, or other related matters) that competition would be substantially restrained by such licensing. (The word "control" as used herein is not limited to majority stock ownership, but includes actual working control in whatever manner exercised.)

§ 3.237 **Dual network operation.** No license shall be issued to an FM broadcast

station affiliated with a network organization which maintains more than one network of FM broadcast stations: *Provided,* That this section shall not be applicable if such networks are not operated simultaneously, or if there is no substantial overlap in the territory served by the group of stations comprising each such network.

§ 3.238 **Control by networks of station rates.** No license shall be granted to an FM broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization under which the station is prevented or hindered from, or penalized for, fixing or altering its rates for the sale of broadcast time for other than the network's programs.

§ 3.239 **Use of common antenna site.** No FM broadcast station license or renewal of FM broadcast station license will be granted to any person who owns, leases, or controls a particular site which is peculiarly suitable for FM broadcasting in a particular area and (a) which is not available for use by other FM broadcast station licensees; and (b) no other comparable site is available in the area; and (c) where the exclusive use of such site by the applicant or licensee would nndnly limit the number of FM broadcast stations that can be authorized in a particular area or would unduly restrict competition among FM broadcast stations.

§ 3.240 **Multiple ownership.** No license for an FM broadcast station shall be granted to any party (including all parties under common control) if:

(a) Such party directly or indirectly owns, operates, or controls another FM broadcast station which serves substantially the same service area; or

(b) Such party, or any stockholder, officer or director of such party, directly or indirectly owns, operates, controls, or has any interest in, or is an officer or director of any other FM broadcast station if the grant of such license would result in a concentration of control of FM broadcasting in a manner inconsistent with public interest, convenience, or necessity. In determining whether there is such a concentration of control, consideration will be given to the facts of each case with particular reference to such factors as the size, extent and location of areas served, the number of people served, classes of stations involved, and the extent of other competitive service to the areas in question. The Commission, however, will in any event consider that there would be such a concentration of control contrary to the public interest, convenience or necessity for any party or any of its stockholders, officers or directors to have a direct or indirect interest in, or be stockholders, officers, or directors of, more than seven FM broadcast stations.

NOTE 1: The word "control" as used herein is not limited to majority stock ownership, but includes actual working control in whatever manner exercised.

NOTE 2: In applying the foregoing provisions to the stockholders of a corporation which has more than 50 voting stockholders, only those stockholders need be considered who are officers or directors or who directly or indirectly own 1 percent or more of the outstanding voting stock.

§ 3.241 **Special rules relating to contracts providing for reservation of time upon sale of a station.** (a) No license, renewal of license, assignment of license, or transfer of control of a corporate licensee shall be granted or authorized to a FM broadcast station which has a contract, arrangement or understanding, express or implied, pursuant to which, as consideration or partial consideration for the assignment of license or transfer of control, the assignor of a station license or the transferor of stock, where transfer of a corporate licensee is involved, or the nominee of such assignor or transferor retains any right of reversion of the license or any right to the reassignment of the license in the future, or reserves the right to nse the facilities of the station for any period whatsoever.

Equipment

§ 3.250 **Acceptability of broadcast transmitters for licensing.** (a) In order to facilitate the filing of, and action on applications for station authorizations, transmitters will be accepted for licensing by the Commission under one of the following conditions:

(1) A transmitter may be type-accepted upon the request of any manufacturer of transmitters built in quantity by following the type acceptance procedure set forth in Part 2 of this chapter, provided that the data and information submitted indicates that the transmitter meets the requirements of § 3.317. If accepted, such transmitter will be included on the Commission's "Radio Equipment List, Part B, Aural Broadcast Equipment." Applicants specifying transmitters included on such a list need not submit detailed descriptions and diagrams where the correct type number is specified, provided that the equipment proposed is identical with that accepted. Copies of this list are available for inspection at the Commission's office in Washington, D.C., and at each of its field offices.

(2) An application specifying a transmitter not included on the Radio Equipment List, Part B, may be accepted upon the request of a prospective licensee submitting with the application for construction permit a complete description of the transmitter, including the circuit diagram, listing of all tubes used, function of each, multiplication in each stage, plate current and voltage applied to each tube, a description of the oscillator circuit together with any devices installed for the purpose of frequency stabilization and the means of varying output power to compensate for power supply voltage variations. However, if this data has been filed with the Commission by a manufacturer in connection with a request for type acceptance, it need not be submitted with the application for construction permit but may be referred to as "on file." Measurement data for type acceptance made in accordance with subparagraph (1) of this paragraph shall be submitted with the license application.

(3) A transmitter shown on an instrument of authorization by manufacturer and type number, or as a composite, and which was in use prior to June 30, 1955, may continue to be used by the licensee, his successors or assignees, provided such transmitter continues to comply with the rules and regulations.

(b) Additional rules with respect to withdrawal of type-acceptance, modification of type-accepted equipment and limitations on the findings upon which type acceptance is based are set forth in Part 2 of this chapter.

§ 3.251 Transmitter power. The standard power rating and operating power range of transmitters shall be in accordance with § 3.317.

§ 3.252 Frequency monitor. (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 operating 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 compared with an external frequency source of known accuracy at sufficiently frequent intervals to insure that the frequency is maintained within the tolerance prescribed in § 3.269. An entry shall be made in the station log as to the method used and the results thereof.

(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 § 1.332(d) 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.

§ 3.253 Modulation monitor. (a) The licensee of each station shall have in

operation, either at the transmitter or at the place where the transmitter is controlled, a modulation monitor of the 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 operating 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) During the period when the station is operated without the modulation monitor the licensee shall provide other suitable means for insuring that the modulation is maintained within the tolerance prescribed in § 3.268.

(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 § 1.332(d) 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.

§ 3.254 Required transmitter performance. (a) The construction, installation, operation and performance of the FM broadcast transmitting system shall be in accordance with § 3.317.

(b) The licensee of each FM broadcast station shall make the following equipment performance measurements at least at yearly intervals. (One such set of measurements shall be made during the four-month period preceding the date of filing application for renewal of station license.)

(1) Audio frequency response from 50 to 15,000 cycles for approximately 25, 50 and 100 percent modulation. Measurements shall be made on at least the following audio frequencies: 50, 100, 400, 1000, 5000, 10,000 and 15,000 cycles. The frequency response measurements should normally be made without deemphasis; however, standard 75 microsecond deemphasis may be employed in the measuring equipment or system provided the accuracy of the deemphasis circuit is sufficient to insure that the measured response is within the prescribed limits.

(2) Audio frequency harmonic distortion for 25, 50 and 100 percent modulation for the fundamental frequencies of 50, 100, 400, 1000, and 5000 cycles. Audio frequency harmonics for 100 percent modulation for fundamental frequencies of 10,000 and 15,000 cycles. Measurements shall normally include harmonics to 30,000 cycles. The distortion measurements shall be made employing 75 microsecond deemphasis in the measuring equipment or system.

(3) Output noise level (frequency modulation) in the band of 50 to 15,000 cycles in decibels below the audio frequency level representing a frequency swing of 75 kilocycles. The noise measurements shall be made employing 75 microsecond deemphasis in the measuring equipment or system.

(4) Output noise level (amplitude modulation) in the band of 50 to 15,000 cycles in decibels below the level representing 100 percent amplitude modulation. The noise measurements shall be made employing 75 microsecond deemphasis in the measuring equipment or system. All measurements shall be made with the equipment adjusted for normal program operation and shall include all circuits between the main studio microphone terminals and the antenna output, including telephone lines, preemphasis circuits and any equalizers employed except for microphones, and without compression if a compression amplifier is installed.

(c) The data required by paragraph (b) of this section together with a description of instruments and procedure signed by the engineer making the measurements shall be kept on file at the transmitter and retained for a period of two years and

shall be made available during that time upon request to any duly authorized representative of the Federal Communications Commission.

§ 3.255 **Auxiliary transmitter.** Upon showing that a need exists for the use of an auxiliary transmitter in addition to the regular transmitter of an FM broadcast station, a license therefor may be issued: *Provided*, That:

(a) An auxiliary transmitter may be installed either at the same location as the main transmitter or at another location.

(b) A licensed operator shall be in control whenever an auxiliary transmitter is placed in operation.

(c) The auxiliary transmitter shall be maintained so that it may be put into immediate operation at any time for the following purposes:

(1) The transmission of the regular programs upon the failure of the main transmitter.

(2) The transmission of regular programs during maintenance or modification work on the main transmitter, necessitating discontinuance of its operation for a period not to exceed 5 days. (This includes the equipment changes which may be made without authority as set forth elsewhere in the rules and regulations or as authorized by the Commission by letter or by construction permit. Where such operation is required for periods in excess of 5 days, request therefor shall be in accordance with § 1.324 of this chapter.)

(3) Upon request by a duly authorized representative of the Commission.

(d) The auxiliary transmitter shall be tested at least once each week to determine that it is in proper operating condition and that it is adjusted to the proper frequency, except that in the case of operation in accordance with paragraph (c) of this section during any week, the test in that week may be omitted provided the operation under paragraph (c) of this section is satisfactory. Tests shall be conducted only between midnight and 6 a.m., local standard time. A record shall be kept of the time and result of each test. Such records shall be retained for a period of two years.

(e) The auxiliary transmitter shall be equipped with satisfactory control equipment which will enable the maintenance of the frequency emitted by the station within the limits prescribed by the regulations in this part.

(f) The operating power of an auxiliary transmitter may be less than the authorized power of the main transmitter, but in no event shall it be greater than such power.

§ 3.256 **Alternate main transmitters.** The licensee of an FM broadcast station may be licensed for alternate main transmitters provided that a technical need for such alternate transmitters is shown (such as licensees maintaining 24-hour schedule and needing alternate operation for maintenance, or where developmental work requires alternate operation) and that the following conditions are met:

(a) Both transmitters are located at the same place.

(b) Both transmitters shall have the same power rating.

(c) Both transmitters shall meet the construction, installation, operation, and performance requirements of § 3.317.

§ 3.257 **Changes in equipment and antenna system.** Licensees of FM broadcast stations shall observe the following provisions with regard to changes in equipment and antenna system:

(a) No changes in equipment shall be made:

(1) That would result in the emission of signals outside of the authorized channel.

(2) That would result in the external performance of the transmitter being in disagreement with that prescribed in § 3.317.

(b) Specific authority, upon filing formal application (FCC Form 301) therefor, is required for a change in service area or for any of the following changes:

(1) Changes involving an increase or decrease in the power rating of the transmitter.

(2) A replacement of the transmitter as a whole.

(3) Change in the location of the transmitting antenna.

(4) Change in antenna system, including transmission line.

(5) Change in location of main studio, if it is proposed to move the main studio to a different city from that specified in the license.

(6) Change in the power delivered to the antenna.
(7) Change in frequency control and/or modulation system.
(8) Change in the authorized transmitter remote control point(s).

(c) Other changes, except as above provided for in this section or in the Technical Standards of this subpart, may be made at any time without the authority of the Commission: *Provided*, That the Commission shall be promptly notified thereof and such changes shall be shown in the next application for renewal of license.

§ 3.258 Indicating instruments. (a) Each FM broadcast station shall be equipped with indicating instruments, which conform with the specifications set forth in § 3.320, for measuring the direct plate voltage and current of the last radio stage and the transmission line radio frequency current, voltage or power.

(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: *Provided*, That:

(1) Appropriate entries shall be made in the operating 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 immediately after the instrument is found to be defective and immediately after the repaired or replaced instrument has been installed and functioning properly.

(3) If the defective instrument is a plate voltmeter or plate ammeter in the last radio stage, the operating power shall be maintained by means of the radio frequency transmission line meter.

(c) If conditions beyond the control of the licensee prevent the restoration of the meter to service within the above allowed period, informal request may be filed in accordance with § 1.332(d) of this chapter 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.

Technical Operation

§ 3.261 Time of operation. All FM broadcast stations will be licensed for unlimited time operation. A minimum of 36 hours per week during the hours of 6:00 a.m. to midnight, consisting of not less than 5 hours in any one day, except Sunday, must be devoted to the FM broadcast operation; time devoted to operations conducted pursuant to a Subsidiary Communications Authorization (see §§ 3.293–3.295) shall not be included in meeting this 36-hour broadcast requirement. In an emergency when, due to causes beyond the control of a licensee, it becomes impossible to continue operation, the station may cease operation for a period not to exceed 10 days, provided that the Commission and the Engineer in Charge of the radio district in which the station is located shall be notified in writing immediately after the emergency develops.

§ 3.262 Experimental operation. The period between 1:00 a.m. and 6:00 a.m., local standard time, may be used for experimental purposes in testing and maintaining apparatus by the licensee of any FM broadcast station on its assigned frequency and not in excess of its authorized power without specific authorization by the Commission.

§ 3.263 Station inspection. The licensee of any FM broadcast station shall make the station available for inspection by representatives of the Commission at any reasonable hour.

§ 3.264 Station and operator licenses; posting of. (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.

§ 3.265 **Operator requirements.** (a) One or more radio operators holding a valid radiotelephone first-class operator license, except as provided in paragraph (b) of this section, shall be in actual charge of the transmitting apparatus and shall be on duty either at the transmitter location or remote control point.

(b) A station which is authorized with transmitter power output of 10 kilowatts or less may be operated by persons holding commercial radio operator license of any class, except an aircraft radiotelephone operator authorization or a temporary limited radiotelegraph second-class operator license, when the equipment is so designed that the stability of the frequency is maintained by the transmitter itself within the limits of tolerance specified, and none of the operations, except those specified in subparagraphs (1), (2) and (3) of this paragraph, necessary to be performed during the course of normal operation may cause off-frequency operation or result in any unauthorized radiation. Adjustments of transmitting equipment by such operators, except when under the immediate supervision of a radiotelephone first-class operator shall be limited to the following:

(1) Those necessary to commence or terminate transmitter emissions as a routine matter.

(2) Those external adjustments that may be required as a result of variations of primary power supply.

(3) Those external adjustments which may be necessary to insure modulation within the limits required.

Should the transmitting apparatus be observed to be operating in a manner inconsistent with the station's instrument of authorization and none of the above adjustments are effective in bringing it into proper operation, a person holding other than a radiotelephone first-class operator license and not acting under the immediate supervision of a radiotelephone first-class operator, shall be required to terminate the station's emissions.

(c) The licensee of a station which is operated by one or more operators holding other than a radiotelephone first-class operator license shall have one or more operators holding a radiotelephone first-class operator license in regular full-time employment at the station whose primary duties shall be to effect and insure the proper functioning of the transmitting equipment. In the event that the licensee also operates a standard broadcast station in the same community, a regular full-time radiotelephone first-class operator or operators employed in connection with the FM broadcast station may concurrently be employed to satisfy the requirements of § 3.93(c): *Provided,* That the duties of such operator or operators concerning the standard broadcast transmitting equipment shall in nowise interfere with the proper performance of his duties with respect to the FM broadcast transmitter.

(d) The licensed operator on duty and in charge of an FM broadcast transmitter may, at the discretion of the licensee, 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 duties shall in nowise interfere with the proper operation of the FM broadcast transmitter.

§ 3.266 **Facsimile broadcasting and multiplex transmission.** (a) FM broadcast stations may transmit simplex facsimile in accordance with transmission standards set forth in § 3.318 during periods not devoted to FM aural broadcasting. Such transmissions may not exceed one hour during the period between 7 a.m. and midnight (no limit for the hours between midnight and 7 a.m.) and may not be counted toward the minimum operation required by § 3.261. The Commission shall be notified by the licensee of the FM broadcast station of its intent to transmit such facsimile.

(b) FM broadcast stations may, upon securing authorization from the Commission, transmit multiplex facsimile in accordance with transmission standards set forth in § 3.318: *Provided,* That the transmission of such facsimile does not reduce the quality of aural programs simultaneously transmitted by the licensee below that required by the Technical Standards of this subpart and that no degradation of such aural programs will result from such facsimile transmissions when received on FM receivers not equipped with filter or other additional equipment.

§ 3.267 **Operating power; determination and maintenance of.** (a) The operating power of each station shall be determined by the indirect method. This 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; that is:

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

The efficiency factor, F, shall be established by the transmitter manufacturer for each type of transmitter for which Commission approval is requested, and shall be specified in the instruction books supplied to the customer with each transmitter. In the case of composite equipment the factor, F, shall be furnished to the Commission along with a statement of the basis used in determining such factor.

(b) The operating power of each station shall be maintained as near as practicable to the authorized operating power, and shall not exceed the limits of 5 percent above and 10 percent below the authorized power, except that in an emergency when it becomes impossible to operate with the authorized 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 normal operating power.

§ 3.268 **Modulation.** The percentage of modulation of FM broadcast stations shall be maintained as high as possible consistent with good quality of transmission and good broadcast practice and in no case less than 85 percent nor more than 100 percent on peaks of frequent recurrence during any selection which normally is transmitted at the highest level of the program under consideration.

§ 3.269 **Frequency tolerance.** The center frequency of each FM broadcast station shall be maintained within 2000 cycles of the assigned center frequency.

§ 3.270 **Antenna structure, marking and lighting.** Where an antenna structure(s) is required to be painted or lighted see § 17.29, *Inspection of tower lights and associated control equipment;* § 17.39, *Cleaning and repainting;* § 17.40, *Time when lights shall be exhibited;* § 17.41, *Spare lamps;* and § 17.42, *Lighting equipment;* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 3.271 **Discontinuance of operation.** The licensee of each station shall notify the Commission in Washington, D.C., and the Engineer in Charge of the radio district where such station is located of permanent discontinuance of operation at least two days before operation is discontinued. The licensee shall, in addition, immediately forward the station license and other instruments of authorization to the Washington, D.C., office of the Commission for cancellation.

§ 3.272 **Field intensity measurements.** The Commission may require field intensity measurements in connection with applications and in other cases where such measurements are found to be necessary. For example, any application which asserts that interference predicted under the Technical Standards of this subpart would not be realized may require supplementary data including appropriate field intensity measurements. Furthermore, in order that FM broadcast station coverage data may be accumulated it is desirable that existing FM broadcast stations make such measurements where feasible and file the data with the Commission.

§ 3.273 **Emergency antenna.** In the event it becomes impossible to operate with the regularly authorized antenna, the station may, without further authority, be operated with an emergency antenna for a period of 10 days or less pending necessary repairs: *Provided,* That the Commission and the Engineer in Charge of the radio district in which the station is located shall be notified in writing immediately upon the beginning of such operation and upon the resumption of normal operation.

§ 3.274 **Remote control authorization.** (a) Application to operate a station by remote control may be made as a part of the application for construction permit for a new station. Application to operate an authorized station shall be made on FCC Form 301-A.

(b) An authorization for remote control will be issued only after a satisfactory showing has been made in regard to the following, among others:

(1) The location of the remote control point(s);

(2) The transmitter, if the power rating is in excess of 10 kw, is reliable and capable of being operated by remote control.

§ 3.275 Remote control operation. (a) 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 position 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 the 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 Commission's rules.

(b) All stations, whether operating by remote control or direct control, shall be so equipped, in accordance with § 3.932, so as to be able to follow the prescribed CONELRAD alerting procedure set forth in the CONELRAD Manual for Broadcast Stations.

Other Operating Requirements

§ 3.281 Logs. The licensee or permittee of each FM broadcast station shall maintain separate program and operating logs for such station: *Provided, however,* If the same licensee or permittee operates an FM broadcast station and a standard broadcast station and simultaneously broadcasts the same programs over the facilities of both such stations, one program log may be maintained for both stations for such periods as both stations simultaneously broadcast the same programs. Such licensee or permittee shall require entries to be made as follows:

(a) In the program log:

(1) An entry of the time each station identification announcement (call letters and location) is made.

(2) An entry briefly describing each program broadcast, such as "music," "drama," "speech," etc., together with the name or title thereof and the sponsor's name, with the time of the beginning and ending of the complete program. If a mechanical record is used, the entry shall show the exact nature thereof, such as "record," "transcription," etc., and the time it is announced as a mechanical reproduction. If a speech is made by a political candidate, the name and political affiliations of such speaker shall be entered.

(3) An entry showing that each sponsored program broadcast has been announced as sponsored, paid for, or furnished by the sponsor.

(4) An entry showing, for each program of network origin, the name of the network originating the program.

(b) In the operating log:

(1) An entry of the time the station begins to supply power to the antenna, and the time it stops.

(2) An entry of the time the program begins and ends.

(3) An entry of each interruption to the carrier wave, its cause, and duration.

(4) An entry of the following each 30 minutes:

(i) Operating constants of last radio stage (total plate current and plate voltage).

(ii) RF transmission line meter reading.

(iii) Frequency monitor reading.

(5) Log of experimental operation during experimental period (if regular operation is maintained during this period, the above logs shall be kept).

(i) A log must be kept of all operation during the experimental period. If the entries required above are not applicable thereto, then the entries shall be made so as to fully describe the operation.

(c) Where an antenna structure(s) is required to be illuminated see § 17.38, *Recording of tower light inspections in the station record,* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 3.282 **Logs; retention of.** Logs of FM broadcast stations shall be retained by the licensee or permittee for a period of two 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.

§ 3.283 **Logs; by whom kept.** Each log shall be kept by the person or persons competent to do so, having actual knowledge of the facts required, who shall sign the log when starting duty and again when going off duty. The logs shall be made available upon request by an authorized representative of the Commission.

§ 3.284 **Log form.** The log shall be kept in an orderly manner, in suitable form, and in such detail that the data required for the particular class of station concerned are readily available. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log.

§ 3.285 **Correction of logs.** No log or portion thereof shall be erased, obliterated, or willfully destroyed within the period of retention provided by the rules. Any necessary correction may be made only by the person originating the entry who shall strike out the erroneous portion, initial the correction made, and indicate the date of correction.

§ 3.286 **Rough logs.** Rough logs may be transcribed into condensed form, but in such case the original log or memoranda and all portions thereof shall be preserved and made a part of the complete log.

§ 3.287 **Station identification.** (a) A licensee of an FM broadcast station shall make separate station identification announcement (call letters and location) for such station: *Provided, however,* That, if the same licensee operates an FM broadcast station and a standard broadcast station and simultaneously broadcasts the same programs over the facilities of both such stations, station identification announcements may be made jointly for both stations for periods of such simultaneous operation. If the call letters of the FM station do not clearly reveal that it is an FM station, the joint announcement shall state that one of the stations is an FM station. Station identification announcement shall be made at the beginning and ending of each time of operation and during operation (1) on the hour and (2) either on the half hour or at the quarter hour following the hour and at the quarter hour preceding the next hour: *Provided,*

(b) Such identification announcement need not be made on the hour when to make such announcement would interrupt a single consecutive speech, play, religious service, symphony concert, or operatic production of longer duration than 30 minutes. In such cases the identification announcement shall be made at the beginning of the program, at the first interruption of the entertainment continuity, and at the conclusion of the program.

(c) Such identification announcement need not be made on the half hour or quarter hours when to make such announcement would interrupt a single consecutive speech, play, religious service, symphony concert, or operatic production. In such cases an identification announcement shall be made at the first interruption of the entertainment continuity and at the conclusion of the program: *Provided,* That an announcement within 5 minutes of the times specified in paragraph (a)(2) of this section will satisfy the requirements of identification announcements.

(d) In the case of variety show programs, baseball game programs or similar programs of longer duration than 30 minutes, the identification announcement shall be made within 5 minutes of the hour and of the times specified in paragraph (a)(2) of this section.

(e) In the case of all other programs, the identification announcement shall be

made within 2 minutes of the hour and of the times specified in paragraph (a)(2) of this section.

(f) In making the identification announcement the call letters shall be given only on the channel of the station identified thereby except as otherwise provided herein.

§ 3.288 Mechanical reproductions. (a) No mechanically reproduced program consisting of a speech, news event, news commentator, forum, panel discussion, or special event in which the element of time is of special significance, or any other program in which the element of time is of special significance and presentation of which would create, either intentionally or otherwise, the impression or belief on the part of the listening audience that the event or program being broadcast is in fact occurring simultaneously with the broadcast, shall be broadcast without an appropriate announcement being made either at the beginning or end of such reproduction or at the beginning or end of the program in which such reproduction is used that it is a mechanical reproduction or a mechanically reproduced program: *Provided, however,* That each such program of one minute or less need not be announced as such.

(b) The exact form of identifying announcement is not prescribed, but the language shall be clear and in terms commonly used and understood. Any other program mechanically reproduced or series of mechanical reproductions, including a mechanical reproduction used for background music, sound effects, station identification, program identification (theme music of short duration) or identification of sponsorship of the program proper, need not be announced as provided in paragraph (a) of this section, but the licensee shall not attempt affirmatively to create the impression that any program being broadcast by mechanical reproduction consists of live talent.

(c) The requirements of paragraph (a) of this section are waived with respect to network programs, transcribed and rebroadcast at a later hour because of the time zone differential between the place where the program originates and where it is rebroadcast, this waiver being applicable whether the off-the-line recording is made by the network itself at one of its key stations or by an individual station, but only when the off-the-line recording is for broadcast at an hour not exceeding the time zone differential between the place where the program originates and where it is rebroadcast. Each station which broadcasts network programs at a later hour in accordance with this waiver shall make an appropriate announcement at least once each day between the hours of 10:00 a.m. and 10:00 p.m., stating that some or all of the network programs which are broadcast by that station are delayed broadcasts by means of transcription. This waiver provision also applies during the annual periods in which daylight saving time will be effective with respect to network programs transcribed and rebroadcast one hour later because of the time differential resulting from the adoption of daylight saving time in some areas.

§ 3.289 Sponsored programs; announcement of. (a) In the case of each program for the broadcasting of which money, services, or other valuable consideration is either directly or indirectly paid or promised to, or charged or received by, any radio broadcast station, the station broadcasting such program shall make, or cause to be made, an appropriate announcement that the program is sponsored, paid for, or furnished, either in whole or in part.

(b) In the case of any political program or any program involving the discussion of public controversial issues for which any records, transcriptions, talent, scripts, or other material or services of any kind are furnished, either directly or indirectly, to a station as an inducement to the broadcasting of such program, an announcement shall be made both at the beginning and conclusion of such program on which such material or services are used that such records, transcriptions, talent, scripts, or other material or services have been furnished to such station in connection with the broadcasting of such program: *Provided, however,* That only one such announcement need be made in the case of any such program of 5 minutes' duration or less, which announcement may be made either at the beginning or conclusion of the program.

(c) The announcement required by this section shall fully and fairly disclose the true identity of the person or persons by whom or in whose behalf such payment is made or promised, or from whom or in whose behalf such services or other valuable consideration is received, or by whom the material or services referred to in paragraph (b) of this section are furnished. Where an agent or other person contracts

or otherwise makes arrangements with a station on behalf of another, and such fact is known to the station, the announcement shall disclose the identity of the person or persons in whose behalf such agent is acting instead of the name of such agent.

(d) In the case of any program, other than a program advertising commercial products or services, which is sponsored, paid for, or furnished, either in whole or in part, or for which material or services referred to in paragraph (b) of this section are furnished, by a corporation, committee, association or other unincorporated group, the announcement required by this section, shall disclose the name of such corporation, committee, association or other unincorporated group. In each such case the station shall require that a list of the chief executive officers or members of the executive committee or of the board of directors of the corporation, committee, association or other unincorporated group shall be made available for public inspection at one of the radio stations carrying the program.

(e) In the case of programs advertising commercial products or services, an announcement stating the sponsor's corporate or trade name or the name of the sponsor's product, shall be deemed sufficient for the purposes of this section and only one such announcement need be made at any time during the course of the program.

§ 3.290 **Broadcasts by candidates for public office.** (a) *Definitions.* A "legally qualified candidate" means any person who has publicly announced that he is a candidate for nomination by a convention of a political party or for nomination or election in a primary, special, or general election, municipal, county, state or national, and who meets the qualifications prescribed by the applicable laws to hold the office for which he is a candidate, so that he may be voted for by the electorate directly or by means of delegates or electors, and who—

(1) Has qualified for a place on the ballot or

(2) Is eligible under the applicable law to be voted for by sticker, by writing in his name on the ballot, or other method, and (i) has been duly nominated by a political party which is commonly known and regarded as such, or (ii) makes a substantial showing that he is a bona fide candidate for nomination or office, as the case may be.

(b) *General requirements.* No station licensee is required to permit the use of its facilities by any legally qualified candidate for public office, but if any licensee shall permit any such candidate to use its facilities, it shall afford equal opportunities to all other such candidates for that office to use such facilities: *Provided,* That such licensee shall have no power of censorship over the material broadcast by any such candidate.

(c) *Rates and practices.* (1) The rates, if any, charged all such candidates for the same office shall be uniform and shall not be rebated by any means direct or indirect. A candidate shall, in each case, be charged no more than the rate the station would charge if the candidate were a commercial advertiser whose advertising was directed to promoting its business within the same area as that encompassed by the particular office for which such person is a candidate. All discount privileges otherwise offered by a station to commercial advertisers shall be available upon equal terms to all candidates for public office.

(2) In making time available to candidates for public office no licensee shall make any discrimination between candidates in charges, practices, regulations, facilities, or services for or in connection with the service rendered pursuant to this part, or make or give any preference to any candidate for public office or subject any such candidate to any prejudice or disadvantage; nor shall any licensee make any contract or other agreement which shall have the effect of permitting any legally qualified candidate for any public office to broadcast to the exclusion of other legally qualified candidates for the same public office.

(d) *Inspection of records.* Every licensee shall keep and permit public inspection of a complete record of all requests for broadcast time made by or on behalf of candidates for public office, together with an appropriate notation showing the disposition made by the licensee of such requests, and the charges made, if any, if request is granted. Such records shall be retained for a period of two years.

(e) A request for equal opportunities must be submitted to the licensee within one week of the day on which the prior use occurred.

(f) A candidate requesting equal opportunities of the licensee, or complaining of non-compliance to the Commission shall have the burden of proving that he and his opponent are legally qualified candidates for the same public office.

§ 3.291 Rebroadcast. (a) The term "rebroadcast" means reception by radio of the program of a radio station, and the simultaneous or subsequent retransmission of such program by a broadcast station.

NOTE 1: As used in this section, program includes any complete program or part thereof.
NOTE 2: In case a program is transmitted from its point of origin to a broadcast station entirely by telephone facilities in which a section of such transmission is by radio, the broadcasting of this program is not considered a rebroadcast.

(b) The licensee of an FM broadcast station may, without further authority of the Commission, rebroadcast the program of a United States standard, FM or non-commercial educational FM broadcast station, provided the Commission is notified of the call letters of each station rebroadcast and the licensee certifies that express authority has been received from the licensee of the station originating the program.

NOTE: The notice and certification of consent shall be given within 3 days of any single rebroadcast, but in case of the regular practice of rebroadcasting certain programs of a standard or FM broadcast station several times during a license period, notice and certification of consent shall be given for the ensuing license period with the application for renewal of license, or at the beginning of such rebroadcast practice if begun during a license period.

(c) (1) The licensee of an FM broadcast station located within a State or the District of Columbia may, without further authority of the Commission, rebroadcast on a noncommercial basis a noncommercial program of a United States international broadcast station.

(2) The licensee of an FM broadcast station located in any territory or insular possession of the United States may, without further authority of the Commission, rebroadcast any program of a United States international broadcast station.

(3) In the case of any rebroadcast under the provisions of this paragraph, the Commission shall be notified of the call letters of each station whose program is rebroadcast and the licensee shall certify that express authority has been received from the licensee of the station originating the program.

(d) No licensee of an FM broadcast station shall rebroadcast the program of any United States radio station not designated in paragraph (b) or (c) of this section without written authority having first been obtained from the Commission upon application (informal) accompanied by written consent or certification of consent of the licensee of the station originating the program.

NOTE 1: The broadcasting of a program relayed by a remote pickup broadcast station or an ST broadcast station is not considered a rebroadcast.
NOTE 2: By Order No. 82, dated and effective June 24, 1941, until further order of the Commission, § 3.291(d) is suspended only insofar as it requires prior written authority of the Commission for the rebroadcasting of programs originated for that express purpose by United States Government radio stations.

§ 3.292 Lotteries. (a) An application for construction permit, license, renewal of license, or any other authorization for the operation of a broadcast station, will not be granted where the applicant proposes to follow or continue to follow a policy or practice of broadcasting or permitting "the broadcasting of, any advertisement of or information concerning any lottery, gift enterprise, or similar scheme, offering prizes dependent in whole or in part upon lot or chance, or any list of the prizes drawn or awarded by means of any such lottery, gift enterprise, or scheme, whether said list contains any part or all of such prizes." (See 18 U. S. C. 1304.)

(b) The determination whether a particular program comes within the provisions of paragraph (a) of this section depends on the facts of each case. However, the Commission will in any event consider that a program comes within the provisions of paragraph (a) of this section if in connection with such program a prize consisting of money or thing of value is awarded to any person whose selection is dependent in

whole or in part upon lot or chance, if as a condition of winning or competing for such prize, such winner or winners are required to furnish any money or thing of value or are required to have in their possession any product sold, manufactured, furnished or distributed by a sponsor of a program broadcast on the station in question.

§ 3.293 Subsidiary Communications Authorizations. An FM broadcast licensee or permittee may apply for a Subsidiary Communications Authorization (SCA) to engage in a limited type of non-broadcast service. These services are restricted to those involving programming consisting of news, music, time, weather, and other similar program categories. (The functional music services whereby FM stations undertake to supply programs of a predominantly musical nature to commercial establishments is an example of such an SCA service.) FCC Form 318—Application for Subsidiary Communications Authorization—shall be submitted; the applicant for the SCA shall there specify the particular nature or purposes of the SCA operation or operations sought. New SCA operations will be authorized only for multiplexing. Outstanding Subsidiary Communications Authorizations for simplex operations will not be extended beyond March 1, 1958. SCA operations on a multiplex basis may be carried on without restriction as to time. Simplex operations pursuant to outstanding authorizations shall be conducted during those times not devoted to the 36 hours required under § 3.261 for FM broadcast operation.

§ 3.294 Nature of the SCA. (a) The SCA is of a subsidiary or secondary nature and shall not exist apart from the FM license or permit. No transfer or assignment of it shall be made separate from the FM broadcast license, and failure to transfer the SCA (through application on FCC Form 318) with the FM license or permit renders the SCA void. The licensee or permittee must seek renewal of the SCA (on FCC Form 318) at the same time it applies for its renewal of FM license or permit; failure to renew the latter automatically terminates the SCA.

(b) The grant or renewal of an FM license or permit shall not be furthered or promoted by the proposed or past operation under an SCA; the licensee must establish that his broadcast operation is in the public interest wholly apart from the SCA activities. (Violation of rules applicable to the SCA operation would, of course, reflect on the licensee's qualifications to hold its broadcast license or permit.)

§ 3.295 Operation under the SCA. (a) The SCA holder must restrict its operation to the uses or purposes granted by the Commission in acting upon his application; prior permission to engage in any additional or new activity must be obtained from the Commission.

(b) Supersonic tones or other similar devices may be employed with respect to material transmitted during the SCA operation in order to promote or maintain its commercial marketability, with the station using appropriate actuating devices with the subscribers' receivers.

(c) In all arrangements entered into under the SCA with outside parties, the licensee or permittee must pass on all material to be transmitted over the station's facilities, with the right to reject any material which it deems inappropriate or undesirable; when the SCA operation is conducted on a simplex basis, the licensee must be able, through appropriate contractual arrangement, to substitute a broadcast program at any time it deems it in the public interest to do so.

(d) The requirements of §§ 3.290 and 3.291 are equally applicable when the FM licensee or permittee is engaged in operations pursuant to the SCA.

(e) The requirements of § 3.287 with respect to station identification announcements must be met by identification on the main carrier when a station is engaged in SCA operations. The licensee may prevent their reception on subscribers' receivers through the use of supersonic tones capable of deactivating these specialized receivers.

(f) The requirements of §§ 3.288 and 3.289 are applicable to the SCA operation when the latter is conducted on a simplex basis; provided that the station may employ supersonic tones or other devices to prevent the reception of such announcements over subscribers' receivers. The requirement of § 3.289 shall be deemed to have been met by the SCA operator by the latter's announcement that the program is being transmitted for a fee to commercial subscribers.

(g) The FM licensee or permittee shall maintain logs for the SCA operations. In the program log, the following entries shall be made:

(1) An entry of the time each station identification announcement (call letters and location) is made.

(2) An entry describing the material transmitted in each hour segment. If a speech is made by a political candidate, the name and political affiliations of such speaker shall be entered.

(3) An entry showing that sponsorship and mechanical record announcements, when required under paragraph (f) of this section, have been made, and the time of the latter announcements.

(h) The requirements of § 3.281(b), (1)-(4), inclusive and (c), and §§ 3.282 to 3.286, inclusive, are equally applicable to logs to be maintained during the SCA operation.

(i) The requirements of § 3.265 with respect to operators and the provisions of § 3.274 relating to remote control operation are equally applicable to operation during the SCA period.

(j) The licensee must observe all technical rules and standards applicable to FM broadcast stations when conducting the SCA operation. (For criteria applicable to the multiplex SCA operation, see § 3.318.)

§ 3.296 Emergency weather warnings. Upon receipt of notification of an Emergency Weather Warning of a condition of immediate danger to life and property from the United States Weather Bureau, all FM broadcast stations may, at their option, broadcast CONELRAD Attention Signals (two five second carrier breaks and fifteen seconds of 1,000 CPS tone) followed by the Emergency Weather Warning as outlined in CONELRAD Manual BC-3 (Revised), Appendix A.

FM Technical Standards

§ 3.301 Introduction. (a) There are presented herein the Commission's engineering standards relating to the allocation and operation of FM broadcast stations. These standards also apply to noncommercial educational FM broadcast stations, except as noted herein. The Commission's rules and regulations contain references to these standards, which have been approved by the Commission and thus are considered as reflecting its opinion in all matters involved.

(b) The standards set forth herein are those deemed necessary for the construction and operation of FM broadcast stations to meet the requirements of technical regulations and for operation in the public interest along technical lines not otherwise enunciated. These standards are based upon the best engineering data available, including evidence at hearings, conferences with radio engineers, and data supplied by manufacturers of radio equipment and by licensees of FM broadcast stations. These standards are complete in themselves and supersede previous engineering standards or policies of the Commission concerning FM broadcast stations. While these standards provide for flexibility and indicate the conditions under which they are applicable, it is not expected that material deviation from the fundamental principles will be recognized unless full information is submitted as to the need and reasons therefor.

(c) These standards will necessarily be revised from time to time as progress is made in the art. The Commission will accumulate and analyze engineering data available as to the progress of the art so that these standards may be kept current with technical developments.

§ 3.310 Definitions. (a) *FM broadcast station.* The term "FM broadcast station" means 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.

(b) *Frequency modulation.* The term "frequency modulation" means 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.

(c) *FM broadcast band.* The term "FM broadcast band" means the band of frequencies extending from 88 to 108 megacycles, which includes those assigned to noncommercial educational broadcasting.

(d) *Center frequency.* The term "center frequency" means:

(1) The average frequency of the emitted wave when modulated by a sinusoidal signal.

(2) The frequency of the emitted wave without modulation.

(e) *Frequency swing.* The term "frequency swing" means the instantaneous departure of the frequency of the emitted wave from the center frequency resulting from modulation.

(f) *FM broadcast channel.* The term "FM broadcast channel" means a band of frequencies 200 kilocycles wide and is designated by its center frequency. Channels for FM broadcast stations begin at 88.1 megacycles and continue in successive steps of 200 kilocycles to and including 107.9 megacycles.

(g) *Antenna field gain.* The term "antenna field gain" of an FM broadcast antenna means the ratio of the effective free space field intensity produced at one mile in the horizontal plane expressed in millivolts per meter for 1 kilowatt antenna input power to 137.6 mv/m.

(h) *Free space field intensity.* The term "free space field intensity" means the field intensity that would exist at a point in the absence of waves reflected from the earth or other reflecting objects.

(i) *Multiplex transmission.* The term "multiplex transmission" means 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.

(j) *Percentage modulation.* The term "percentage modulation" as applied to frequency modulation means 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.

(k) *Effective radiated power.* The term "effective radiated power" means 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.

(l) *Service area.* The term "service area" as applied to FM broadcasting means the service resulting from an assigned effective radiated power and antenna height above average terrain.

(m) *Antenna height above average terrain.* (1) The term "antenna height above average terrain" means the height of the radiation center of the antenna above the terrain 2 to 10 miles from the antenna. (In general a different antenna height will be determined for each direction from the antenna. The average of these various heights is considered as the antenna height above average terrain.)

(2) 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.

(n) *Field intensity.* The term "field intensity" as used in these standards shall mean the electric field intensity in the horizontal direction.

(o) *Index of cooperation.* The index of cooperation as applied to facsimile broadcasting is 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., $105 \times 8.2 \times 8/7 = 984$).

(p) *Line-use ratio.* The term "line-use ratio" as applied to facsimile broadcasting is the ratio of the available line to the total length of scanning line.

(q) *Available line.* The term "available line" means the portion of the total length of scanning line that can be used specifically for picture signals.

(r) *Rectilinear scanning.* The term "rectilinear scanning" means the process of scanning an area in a predetermined sequence of narrow straight parallel strips.

(s) *Optical density.* The term "optical density" means the logarithm (to the base 10) of the ratio of incident to transmitted or reflected light.

§ 3.311 Engineering standards of allocation. (a) Sections 3.202 to 3.205 inclusive of the rules and regulations describe the basis for allocation of FM broadcast stations, including the division of the United States into Areas I and II.

(b) FM broadcast stations shall determine the extent of their 1 mv/m and 50 uv/m contours in accordance with the methods prescribed in these Standards.

(c) Although some service is provided by tropospheric waves, the service area is considered to be only that served by the ground wave. The extent of service is determined by the point at which the ground wave is no longer of sufficient intensity to provide satisfactory broadcast service. The field intensity considered necessary for service is as follows:

Area:	*Median field intensity*
City business or factory areas	1 mv/m
Rural areas	50 uv/m

A median field intensity of 3 to 5 mv/m should be placed over the principal city to be served and for class B stations, a median field intensity of 1 mv/m should be placed over the business district of cities of 10,000 or greater within the metropolitan district served. A field intensity of 5 mv/m should be provided over the main studio of a class B station except as otherwise provided in § 3.205. These figures are based upon the usual noise levels encountered in the several areas and upon the absence of interference from other FM stations.

(d) A basis for allocation of satellite stations has not yet been determined. For the present, applications will be considered on their individual merits.

(e) The service area is predicted as follows: Profile graphs must be drawn for at least eight radials from the proposed antenna site. These profiles should be prepared for each radial beginning at the antenna site and extending to 10 miles therefrom. Normally the radials are drawn for each 45° of azimuth; however, where feasible the radials should be drawn for angles along which roads tend to follow. (The latter method may be helpful in obtaining topographical data where otherwise unavailable, and is particularly useful in connection with mobile field intensity measurements of the station and the correlation of such measurements with predicted field intensities.) In each case one or more radials must include the principal city or cities to be served, particularly in cases of rugged terrain, even though the city may be more than 10 miles from the antenna site. The profile graph for each radial should be plotted by contour intervals of from 40 to 100 feet and, where the data permits, at least 50 points of elevation (generally uniformly spaced) should be used for each radial. In instances of very rugged terrain where the use of contour intervals of 100 feet would result in several points in a short distance, 200- or 400-foot contour intervals may be used for such distances. On the other hand, where the terrain is uniform or gently sloping the smallest contour interval indicated on the topographic map (see below) should be nsed, although only a relatively few points may be available. The profile graph should accurately indicate the topography for each radial, and the graphs should be plotted with the distance in miles as the abscissa and the elevation in feet above mean sea level as the ordinate. The profile graphs should indicate the source of the topographical data employed. The graph should also show the elevation of the center of the radiating system. The graph may be plotted either on rectangular coordinate paper or on special paper which shows the curvature of the earth. It is not necessary to take the curvature of the earth into consideration in this procedure, as this factor is taken care of in the chart showing signal intensities (Fig. 1 of § 3.333).

(f) The average elevation of the 8-mile distance between 2 and 10 miles from the antenna site should then be determined from the profile graph for each radial. This may be obtained by averaging a large number of equally spaced points, by using a planimeter, or by obtaining the median elevation (that exceeded for 50 percent of the distance) in sectors and averaging these values.

(g) To determine the distance to a particular contour, Figure 1 of § 3.333 con-

cerning the range of FM broadcast stations should be used. This chart has been prepared for a frequency in the center of the band and is to be used for all FM broadcast channels, since little change results over this frequency range. The distance to a contour is determined by the effective radiated power and the antenna height. The height of the antenna used in connection with Figure 1 of § 3.333 should be the height of the center of the proposed antenna radiator above the average elevation obtained by the preceding method. The distances shown by Fig. 1 of § 3.333 are based upon an effective radiated power of 1 kilowatt; to use the chart for other powers, the sliding scale associated with the chart should be trimmed and used as the ordinate scale. This sliding scale is placed on the chart with the appropriate graduation for power in line with the lower line of the top edge of the chart. The right edge of the scale is placed in line with the appropriate antenna height graduations and the chart then becomes direct reading for this power and antenna height. Where the antenna height is not one of those for which a scale is provided, the signal strength or distance is determined by interpolation between the curves connecting the equidistant points.

(h) The foregoing process of determining the extent of the required contours shall be followed in determining the boundary of the proposed service area. The areas within the required contours must be determined and submitted with each application for an FM broadcast station. Each application shall include a map showing these contours, and for this purpose sectional aeronautical charts or other maps having a convenient scale may be used. The map shall show the radials along which the profile charts and expected field strengths have been determined. The area within each contour should then be measured (by planimeter or other approximate means) to determine the number of square miles therein. In computing the area within the contours, exclude (1) areas beyond the borders of the United States, and (2) large bodies of water, such as ocean areas, gulfs, sounds, bays, large lakes, etc., but not rivers.

(i) In cases where the terrain in one or more directions from the antenna site departs widely from the average elevation of the 2 to 10 mile sector, the application of this prediction method may indicate contour distances that are different from those which may be expected in practice. In such cases the prediction method should be followed, but a showing may be made if desired concerning the distance to the contour as determined by other means. Such showing should include data concerning the procedure employed and sample calculations. For example, a mountain ridge may indicate the practical limit of service although the prediction method may indicate the contour elsewhere. In cases of such limitation, the map of predicted coverage should show both the regular predicted area and the area as limited or extended by terrain. Both areas should be measured as previously described; the area obtained by the regular prediction method should be given in the application form, with a supplementary note giving the limited or extended area. In special cases the Commission may require additional information as to the terrain in the proposed service area.

(j) In determining the population served by FM broadcast stations, it is considered that the built-up city areas and business districts in cities having over 10,000 population and located beyond the 1 mv/m contour do not receive adequate service. Minor civil division maps (1950 census) should be used in making population comts, excluding cities not receiving adequate service. Where a contour divides a minor division, uniform distribution of population within the division should be assumed in order to determine the population included within the contour unless a more accurate count is available.

§ 3.312 Topographic data. (a) In the preparation of the profile graphs previously described, and in determining the location and height above mean sea level of the antenna site, the elevation or contour intervals shall be taken from United States Geological Survey Topographic Quadrangle Maps, United States Army Corps of Engineers Maps or Tennessee Valley Authority maps, whichever is the latest, for all areas for which such maps are available. If such maps are not published for the area in question, the next best topographic information should be used. Topographic

data may sometimes be obtained from state and municipal agencies. The data from the Sectional Aeronautical Charts (including bench marks) or railroad depot elevations and highway elevations from road maps may be used where no better information is available. In cases where limited topographic data can be obtained, use may be made of an altimeter in a car driven along roads extending generally radially from the transmitter site.

(b) The Commission will not ordinarily require the submission of topographical maps for areas beyond 15 miles from the antenna site, but the maps must include the principal city or cities to be served. If it appears necessary, additional data may be requested.

(c) The United States Geological Survey Topography Quadrangle Sheets may be obtained from the United States Geological Survey Department of the Interior, Washington, D.C., for 20 cents each. The Sectional Aeronautical Charts are available from the United States Coast and Geodetic Survey, Department of Commerce, Washington, D.C., for 25 cents each. These maps may also be secured from branch offices and from authorized agents or dealers in most principal cities.

§ 3.313 Interference standard. (a) Field intensity measurements are preferable in predicting interference between FM broadcast stations and should be used, when available, in determining the extent of interference. (For methods and procedure, see § 3.314.) In lieu of measurements, the interference should be predicted in accordance with the method described herein.

(b) Objectionable interference is considered to exist when the interfering signal exceeds that given by the following ratios. (The desired signal is median field and the undesired signal is the tropospheric signal intensity exceeded for 1 percent of the time.)

Channel separation:	*Ratio of desired to undesired signals*
Same channel	10:1.
200 kc	2:1.
400 kc	1:10.
600 kc	1:100.
800 kc and above	No restriction.[1]

[1] Intermediate frequency amplifiers of most FM broadcast receivers are designed to operate on 10.7 megacycles. For this reason the assignment of two stations in the same area, one with a frequency 10.6 or 10.8 megacycles removed from that of the other, should be avoided if possible.

(c) Stations normally will not be authorized to operate in the same city or in nearby cities with a frequency separation of less than 800 kc: *Provided,* That stations may be authorized to operate in nearby cities with a frequency separation of not less than 400 kc where necessary in order to provide an equitable and efficient distribution of facilities: *And provided further,* That class B stations will not be authorized in the same metropolitan district with a frequency separation of less than 800 kc. In the assignment of FM broadcast facilities the Commission will endeavor to provide the optimum use of the channels in the band, and accordingly may assign a channel different from that requested in an application.

(d) In predicting the extent of interference within the ground wave service area of a station, use should be made of the groundwave chart. (Figure 1 of § 3.333.)

(e) In determining the points at which the interference ratio is equal to the values shown in paragraph (b) of this section, the field intensities for the two interfering signals under consideration should be computed for a considerable number of points along the line between the two stations. Using this data, field intensity versus distance curves should be plotted (e.g., cross-curves on graph paper) in order to determine the points on this path where the interference ratios exist. The points established by this method together with the points along the contours where the same ratios are determined, are considered to be generally sufficient to predict the area of interference. Additional points may be required in the case of irregular terrain or the use of directional antenna systems.

(f) The area of interference, if any, shall be shown in connection with the map

of predicted coverage required by the application form, together with the basic data employed in computing such interference. The map shall show the interference within the 50 uv/m contour.

§ 3.314 **Field intensity measurements in allocation.** (a) When field intensity measurements are required by the Commission's rules or when employed in determining the extent of service or interference of existing stations, such measurements should be made in accordance with the procedure outlined herein.

(b) Measurements made to determine the service and interference areas of FM broadcast stations should be made with mobile equipment along roads which are as close and similar as possible to the radials showing topography which were submitted with the application for construction permit. Suitable measuring equipment and a continuous recording device must be employed, the chart of which is either directly driven from the speedometer of the automobile in which the equipment is mounted or so arranged that distances and identifying landmarks may be readily noted. The measuring equipment must be calibrated against recognized standards of field intensity and so constructed that it will maintain an acceptable accuracy of measurement while in motion or when stationary. The equipment should be so operated that the recorder chart can be calibrated directly in field intensity in order to facilitate analysis of the chart. The receiving antenna shall be primarily responsive to the horizontal electric field and should be nondirectional unless otherwise authorized. Authorization to use a half-wave dipole may be requested by filing application with the Commission prior to the making of measurements. The application may be filed by letter describing the proposed antenna, the method of installation and operation, and calibration procedures. Such authorization will remain in effect throughout the series of measurements for which granted.

(c) Mobile measurements should be made with a minimum chart speed of 3 inches per mile and preferably 5 or 6 inches per mile. Locations shall be noted on the recorder chart as frequently as necessary to definitely fix the relation between the measured field intensity and the location. The time constant of the equipment should be such to permit adequate analysis of the charts, and the time constant employed shall be shown. Measurements should be made to a point on each radial well beyond the particular contour under investigation. The transmitter power shall be maintained as close as possible to the authorized power throughout the survey.

(d) After the measurements are completed, the recorder chart shall be divided into not less than 15 sections on each equivalent radial from the station. The field intensity in each section of the chart shall be analyzed to determine the field intensity received 50 percent of the distance (median field) throughout the section, and this median field intensity associated with the corresponding sector of the radial. The field intensity figures must be corrected for a receiving antenna elevation of 30 feet and for any directional effects of the automobile not otherwise compensated. This data should be plotted for each radial, using log-log coordinate paper with distance as the abscissa and field intensity as the ordinate. A smooth curve should be drawn through these points (of median fields for all sectors), and this curve used to determine the distance to the desired contour. The distances obtained for each radial may then be plotted on the map of predicted coverage or on polar coordinate paper (excluding water areas, etc.) to determine the service and interference areas of a station.

(e) In making measurements to establish the field intensity contours of a station, mobile recordings should be made along each of the radials drawn in § 3.311(e). Measurements should extend from the vicinity of the station out to the 1 mv/m measured contour and somewhat beyond (at the present time it is not considered practical to conduct mobile measurements far beyond this contour due to the fading ratio at weak fields, which complicates analysis of the charts). These measurements would be made for the purpose of determining the variation of the measured contours from those predicted, and it is expected that initially the correlation of the measured 1 mv/m with the predicted 1 mv/m contour will be used as a basis in determining adherence to authorized service areas within the 50 mv/m contour.

(f) In addition to the 1 mv/m contour, the map of measured coverage shall show the 50 uv/m contour as determined by employing Figure 1 of § 3.333 and the dis-

tance to the 1 mv/m contour along each radial. The sliding scale shall be placed on the figure at the appropriate antenna height for the radial in question and then moved so the distance to the 1 mv/m contour (as measured) and the 1 mv/m mark are opposite. The distance to the 50 uv/m contour is then given opposite the 50 uv/m mark on the scale.

(g) In certain cases the Commission may desire more information or recordings and in these instances special instructions will be issued. This may include fixed location measurements to determine tropospheric propagation and fading ratios.

(h) Complete data taken in conjunction with field intensity measurements shall be submitted to the Commission in affidavit form including the following:

(1) Map or maps showing the roads or points where measurements were made, the service and/or interference areas determined by the prediction method and by the measurements, and any unusual terrain characteristics existing in these areas. (This map may preferably be of a type showing topography in the area.)

(2) If a directional transmitting antenna is employed, a diagram on polar coordinate paper showing the predicted free space field intensity in millivolts per meter at one mile in all directions. (See § 3.316.)

(3) A full description of the procedures and methods employed including the type of equipment, the method of installation and operation, and calibration procedures.

(4) A representative sample of the recording tape, including calibration.

(5) Antenna system and power employed during the survey.

(6) Name, address, and qualifications of the engineer or engineers making the measurements.

(i) All data shall be submitted to the Commission in triplicate.

§ 3.315 Transmitter location. (a) The transmitter location should be as near the center of the proposed service area as possible consistent with the applicant's ability to find a site with sufficient elevation to provide service throughout the area. Location of the antenna at a point of high elevation is necessary to reduce to a minimum the shadow effect on propagation due to hills and buildings which may reduce materially the intensity of the station's signals in a particular direction. The transmitting site should be selected consistent with the purpose of the station, i.e., whether it is intended to serve a small city, a metropolitan area, or a large region. Inasmuch as service may be provided by signals of 1 mv/m or greater field intensities in metropolitan areas, and inasmuch as signals as low as 20 uv/m may provide service in rural areas, considerable latitude in the geographical location of the transmitter is permitted; however, the necessity for a high elevation for the antenna may render this problem difficult. In general, the transmitting antenna of a station should be located at the most central point at the highest elevation available. In providing the best degree of service to an area, it is usually preferable to use a high antenna rather than a lower antenna with increased transmitter power. The location should be so chosen that line-of-sight can be obtained from the antenna over the principal city or cities to be served; in no event should there be a major obstruction in this path.

(b) The transmitting location should be selected so that the 1 mv/m contour encompasses the urban population within the area to be served and the 50 uv/m or the interference free contour coincides generally with the limits of the area to be served. It is recognized that topography, shape of the desired service area, and population distribution may make the choice of a transmitter location difficult. In such cases consideration may be given to the use of a directional antenna system, although it is generally preferable to choose a site where a nondirectional antenna may be employed.

(c) In cases of questionable antenna locations it is desirable to conduct propagation tests to indicate the field intensity expected in the principal city or cities to be served and in other areas, particularly where severe shadow problems may be expected. In considering applications proposing the use of such locations, the Commission may require site tests to be made. Such tests should be made in accordance with the measurement procedure previously described, and full data thereon must be supplied to the Commission. Test transmitters should employ an antenna having a height as close as possible to the proposed antenna height, using a balloon or other

support if necessary and feasible. Information concerning the authorization of site tests may be obtained from the Commission upon request.

(d) Present information is not sufficiently complete to establish "blanket areas" of FM broadcast stations, which are defined as those areas adjacent to the transmitters in which the reception of other stations is subject to interference due to the strong signal from the stations. Where it is found necessary to locate the transmitter in a residential area where blanketing problems may appear to be excessive, the application must inculde a showing concerning the availability of other sites. The authorization of station construction in areas where blanketing problems appear to be excessive will be on the basis that the applicant will assume full responsibility for the adjustment of reasonable complaints arising from excessively strong signals of the applicant's station. As a means of minimizing interference problems it is expected that stations adjacent in location will generally be assigned frequencies that are generally adjacent. Insofar as is feasible, frequency assignments for stations at separated locations will also be separated.

(e) Cognizance must of course be taken regarding the possible hazard of the proposed antenna structure to aviation and the proximity of the proposed site to airports and airways. Procedures and standards with respect to the Commission's consideration of proposed antenna structures which will serve as a guide to persons intending to apply for radio station licenses are contained in Part 17 of this chapter (Rules Concerning the Construction, Marking and Lighting of Antenna Structures).

§ 3.316 Antenna systems. (a) It shall be standard to employ horizontal polarization; however, circular or elliptical polarization may be employed if desired. Clockwise or counterclockwise rotation may be used. The supplemental vertically polarized effective radiated power required for circular or elliptical polarization shall in no event exceed the effective radiated power authorized.

(b) The antenna must be constructed so that it is as clear as possible of surrounding buildings or objects that would cause shadow problems.

(c) Applications proposing the use of directional antenna systems must be accompanied by the following:

(1) Complete description of the proposed antenna system.

(2) Orientation of array with respect to true north; time phasing of fields from elements (degrees leading or lagging); space phasing of elements (in feet and in degrees); ratio of fields from elements.

(3) Calculated field intensity pattern (on letter-size polar coordinate paper) giving the free space field intensity in millivolts per meter at one mile in the horizontal plane, together with the formula used, constants employed, sample calculations and tabulation of calculation data.

(4) Name, address, and qualifications of the engineer making the calculations.

(d) Applications proposing the use of FM broadcast antennas in the immediate vicinity (i.e., 200 feet or less) of (1) other FM broadcast antennas, or (2) television broadcast antennas for frequencies adjacent to the FM broadcast band, must include a showing as to the expected effect, if any, of such proximate operation.

(e) In cases where it is proposed to use a tower of a standard broadcast station as a supporting structure for an FM broadcast antenna, an application for construction permit (or modification of construction permit) for such station must be filed for consideration with the FM application. Applications may be required for other classes of stations when their towers are to be used in connection with FM broadcast stations.

(f) When an FM broadcast antenna is mounted on a nondirectional standard broadcast antenna, new resistance measurements must be made of the standard broadcast antenna after installation and testing of the FM broadcast antenna. During the installation and until the new resistance determination is approved, the standard broadcast station licensee should apply for authority (informal application) to operate by the indirect method of power determination. The FM broadcast license application will not be considered until the application form concerning resistance measurements is filed for the standard broadcast station.

(g) When an FM broadcast antenna is mounted on an element of a standard

broadcast directional antenna, a full engineering study concerning the effect of the FM broadcast antenna on the directional pattern must be filed with the application concerning the standard broadcast station. Depending upon the individual case, the Commission may require readjustment and certain field intensity measurements of the standard broadcast station following the completion of the FM broadcast antenna system.

(h) When the proposed FM broadcast antenna is to be mounted on a tower in the vicinity of a standard broadcast directional array and it appears that the operation of the directional antenna system may be affected, an engineering study must be filed with the FM broadcast application concerning the effect of the FM broadcast antenna on the directional pattern. Readjustment and field intensity measurements of the standard broadcast station may be required following construction of the FM broadcast antenna.

(i) Information regarding data required in connection with standard broadcast directional antenna systems may be found in § 3.150 of this chapter. (See also Standard Broadcast Technical Standards.)

(j) In the event a common tower is used by two or more licensees for antenna and/or antenna supporting purposes, the licensee who is owner of the tower shall assume full responsibility for the installation and maintenance of any painting or lighting requirements. In the event of shared ownership, one licensee shall assume such responsibility and advise the Commission accordingly.

(k) It is recommended that an emergency FM broadcast antenna be installed, or, alternately, an auxiliary transmission line or lines if feasible in the particular circumstances. Data thereon should be supplied with the application for construction permit; if proposed after station construction, an informal application should be submitted to the Commission.

(l) When necessary for the protection of air navigation, the antenna and supporting structure shall be painted and illuminated in accordance with the specifications supplied by the Commission pursuant to section 303(q) of the Communications Act of 1934, as amended.

§ 3.317 Transmitters and associated equipment. (a) *Electrical performance standards.* The general design of the FM broadcast transmitting system (from input terminals of microphone preamplifier, through audio facilities at the studio, through lines or other circuits between studio and transmitter, through audio facilities at the transmitter, and through the transmitter, but excluding equalizers for the correction of deficiencies in microphone response) shall be in accordance with the following principles and specifications:

(1) Standard power ratings and operating power range of FM broadcast transmitters shall be in accordance with the following table:

Standard power rating:	*Operating power range*
10 watts [1]	10 watts or less.
250 watts	250 watts or less.
1 kw	250 watts–1 kw.
3 kw	1–3 kw.
5 kw	1–5 kw.
10 kw	3–10 kw.
25 kw	10–25 kw.
50 kw	10–50 kw.
100 kw	50–100 kw.

[1] For noncommercial educational FM stations.

(i) Composite transmitters may be authorized with a power rating different from the above table, provided full data is supplied in the application concerning the basis employed in establishing the rating and the need therefor. The operating range of such transmitters shall be from one-third of the power rating to the power rating.

(ii) The transmitter shall operate satisfactorily in the operating power range with a frequency swing of ±75 kilocycles, which is defined as 100 percent modulation.

(2) The transmitting system shall be capable of transmitting a band of frequencies

from 50 to 15,000 cycles. Preemphasis shall be employed in accordance with the impedance-frequency characteristic of a series inductance-resistance network having a time constant of 75 microseconds. (See Fig. 2 of § 3.333.) The deviation of the system response from the standard preemphasis curve shall lie between two limits as shown in Figure 2 of § 3.333. The upper of these limits shall be uniform (no deviation) from 50 to 15,000 cycles. The lower limit shall be uniform from 100 to 7,500 cycles, and 3 db below the upper limit; from 100 to 50 cycles the lower limit shall fall from the 3 db limit at a uniform rate of 1 db per octave (4 db at 50 cycles); from 7,500 to 15,000 cycles the lower limit shall fall from the 3 db limit at a uniform rate of 2 db per octave (5 db at 15,000 cycles).

(3) At any modulation frequency between 50 and 15,000 cycles and at modulation percentages of 25, 50, and 100 percent, the combined audio frequency harmonics measured in the output of the system shall not exceed the root-mean-square values given in the following table:

Modulating frequency:	*Distortion percent*
50 to 100 cycles	3.5
100 to 7,500 cycles	2.5
7,500 to 15,000 cycles	3.0

(i) Measurements shall be made employing 75 microsecond deemphasis in the measuring equipment and 75 microsecond preemphasis in the transmitting equipment, and without compression if a compression amplifier is employed. Harmonics shall be included to 30 kc.

(ii) It is recommended that none of the three main divisions of the system (transmitter, studio to transmitter circuit, and audio facilities) contribute over one-half of these percentages since at some frequencies the total distortion may become the arithmetic sum of the distortions of the divisions.

(4) The transmitting system output noise level (frequency modulation) in the band of 50 to 15,000 cycles shall be at least 60 decibels below 100 percent modulation (frequency swing of ±75 kilocycles). The measurement shall be made using 400 cycle modulation as a reference. The noise-measuring equipment shall be provided with standard 75 microsecond deemphasis; the ballistic characteristics of the instrument shall be similar to those of the standard VU meter.

(5) The transmitting system output noise level (amplitude modulation) in the band of 50 to 15,000 cycles shall be at least 50 decibels below the level representing 100 percent amplitude modulation. The noise-measuring equipment shall be provided with standard 75 microsecond deemphasis; the ballistic characteristics of the instrument shall be similar to those of the standard VU meter.

(6) Automatic means shall be provided in the transmitter to maintain the assigned center frequency within the allowable tolerance (±2000 cycles).

(7) The transmitter shall be equipped with suitable indicating instruments for the determination of operating power and with other instruments as are necessary for proper adjustment, operation, and maintenance of the equipment (see § 3.320).

(8) Adequate provision shall be made for varying the transmitter output power to compensate for excessive variations in line voltage or for other factors affecting the output power.

(9) Adequate provision shall be provided in all component parts to avoid overheating at the rated maximum output power.

(10) Means should be provided for connection and continuous operation of approved frequency and modulation monitors.

(11) If a limiting or compression amplifier is employed, precaution should be maintained in its connection in the circuit due to the use of preemphasis in the transmitting system.

(12) Any emission appearing on a frequency removed from the carrier by between 120 kc and 240 kc inclusive shall be attenuated at least 25 decibels below the level of the unmodulated carrier. Compliance with this specification will be deemed to show the occupied bandwidth to be 240 kc or less.

(13) Any emission appearing on a frequency removed from the carrier by more

than 240 kc and up to and including 600 kc shall be attenuated at least 35 db below the level of the unmodulated carrier.

(14) Any emission appearing on a frequency removed from the carrier by more than 75 kc shall be attenuated at least 43 + 10 log 10 (power, in watts) decibels below the level of the unmodulated carrier or 80 decibels, whichever is the lesser attenuation.

(b) *Construction.* In general, the transmitter shall be constructed either on racks and panels or in totally enclosed frames protected as required by article 810 of the National Electrical Code and set forth below:

NOTE: The pertinent sections of article 810 of the National Electrical Code read as follows:

"8191. *General.* Transmitters shall comply with the following:

"a. *Enclosing.* The transmitter shall be enclosed in a metal frame or grille, or separated from the operating space by a barrier or other equivalent means, all metallic parts of which are effectually connected to ground.

"b. *Grounding of controls.* All external metallic handles and controls accessible to the operating personnel shall be effectually grounded. No circuit in excess of 150 volts shall have any parts exposed to direct contact. A complete dead-front type of switchboard is preferred.

"c. *Interlocks on doors.* All access doors shall be provided with interlocks which will disconnect all voltages in excess of 350 volts when any access door is opened."

(1) Means shall be provided for making all tuning adjustments, requiring voltages in excess of 350 volts to be applied to the circuit, from the front of the panels with all access doors closed.

(2) Proper bleeder resistors or other automatic means shall be installed across all capacitor banks to lower any voltage which may remain accessible with access door open to less than 350 volts within 2 seconds after the access door is opened.

(3) All plate supply and other high voltage equipment, including transformers, filters, rectifiers and motor generators, shall be protected so as to prevent injury to operating personnel.

(i) Commutator guards shall be provided on all high voltage rotating machinery. Coupling guards should be provided on motor generators.

(ii) Power equipment and control panels of the transmitter shall meet the above requirements (exposed 220 volt AC switching equipment on the front of the power control panels is not recommended but is not prohibited).

(iii) Power equipment located at a broadcast station but not directly associated with the transmitter (not purchased as part of same), such as power distribution panels, are not under the jurisdiction of the Commission; therefore § 3.254 does not apply.

(4) Metering equipment:

(i) All instruments having more than 1,000 volts potential to ground on the movement shall be protected by a cage or cover in addition to the regular case. (Some instruments are designed by the manufacturer to operate safely with voltages in excess of 1,000 volts on the movement. If it can be shown by the manufacturer's rating that the instrument will operate safely at the applied potential, additional protection is not necessary.)

(ii) In case the plate voltmeter is located on the low potential side of the multiplier resistor with the potential of the high potential terminal of the instrument at or less thau 1,000 volts above ground, no protective case is required. However, it is good practice to protect voltmeters subject to more than 5,000 volts with suitable over-voltage protective devices across the instrument terminals in case the winding opens.

(iii) Transmission line meters and any other radio frequency instrument which may be necessary for the operator to read shall be so installed as to be easily and accurately read without the operator having to risk contact with circuits carrying high potential radio frequency energy.

(5) It is recommended that component parts comply as much as possible with the component specifications designated by the Army-Navy Electronics Standards Agency.

(c) *Wiring and shielding.* (1) The transmitter panels or units shall be wired in

accordance with standard switchboard practice, either with insulated leads properly cabled and supported or with rigid bus bar properly insulated and protected.

(2) Wiring between units of the transmitter, with the exception of circuits carrying radio frequency energy, shall be installed in conduits or approved fiber or metal raceways for protection from mechanical injury.

(3) Circuits carrying radio frequency energy between units shall be coaxial, two wire balanced lines, or properly shielded.

(4) All stages or units shall be adequately shielded and filtered to prevent interaction and radiation.

(5) The frequency and modulation monitors and associated radio frequency lines to the transmitter shall be thoroughly shielded.

(d) *Installation.* (1) The installation shall be made in suitable quarters.

(2) Since an operator must be on duty at the transmitter control point during operation, suitable facilities for his welfare and comfort shall be provided at the control point.

(e) An accurate circuit diagram and list of required spare tubes, as furnished by the manufacturer of the equipment, shall be retained at the transmitter location.

(f) *Operation.* In addition to specific requirements of the rules governing FM broadcast stations, the following operating requirements are specified:

(1) The maximum percentage of modulation shall be maintained in accordance with § 3.268. However, precautions shall be taken so as not to substantially alter the dynamic characteristics of musical programs.

(2) The station equipment shall be so operated, tuned, and adjusted that emissions outside of the authorized channel do not cause harmful interference to the reception of other radio stations. FM broadcast stations employing transmitters type accepted after January 1, 1960, shall maintain the bandwidth occupied by their emissions in accordance with the specifications set forth in paragraph (a) of this section. Stations employing transmitters installed or type accepted prior to January 1, 1960, shall achieve the highest degree of compliance practicable with their existing equipment. In either case, should harmful interference to the reception of other radio stations occur, the licensee may be required to take such further steps as may be necessary to eliminate the interference.

(3) If a limiting or compression amplifier is employed, care should be maintained in its use due to preemphasis in the transmitting system.

(g) *Studio equipment.* (1) Studio equipment shall be subject to all the above requirements where applicable except as follows:

(i) If properly covered by an underwriter's certificate, it will be considered as satisfying safety requirements.

(ii) Section 8191 of article 810 of the National Electrical Code shall apply for voltages only in excess of 500 volts.

(2) No specific requirements are made with regard to the microphones to be employed. However, microphone performance (including compensating networks, if employed) shall be compatible with the required performance of the transmitting system.

(3) No specific requirements are made relative to the design and acoustical treatment of studios. However, the design of studios, particularly the main studio, shall be compatible with the required performance characteristics of FM broadcast stations.

§ 3.318 Facsimile: engineering standards. The following standards apply to facsimile broadcasting under § 3.266:

(a) Rectilinear scanning shall be employed, with scanning spot progressing from left to right and scanned lines progressing from top to bottom of subject copy.

(b) The standard index of cooperation shall be 984.

(c) The number of scanning lines per minute shall be 360.

(d) The line-use ratio shall be ⅞, or 315° of the full scanning cycle.

(e) The ⅛ cycle or 45° not included in the available scanning line shall be divided into 3 equal parts, the first 15° being used for transmission at approximately white level, the second 15° for transmission at approximately black level, and the third 15° for transmission at approximately white level.

(f) An interval of not more than 12 seconds shall be available between two pages of subject copy, for the transmission of a page-separation signal and/or other services.

(g) Amplitude or frequency (frequency-shift) modulation of the sub-carrier shall be used.

(h) Subcarrier modulation shall normally vary approximately linearly with the optical density of the subject copy.

(i) Negative modulation shall be used, i.e., for amplitude modulation of subcarrier, maximum subcarrier amplitude and maximum radio frequency swing on black; for frequency modulation of subcarrier, highest instantaneous frequency of subcarrier on black.

(j) Subcarrier noise level shall be maintained at least 30 db. below maximum (black) picture modulation level, at the radio transmitter input.

(k) The facsimile subcarrier transmission shall be conducted in the frequency range between 22 and 28 kilocycles. Should amplitude modulation of the subcarrier be employed the subcarrier frequency shall be 25 kilocycles with sidebands extending not more than 3 kilocycles in either direction from the subcarrier frequency. Should frequency modulation of the subcarrier be employed the total swing of the subcarrier shall be within the range from 22 to 28 kilocycles, with 22 kilocycles corresponding to white and 28 kilocycles corresponding to black on the transmitted copy. In multiplex operation the modulation of the FM carrier by the modulated subcarrier shall not exceed 5 percent. In simplex operation the modulation of the FM carrier by the modulated subcarrier shall not exceed 30 percent.

(l) During periods of multiplex facsimile transmission, frequency modulation of the FM carrier caused by the aural signals shall, in the frequency range from 20 to 30 kilocycles, be at least 60 db. below 100 percent modulation. Frequency modulation of the FM carrier caused by the facsimile signals shall, in the frequency range from 50 to 15,000 cycles, be at least 60 db. below 100 percent modulation.

§ 3.319 **Subsidiary communications multiplex operations: engineering standards.** The following standards apply to subsidiary communications multiplex operations under §§ 3.293 to 3.295.

(a) Frequency modulation of subcarrier shall be used.

(b) The instantaneous frequency of the subcarriers shall at all times lie within the range 20 to 75 kilocycles.

(c) The arithmetic sum of the modulation of the main carrier by the subcarriers shall not exceed 30 percent.

NOTE: Inasmuch as presently approved FM modulation monitors have been designed to meet requirements for modulation frequencies of from 50 to 15,000 cycles, the use of such monitors for reading the modulation percentages during multiplex operation may not be appropriate since the subcarriers utilized are above 20,000 cycles.

(d) The total modulation of the main carrier, including the subcarriers, shall meet the requirements of § 3.268.

(e) Frequency modulation of the main carrier caused by the subcarrier operation shall, in the frequency range 50 to 15,000 cycles, be at least 60 db. below 100 percent modulation.

§ 3.320 **Indicating instruments—specifications.** The following requirements and specifications shall apply to indicating instruments used by FM broadcast stations:

(a) Instruments indicating the plate current or plate voltage of the last radio stage (linear scale instruments) shall meet the following specifications:

(1) Length of scale shall be not less than $2\frac{3}{10}$ inches.

(2) Accuracy shall be at least 2 percent of the full scale reading.

(3) Scale shall have at least 40 divisions.

(4) Full scale reading shall not be greater than five times the minimum normal indication.

(b) Instruments indicating transmission line current or voltage shall meet the following specifications:

(1) Instruments having linear scales shall meet the requirements of paragraph (a)(1), (2), (3), and (4) of this section.

(2) Instruments having logarithmic or square law scales:

(i) Shall meet the requirements of paragraph (a)(1) and (2) of this section for linear scale instruments.

(ii) Full scale reading shall not be greater than three times the minimum normal indication.

(iii) No scale division above one-third full scale reading shall be greater than one-thirtieth of the full scale reading.

(c) Radio frequency instruments having expanded scales:

(1) Shall meet the requirements of paragraph (a)(1), (2), and (4) of this section for linear scale instruments.

(2) No scale division above one-fifth full scale reading shall be greater than one-fiftieth of the full scale reading.

(3) The meter face shall be marked with the words "Expanded scale" or the abbreviation thereof (E. S.).

(d) No required instrument, the accuracy of which is questionable, shall be employed. Repairs and recalibration of instruments shall be made by the manufacturer, or by an authorized instrument repair service of the manufacturer, or by some other properly qualified and equipped instrument repair service. In any event the repaired instrument must be supplied with a certificate of calibration.

(e) Recording instruments may be employed in addition to the indicating instruments to record the transmission line current or voltage and the direct plate current and/or direct plate voltage of the last radio stage, provided that they do not affect the operation of the circuits or accuracy of the indicating instruments. If the records are to be used in any proceeding before the Commission as representative of operation, the accuracy must be the equivalent of the indicating instruments and the calibration shall be checked at such intervals as to insure the retention of the accuracy.

(f) The function of each instrument used in the equipment shall be clearly and permanently shown on the instrument itself or on the panel immediately adjacent thereto.

§ 3.321 Auxiliary transmitters. Auxiliary transmitters may not exceed the power rating or operating power range of the main transmitter, but need not conform to the performance characteristics specified by § 3.317(a)(2) to (a)(5) inclusive. The subsequent portions of § 3.317 apply to auxiliary transmitters.

§ 3.330 Frequency and modulation monitors at auxiliary transmitters. (a) The following shall govern the installation of approved frequency and modulation monitors at auxiliary transmitters of FM broadcast stations in compliance with these rules:

(1) In case the auxiliary transmitter location is at a site different from that of the main transmitter, an approved frequency monitor shall be installed at the auxiliary transmitter except when the frequency of the auxiliary transmitter can be monitored by means of the frequency monitor at the main transmitter. When the auxiliary transmitter is operated without a frequency monitor under this exemption, it shall be monitored by means of the frequency monitor at the main transmitter.

(2) The licensee will be held strictly responsible for any center frequency deviation of the auxiliary transmitter in excess of 2,000 cycles from the assigned frequency, even though exempted by the above from installing an approved frequency monitor.

(3) Installation of an approved modulation monitor at the location of the auxiliary transmitter, when different from that of the main transmitter, is optional with the licensee. However, when it is necessary to operate the auxiliary transmitter beyond two calendar days, a modulation monitor shall be installed and operated at the auxiliary transmitter. The monitor (if taken from the main transmitter) shall be reinstalled at the main transmitter immediately upon resumption of operation of the main transmitter.

(4) In all cases where the auxiliary transmitter and the main transmitter have the same location, the same frequency and modulation monitors may be used for monitoring both transmitters, provided they are so arranged as to be readily switched from one transmitter to the other.

§ 3.331 Requirements for type approval of frequency monitors. (a) *General requirements.* (1) Any manufacturer desiring to submit a monitor for type approval

shall supply the Commission with full specification details (two sworn copies) as well as the test data specified in paragraph (c) of this section. If this information appears to meet the requirements of the rules, shipping instructions will be issued to the manufacturer. The shipping charges to and from the Laboratory at Laurel, Maryland, shall be paid for by the manufacturer. Approval of a monitor will only be given on the basis of the data obtained from the sample monitor submitted to the Commission for test.

(2) In approving a monitor upon the basis of the tests conducted by the Laboratory, the Commission merely recognizes that the type of monitor has the inherent capability of functioning in compliance with the rules, if properly constructed, maintained, and operated. The Commission realizes that the frequency monitor may have limited range over which the visual indicator will determine deviations. Accordingly, it may be necessary that adjunct equipment be used to determine major deviations.

(3) Additional rules with respect to withdrawal of type approval, modification of type approval equipment and limitations of the findings upon which type approval is based are set forth in Part 2, Subpart F, of this chapter.

(b) *General specifications.* The general specifications that frequency monitors shall meet before they will be approved by the Commission are as follows:

(1) The unit shall have an accuracy of at least ±1000 cycles under ordinary conditions (temperature, humidity, power supply variations and other conditions which may affect its accuracy) encountered in FM broadcast stations throughout the United States, for any channel within the FM broadcast band.

(2) The range of the indicating device shall be at least from 2000 cycles below to 2000 cycles above the assigned center frequency.

(3) The scale of the indicating device shall be so calibrated as to be accurately read within at least 100 cycles.

(4) Means shall be provided for adjustment of the monitor indication to agree with an external standard.

(5) The monitor shall be capable of continuous operation and its circuit shall be such as to permit continuous monitoring of the transmitter center frequency.

(6) Operation of the monitor shall have no deleterious effect on the operation of the transmitter or the signal emitted therefrom.

(c) *Tests to be made for approval of FM broadcast frequency monitors.* The manufacturer of a monitor shall submit data on the following at the time of requesting approval:

(1) Constancy of oscillator frequency as measured several times in 1 month.

(2) Constancy of oscillator frequency when subjected to vibration tests which would correspond to the treatment received in shipping, handling and installing the instrument.

(3) Accuracy of readings of the frequency deviation instrument.

(4) Functioning of frequency adjnstment device.

(5) Effects on frequency and readings, of the changing of tubes, of voltage variations, and of variations of room temperature through a range not to exceed 10° to 40° C.

(6) Response of indicating instrument to small changes of frequency.

(7) General information on the effect of tilting or tipping or other tests to determine ability of equipment to withstand shipment.

(d) Various other tests may be made or required, such as effects of variation of input from the transmitter depending upon the character of the apparatus.

(e) Tests shall be conducted in such a manner as to approximate actual operating conditions as nearly as possible. The equipment under test shall be operated on any channel in the FM broadcast band.

§ 3.332 **Requirements for type approval of modulation monitors.** (a) Any manufacturer desiring to submit a monitor for type approval shall supply the Commission with full specification details (two sworn copies) specified in paragraph (b) of this section. If this information appears to meet the requirements of the rules, shipping instructions will be issued to the manufacturer. The shipping charges to and from the Laboratory at Laurel, Maryland, shall be paid for by the manufacturer. Approval

of a monitor will only be given on the basis of the data obtained from the sample monitor submitted to the Commission for test.

(1) In approving a monitor upon the basis of the tests conducted by the Laboratory, the Commission merely recognizes that the type of monitor has the inherent capability of functioning in compliance with the rules, if properly constructed, maintained and operated.

(2) Additional rules with respect to withdrawal of type approval, modification of type approval equipment and limitations on the findings upon which type approval is based are set forth in Part 2, Subpart F, of this chapter.

(b) The specifications that the modulation monitor shall meet before it will be approved by the Commission are as follows:

(1) A means for insuring that the transmitter input to the modulation monitor is proper.

(2) A modulation peak indicating device that can be set at any predetermined value from 50 to 120 percent modulation (±75 kc swing is defined as 100 percent modulation) and for either positive or negative swings (i.e., either above or below transmitter center frequency).

(3) A semi-peak indicator with a meter having the characteristics given below shall be used with a circuit such that peaks of modulation of duration between 40 and 90 milliseconds are indicated to 90 percent of full value and the discharge rate adjusted so that the pointer returns from full reading to 10 percent of zero within 500 to 800 milliseconds. A switch shall be provided so that this meter will read either positive or negative swings.

(i) The characteristics of the indicating meter are: (*a*) *Speed.* The time for one complete oscillation of the pointer shall be 290 to 350 milliseconds. The damping factor shall be between 16 and 200. (*b*) *Scale.* The meter scale shall be similar in appearance to that of a standard VU meter. The scale length between 0 and 100 percent modulation markings should be at least 2.3 inches. In addition to other markings a small mark for 133 percent modulation and designated as such should be included for the purpose of testing transmitters with 100 kc swing.

(4) The accuracy of reading of percentage of modulation shall be within ±5 percent modulation percentage at any percentage of modulation up to 100 percent modulation.

(5) The frequency characteristic curve shall not depart from a straight line more than ±½ db. from 50 to 15,000 cycles. Distortion shall be kept to a minimum.

(6) The monitor shall not absorb appreciable power from the transmitter.

(7) Operation of the monitor shall have no deleterious effect on the operation of the transmitter.

(8) General design, construction, and operation shall be in accordance with good engineering practice.

(c) The modulation monitor may be a part of the frequency monitor.

§ 3.333 **Engineering charts.** [See Figures 1 and 2.]

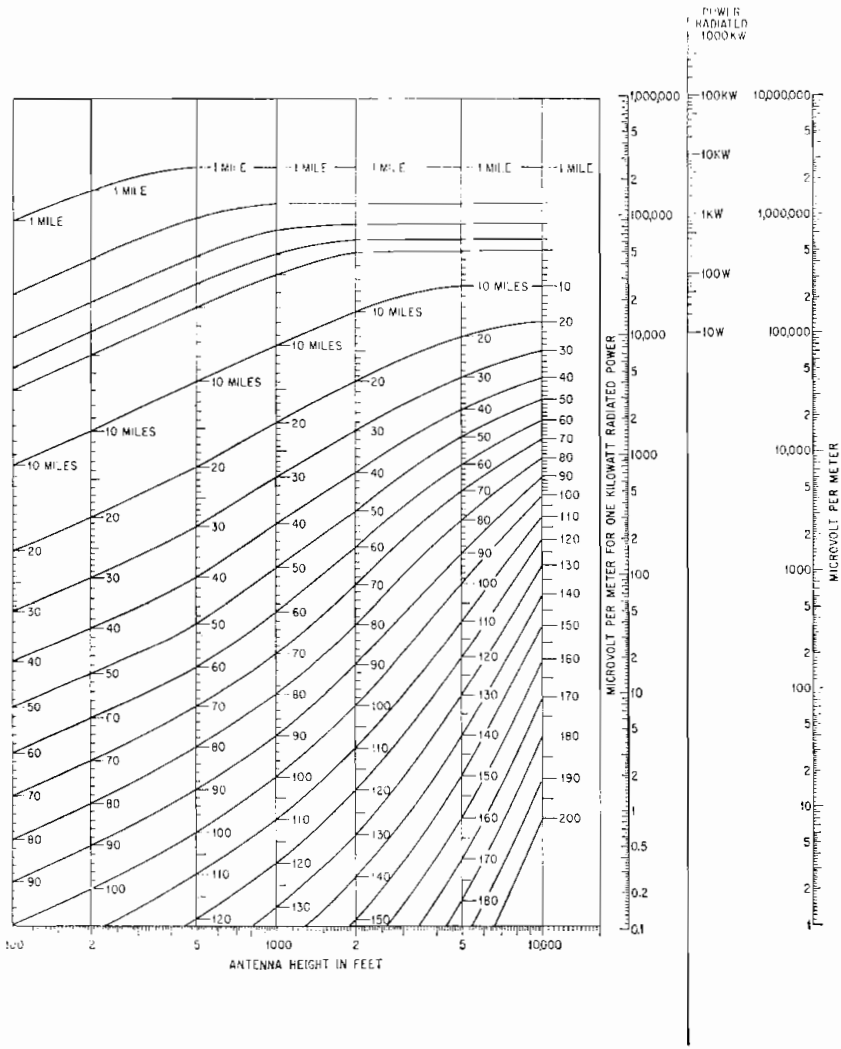


FIGURE 1. Groundwave signal range for FM broadcasting. 98 mc, $\sigma = 5 \times 10^{-14}$ emu, $\epsilon = 15$, receiving antenna height 30 feet for horizontal (and approx. for vertical) polarization.

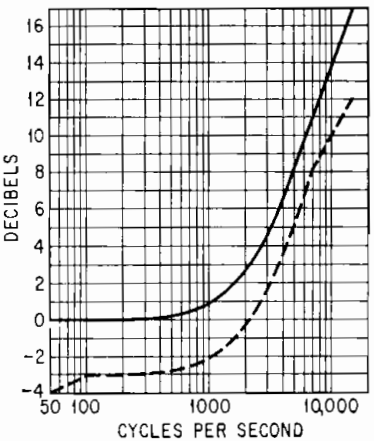


FIGURE. 2. Standard pre-emphasis curve. Time constant 75 microseconds (solid line). Frequency response limits shown by use of solid and dashed lines.

SUBPART C—NONCOMMERCIAL EDUCATIONAL FM BROADCAST STATIONS

Classification of Stations and Allocation of Frequencies

§ 3.501 Channels available for assignment. (a) The following frequencies, except as provided in paragraph (b) of this section, are available for noncommercial educational FM broadcasting:

(b) In Alaska, the frequency band 88–100 Mc is allocated exclusively to Government radio services and the non-Government fixed service. The frequencies 88.1 Mc through 91.9 Mc (Channels 201 through 220, inclusive) will not be assigned in Alaska for use by noncommercial educational FM broadcast stations; however, frequencies in the 100.1–107.9 Mc (Channels 261 through 300, inclusive) are available for such use.

Frequency (Mc):	*Channel No.*	Frequency (Mc):	*Channel No.*	Frequency (Mc):	*Channel No.*
88.1	201	89.5	208	90.9	215
88.3	202	89.7	209	91.1	216
88.5	203	89.9	210	91.3	217
88.7	204	90.1	211	91.5	218
88.9	205	90.3	212	91.7	219
89.1 [1]	206	90.5	213	91.9	220
89.3	207	90.7	214		

[1] The frequency 89.1 Mc in the New York City metropolitan area is reserved for the use of the United Nations with the equivalent of an antenna height of 500 feet above average terrain and effective radiated power of 20 kw, and the Commission will make no assignments which would cause objectionable interference with such use.

§ 3.502 State-wide plans. In considering the assignment of a channel for a noncommercial educational FM broadcast station, the Commission will take into consideration the extent to which each application meets the requirements of any state-wide plan for noncommercial educational FM broadcast stations filed with the Commission, provided that such plans afford fair treatment to public and private educational institutions, urban and rural, at the primary, secondary, higher, and adult educational levels, and appear otherwise fair and equitable.

§ 3.503 Licensing requirements and service. The operation of, and the service furnished by, noncommercial educational FM broadcast stations shall be governed by the following:

(a) A noncommercial educational FM broadcast tsation will be licensed only to a nonprofit educational organization and upon showing that the station will be used for the advancement of an educational program.

(1) In determining the eligibility of publicly supported educational organizations, the accreditation of their respective state departments of education shall be taken into consideration.

(2) In determining the eligibility of privately controlled educational organizations, the accreditation of state departments of education and/or recognized regional and national educational accrediting organizations shall be taken into consideration.

(b) Each station may transmit programs directed to specific schools in a system or systems for use in connection with the regular courses as well as routine and administrative material pertaining thereto and may transmit educational, cultural, and entertainment programs to the public.

(c) Each station shall furnish a nonprofit and noncommercial broadcast service. No sponsored or commercial program shall be transmitted nor shall commercial announcements of any character be made. A station shall not transmit the programs of other classes of broadcast stations unless all commercial announcements and commercial references in the continuity are eliminated.

§ 3.504 Frequency, power and service area. (a) In the assignment of frequency and power to a noncommercial educational FM broadcast station the Commission will consider with the application: (1) the area served by applicant's existing educational facilities; and (2) the provisions of any statewide plan on file with the Commission which meets the requirements of § 3.502. A station licensed for transmitter power output of 10 watts or less normally will be licensed to operate on the frequency 88.1 megacycles; however, should it appear that operation on this frequency would cause objectionable interference, such station may be licensed to operate on the next higher frequency that would not cause objectionable interference.

(b) The license of each noncommercial educational FM broadcast station licensed for transmitter power output of 10 watts or less shall specify the maximum authorized operating power output of the transmitter. The license of each noncommercial educational FM broadcast station licensed for transmitter power output above 10 watts shall specify the authorized effective radiated power of the station and the authorized operating power output of the transmitter.

(c) Each application for a new noncommercial educational FM broadcast station or increase in facilities of an existing station which proposes transmitter power output above 10 watts shall contain a determination of the antenna height above average terrain and the extent of the 1 mv/m and 50 uv/m contours of the proposed station by the methods prescribed in the FM Technical Standards in Subpart B of this part.

§ 3.505 Standards of good engineering practice. The definitions and interference standards contained in the FM Technical Standards in Subpart B of this part shall be applicable to noncommercial educational FM broadcast stations. Other portions of such Standards shall be applicable to the extent specifically prescribed by this part.

Administrative Procedure

§ 3.514 Cross reference. See §§ 1.300 to 1.364, Subpart D of Part 1 of this chapter, for general requirements as to applications, filing of applications and description of application forms, other forms and information to be filed with the Commission, the manner in which applications are processed, and provisions applying to action on applications.

§ 3.515 In order to minimize possible harmful interference at the National Radio Astronomy Observatory site located at Green Bank, Pocahontas County, West Virginia, and at the Naval Radio Research Observatory site at Sugar Grove, Pendleton County, West Virginia, an applicant for authority to construct a new noncommercial educational FM broadcast station or for authority to make changes in the frequency, power, antenna height, or antenna directivity of an existing station within the area bounded by 39°15′ N on the north, 78°30′ W on the east, 37°30′ N on the south and 80°30′ W on the west shall, at the time of filing such application with the Commis-

sion, simultaneously notify the Director, National Radio Astronomy Observatory, P.O. Box #2, Green Bank, West Virginia, in writing, of the technical particulars of the proposed station. Such notification shall include the geographical coordinates of the antenna, antenna height, antenna directivity if any, proposed frequency, type of emission, and power. In addition, the applicant shall indicate in his application to the Commission the date notification was made to the Observatory. After receipt of such applications, the Commission will allow a period of twenty (20) days for comments or objections in response to the notifications indicated. If an objection to the proposed operation is received during the twenty day period from the National Radio Astronomy Observatory for itself or on behalf of the Naval Radio Research Observatory, the Commission will consider all aspects of the problem and take whatever action is deemed appropriate.

§ 3.516 **Equipment tests.** (a) During the process of construction of a noncommercial educational FM broadcast station, the permittee, after notifying the Commission and Engineer in Charge of the radio district in which the station is located, may without further authority of the Commission, conduct equipment tests for the purpose of such adjustments and measurements as may be necessary to assure compliance with the terms of the construction permit, the technical provisions of the application therefor, the rules and regulations, and the applicable engineering standards.

(b) The Commission may notify the permittee to conduct no tests or may cancel, suspend, or change the date for the beginning of equipment tests as and when such action may appear to be in the public interest, convenience, and necessity.

(c) Equipment tests may be continued so long as the construction permit shall remain valid.

(d) Inspection of a station will ordinarily be required during the equipment test period and before the commencement of the program test. After construction and after adjustments and measurements have been completed to show compliance with the terms of the construction permit, the technical provisions of the application therefor, the rules and regulations and the applicable engineering standards, the permittee should notify the Engineer in Charge of the radio district in which the station is located that it is ready for inspection.

(e) The authorization for tests embodied in this section shall not be construed as constituting a license to operate but as a necessary part of construction.

§ 3.517 **Program tests.** (a) Upon completion of construction of a noncommercial educational FM broadcast station in accordance with the terms of the construction permit, the technical provisions of the application therefor, and the rules and regulations and applicable engineering standards, and when an application for station license has been filed showing the station to be in satisfactory operating condition, the permittee may request authority to conduct program tests: *Provided*, That such request shall be filed with the Commission at least ten (10) days prior to the date on which it is desired to begin such operation and that the Engineer in Charge of the radio district in which the station is located is notified. (All data necessary to show compliance with the terms and conditions of the construction permit must be filed with the license application.)

(b) Program tests shall not commence until specific Commission authority is received. The Commission reserves the right to change the date of the beginning of such tests, or to suspend or revoke the authority for program tests as and when such action may appear to be in the public interest, convenience, and necessity.

(c) Unless sooner suspended or revoked program test authority continues valid during Commission consideration of the application for license and during this period further extension of the construction permit is not required. Program test authority shall be automatically terminated by final determination upon the application for station license.

(d) All operation under program test authority shall be in strict compliance with the rules governing noncommercial educational FM broadcast stations and in strict accordance with representations made in the application for license pursuant to which the tests were authorized.

(e) The grant of program test authority shall not be construed as approval by the Commission of the application for station license.

§ 3.518 **Normal license period.** (a) All noncommercial educational FM broadcast station licenses will be issued for a normal license period of three years. Licenses will be issued to expire at the hour of 3:00 a.m., e.s.t., in accordance with the following schedule and at three-year intervals thereafter.

(1) For stations located in Delaware and Pennsylvania, August 1, 1957.

(2) For stations located in Maryland, District of Columbia, Virginia, West Virginia, October 1, 1957.

(3) For stations located in North Carolina, South Carolina, December 1, 1957.

(4) For stations located in Florida, Puerto Rico, and Virgin Islands, February 1, 1958.

(5) For stations located in Alabama and Georgia, April 1, 1958.

(6) For stations located in Arkansas, Louisiana, and Mississippi, June 1, 1958.

(7) For stations located in Tennessee, Kentucky, and Indiana, August 1, 1958.

(8) For stations located in Ohio and Michigan, October 1, 1958.

(9) For stations located in Illinois and Wisconsin, December 1, 1958.

(10) For stations located in Iowa and Missouri, February 1, 1956.

(11) For stations located in Minnesota, North Dakota, South Dakota, Montana, and Colorado, April 1, 1956.

(12) For stations located in Kansas, Oklahoma, Nebraska, June 1, 1956.

(13) For stations located in Texas, August 1, 1956.

(14) For stations located in Wyoming, Nevada, Arizona, Utah, New Mexico, and Idaho, October 1, 1956.

(15) For stations located in California, December 1, 1956.

(16) For stations located in Washington, Oregon, Alaska, and Hawaii, February 1, 1957.

(17) For stations located in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont, April 1, 1957.

(18) For stations located in New Jersey and New York, June 1, 1957.

Equipment

§ 3.550 **Acceptability of broadcast transmitters for licensing.** (a) In order to facilitate the filing of, and action on, applications for station authorizations, transmitters will be accepted for licensing by the Commission under one of the following conditions:

(1) A transmitter may be type-accepted upon the request of any manufacturer of transmitters built in quantity by following the type acceptance procedure set forth in Part 2 of this chapter, provided that the data and information submitted indicates that the transmitter meets the requirements of § 3.317. If accepted, such transmitter will be included on the Commission's "Radio Equipment List, Part B, Aural Broadcast Equipment." Applicants specifying transmitters included on such a list need not submit detailed descriptions and diagrams where the correct type number is specified, provided that the equipment proposed is identical with that accepted. Copies of this list are available for inspection at the Commission's office in Washington, D.C., and at each of its field offices.

(2) An application specifying a transmitter not included on the Radio Equipment List, Part B, may be accepted upon the request of a prospective licensee submitting with the application for construction permit a complete description of the transmitter, including the circuit diagram, listing of all tubes used, function of each, multiplication in each stage, plate current and voltage applied to each tube, a description of the oscillator circuit together with any devices installed for the purpose of frequency stabilization and the means of varying output power to compensate for power supply voltage variations. However, if this data has been filed with the Commission by a manufacturer in connection with a request for type acceptance, it need not be submitted with the application for construction permit but may be referred to as "on file." Measurement data for type acceptance made in accordance with subparagraph (1) of this paragraph shall be submitted with the license application.

(3) A transmitter shown on an instrument of authorization by manufacturer and

type number, or as a composite, and which was in use prior to June 30, 1955, may continue to be used by the licensee, his successors or assignees, provided such transmitter continues to comply with the rules and regulations.

(b) Additional rules with respect to withdrawal of type acceptance, modification of type-accepted equipment and limitations on the findings upon which type acceptance is based are set forth in Part 2 of this chapter.

§ 3.551 **Transmitter power.** (a) The standard power rating of the transmitter of a noncommercial educational FM broadcast station licensed for transmitter power output above 10 watts shall be in accordance with § 3.317.

(b) The standard power rating of the transmitter of a noncommercial educational FM broadcast station licensed for transmitter power output of 10 watts or less shall be not less than the authorized operating power and not more than 10 watts.

§ 3.552 **Frequency monitor.** (a) The licensee of each station licensed for transmitter power output above 10 watts 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 operating 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 instrument has been installed and is functioning properly.

(3) The frequency of the station shall be compared with an external frequency source of known accuracy at sufficiently frequent intervals to insure that the frequency is maintained within the tolerance prescribed in § 3.568. An entry shall be made in the station log as to the method used and the results thereof.

(c) If conditions beyond the control of the licensee prevent the restoration of the monitor to service within the above-allowed period, informal request may be filed in accordance with § 1.332(d) of this chapter 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) The licensee of each noncommercial educational FM broadcast station licensed for transmitter power output of 10 watts or less shall provide for the measurement of the station frequency by a means independent of the frequency control of the transmitter. The station frequency shall be measured (1) when the transmitter is initially installed, (2) at any time the frequency determining elements are changed, and (3) at any time the licensee may have reason to believe the frequency has shifted beyond the tolerance specified by the Commission's rules.

§ 3.553 **Modulation monitor.** (a) The licensee of each station licensed for transmitter power output above 10 watts shall have in operation, either at the transmitter or at the place where 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: *Provided*, That:

(1) Appropriate entries shall be made in the operating 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) During the period when the station is operated without the modulation monitor the licensee shall provide other suitable means for insuring that the modulation is maintained within the tolerance prescribed in § 3.568.

(c) If conditions beyond the control of the licensee prevent the restoration of the monitor to service within the above allowed period, informal request may be filed in accordance with § 1.332(d) of this chapter 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) The licensee of each noncommercial educational FM broadcast station licensed for transmitter power output of 10 watts or less shall provide a percentage modulation indicator or a calibrated program level meter from which a satisfactory indication of the percentage of modulation of the transmitter can be determined.

§ 3.554 Transmitter performance. (a) The transmitter proper and associated transmitting equipment of each noncommercial educational FM broadcast station licensed for transmitter power output above 10 watts shall be designed, constructed and operated in accordance with § 3.317.

(b) The transmitter proper and associated transmitting equipment of each noncommercial educational FM broadcast station licensed for transmitter power output of 10 watts or less, although not required to meet all requirements of § 3.317 shall be constructed with safety features in accordance with the specifications of article 810 of the current National Electrical Code as approved by the American Standards Association and shall be so operated, tuned, and adjusted that emissions are not radiated outside the authorized band which cause or which are capable of causing interference to the communications of other stations. The audio distortion, audio frequency range, carrier hum, noise level, and other essential phases of the operation which control the external effects, shall at all times be capable of providing satisfactory broadcast service. Studio equipment properly covered by an underwriter's certificate will be considered as satisfying safety requirements.

§ 3.555 Auxiliary transmitter. Upon showing that a need exists for the use of an auxiliary transmitter in addition to the regular transmitter of a broadcast station, a license therefor may be issued: *Provided*, That:

(a) An auxiliary transmitter may be installed either at the same location as the main transmitter or at another location.

(b) A licensed operator shall be in control whenever an auxiliary transmitter is placed in operation.

(c) The auxiliary transmitter shall be maintained so that it may be placed into immediate operation at any time for the following purposes:

(1) The transmission of the regular programs upon the failure of the main transmitter.

(2) The transmission of regular programs during maintenance or modification work on the main transmitter, necessitating discontinuance of its operation for a period not to exceed 5 days. (This includes the equipment changes which may be made without authority as set forth elsewhere in the rules and regulations or as authorized by the Commission by letter or by construction permit. Where such operation is required for periods in excess of 5 days, request therefor shall be in accordance with § 1.331 of this chapter.)

(3) Upon request by a duly authorized representative of the Commission.

(d) The auxiliary transmitter shall be tested at least once each week to determine that it is in proper operating condition and that it is adjusted to the proper frequency, except that in case of operation in accordance with paragraph (c) of this section during any week, the test in that week may be omitted provided the operation under

paragraph (c) is satisfactory. A record shall be kept of the time and result of each test. Such records shall be retained for a period of two years.

(e) The auxiliary transmitter shall be equipped with satisfactory control equipment which will enable the maintenance of the frequency emitted by the station within the limits prescribed by the regulations in this part.

(f) The operating power of an auxiliary transmitter may be less than the authorized power of the main transmitter, but in no event shall it be greater than such power.

§ 3.556 Alternate main transmitters. The licensee of a noncommercial educational FM broadcast station may be licensed for alternate main transmitters provided that a technical need for such alternate transmitters is shown (such as licensees maintaining 24-hour schednle and needing alternate operation for maintenance, or where developmental work requires alternate operation) and that the following conditions are met:

(a) Both transmitters are located at the same place.

(b) Both transmitters shall have the same power rating.

(c) Both transmitters shall meet the requirements of § 3.554.

§ 3.557 Changes in equipment and antenna system. Licenses of noncommercial educational FM broadcast stations shall observe the following provisions with regard to chauges in equipment and antenna system:

(a) No changes in equipment shall be made:

(1) That would result in the emission of signals outside of the authorized channel.

(2) That would result in the external performance of the transmitter being in disagreement with § 3.554.

(b) Specific authority, upon filing formal application (FCC Form 340) therefor, is required for a change in service area or for any of the following changes:

(1) Changes involving an increase or decrease in the power rating of the transmitter.

(2) A replacement of the transmitter as a whole.

(3) Change in the location of the transmitting antenna.

(4) Change in antenna system, including transmission line.

(5) Change in location of main studio, if it is proposed to move the main studio to a different city from that specified in the license.

(6) Chauge in the power delivered to the antenna.

(7) Change in frequency control and/or modulation system.

(8) Change in the authorized transmitter remote control point(s).

(c) Other changes, except as above provided for in this section, may be made at any time without the authority of the Commission, provided that the Commission shall be promptly notified thereof and such changes shall be shown in the next application for renewal of license.

§ 3.558 Indicating instruments. (a) Each noncommercial FM broadcast station licensed for transmitter power above 10 watts shall be equipped with indicating instruments, which conform with the specifications set forth in § 3.320 for measuring the direct plate voltage and current of the last radio stage and the transmission line radio frequency current, voltage, or power.

(b) In the event that any one of these indicating instruments becomes defective when no substitnte 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: *Provided*, That:

(1) Appropriate entries shall be made in the operating 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 replaced instrument has been installed and functioning properly.

(3) If the defective instrnment is a plate voltmeter or plate ammeter in the last radio stage, the operating power shall be maintained by means of the radio frequency transmission line meter.

(c) If conditions beyond the control of the licensee prevent the restoration of the meter to service within the above allowed period, informal request may be filed in accordance with § 1.337 of this chapter 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.

Technical Operation

§ 3.561 Operating schedule. Noncommercial educational FM broadcast stations are not required to operate on a regular schedule and no minimum number of hours of operation is specified; but the hours of actual operation during a license period shall be taken into consideration in considering the renewal of noncommercial educational FM broadcast licenses wherever it appears that the channels available for such stations are insufficient to meet the demand.

§ 3.562 Experimental operation. The period between 1:00 a.m. and 6:00 a.m., local standard time, may be used for experimental purposes in testing and maintaining apparatus by the licensee of any noncommercial educational FM broadcast station on its assigned frequency and not in excess of its authorized power, without specific authorization from the Commission.

§ 3.563 Station inspection. The licensee of any noncommercial educational FM broadcast station shall make the station available for inspection by representatives of the Commission at any reasonable hour.

§ 3.564 Station and operator licenses; posting of. (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.

§ 3.565 Operator requirements. (a) One or more radio operators holding a valid radiotelephone first-class operator license, except as provided in paragraph (b) of this section, shall be in actual charge of the transmitting apparatus and shall be on duty either at the transmitter location or remote control point.

(b) A station which is authorized with transmitter power output of 10 kilowatts or less may be operated by persons holding commercial radio operator license of any class, except an aircraft radiotelephone operator authorization or a temporary limited radiotelegraph second-class operator license, when the equipment is so designed that the stability of the frequency is maintained by the transmitter itself within the limits of tolerance specified, and none of the operations, except those specified in subparagraphs (1), (2) and (3) of this paragraph, necessary to be performed during the course of normal operation may cause off-frequency operation or result in any unauthorized radiation. Adjustments of transmitting equipment by such operators, except when under the immediate supervision of radiotelephone first-class operator, shall be limited to the following:

(1) Those necessary to commence or terminate transmitter emissions as a routine matter.

(2) Those external adjustments that may be required as a result of variations of primary power supply.

(3) Those external adjustments which may be necessary to insure modulation within the limits required.

Should the transmitting apparatus be observed to be operating in a manner inconsistent with the station's instrument of authorization and none of the above adjustments are effective in bringing into proper operation, a person holding other than a radiotelephone first-class operator license and not acting under the immediate supervision of a radiotelephone first-class operator, shall be required to terminate the station's emissions.

(c) The licensee of a station which is operated by one or more operators holding other than a radiotelephone first-class operator license shall have one or more operators holding a radiotelephone first-class operator license in regnlar full-time employment at the station, whose primary duties shall be to effect and insnre the proper functioning of the transmitting equipment. In the event that the licensee also operates a standard broadcast station in the same community, a regular full-time radiotelephone first-class operator or operators employed in connection with the FM broadcast station may concurrently be employed to satisfy the requirements of § 3.93(c): *Provided,* That the duties of such operator or operators concerning the standard broadcast transmitting equipment shall in nowise interfere with the proper performance of his duties with respect to the FM broadcast transmitter: Except, that (1) if the transmitter power output is in excess of 10 watts but not greaer than 1 kw, an operator holding radiotelephone second-class operator license may be on duty and perform the functions required of the radiotelephone first-class operator, or (2) if the transmitter power outpnt is 10 watts or less, a radiotelephone second-class or radiotelegraph first- or second-class operator may be on duty and perform the functions of the radiotelephone first-class operator but need not be in regular full-time employment at the station.

(d) The licensed operator on duty and in charge of a noncommercial educational FM broadcast transmitter may, at the discretion of the licensee, 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 snch duties shall in nowise interfere with the proper operation of the FM broadcast transmitter.

§ 3.566 Facsimile broadcasting and multiplex transmission. (a) Noncommercial educational FM broadcast stations may transmit simplex facsimile in accordance with transmission standards set forth in § 3.318 during periods not devoted to FM aural broadcasting. Such transmissions may not exceed one hour during the period between 7 a.m. and midnight (no limit is placed upon the hours between midnight and 7 a.m.). The Commission shall he notified by the licensee of the noncommercial educational FM broadcast station of its intent to transmit such facsimile.

(b) Noncommercial educational FM broadcast stations may, npon securing authorization from the Commission, transmit multiplex facsimile in accordance with transmission standards set forth in § 3.318: *Provided,* That the transmission of such facsimile does not reduce the quality of the aural program simultaneously transmitted by the licensee below that required by the FM Technical Standards in Subpart B of this part and that no degradation of snch aural programs will result from such facsimile transmissions when received on FM receivers not equipped with filters or other additional equipment.

§ 3.567 Operating power; determination and maintenance of. (a) The operating power of each station shall be determined by the indirect method. This 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; that is:

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

The efficiency factor, F, shall be established by the transmitter manufacturer for each type of transmitter for which Commission approval is requested, and shall be specified in the instruction books supplied to the customer with each transmitter. In the case of composite equipment the factor, F, shall be furnished to the Commission along with a statement of the basis used in determining such factor.

(b) The operating power of each station licensed for transmitter power output above 10 watts shall be maintained as near as practicable to the authorized power, and shall not exceed the limits of 5 percent above and 10 percent below the authorized power, except that in an emergency when it becomes impossible to operate with the authorized 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 emer-

gency develops and also upon the resumption of normal operating power. With respect to each station licensed for transmitter power output of 10 watts or less, the power at which the station is operated may be less than the licensed power, but shall in no event be more than 5 percent above the licensed power. The transmitter of each station shall be so maintained as to be capable of operation at a maximum licensed power.

§ 3.568 **Modulation.** The percentage of modulation of all stations shall be maintained as high as possible consistent with good quality of transmission and good broadcast practice and in no case less than 85 percent or more than 100 percent on peaks of frequent recurrence during any selection which normally is transmitted at the highest level of the program under consideration.

§ 3.569 **Frequency tolerance.** (a) The center frequency of each noncommercial educational FM broadcast station licensed for transmitter power output of 10 watts or less shall be maintained within 3,000 cycles of the assigned center frequency.

(b) The center frequency of each noncommercial educational FM broadcast station licensed for transmitter power ontput above 10 watts shall be maintained within 2,000 cycles of the assigned center frequency.

§ 3.570 **Antenna structure, marking and lighting.** Where an antenna strncture(s) is required to be painted or lighted see § 17.37, *Inspection of tower lights and associated control equipment;* § 17.39, *Cleaning and repainting;* § 17.40, *Time when lights shall be exhibited;* § 17.41, *Spare lamps;* and § 17.42, *Lighting equipment;* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 3.571 **Discontinuance of operation.** The licensee of each station shall notify the Commission in Washington, D.C., and the Engineer in Charge of the radio district in which the station is located of permanent discontinuance of operation at least two days before operation is discontinued. The licensee shall, in addition, immediately forward the station license and other instruments of authorization to the Washington, D.C., office of the Commission for cancellation.

§ 3.572 **Remote control authorization.** (a) Application to operate a station by remote control may be made as a part of the application for constrnction permit for a new station. Application to operate an authorized station shall be made on FCC Form 301-A.

(b) An authorization for remote control will be issued only after a satisfactory showing has been made in regard to the following, among others:

(1) The location of the remote control point(s);

(2) The transmitter, if the power rating is in excess of 10 kw, is reliable and capable of being operated by remote control.

§ 3.573 **Remote control operation.** (a) 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 position 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 Commission's rules.

(b) All stations, whether operating by remote control or direct control, shall be so equipped, in accordance with § 3.1003(a), so as to be able to follow the prescribed CONELRAD procedure.

Other Rules Relating to Operation

§ 3.581 Logs. The licensee or permittee of each noncommercial educational FM broadcast station shall maintain program and operating logs and shall require entries to be made as follows:

(a) In the program log:

(1) An entry of the time each station identification announcement (call letters and location) is made.

(2) An entry briefly describing each program broadcast, such as "music," "drama," "speech," etc., together with the name or title thereof, with the time of the beginning and ending of the complete program. If a mechanical record is used, the entry shall show the exact nature thereof, such as "record," "transcription," etc., and the time it is announced. If the program is of network origin, its source shall be indicated. If the broadcast is under the auspices of an institution or organization other than the licensee, its name shall be noted.

(b) In the operating log:

(1) An entry of the time the station begins to supply power to the antenna, and the time it stops.

(2) An entry of the time the program service begins and ends.

(3) An entry of each interruption to the carrier wave, its cause and duration.

(4) For each station licensed for transmitter power output above 10 watts, an entry of the following each 30 minutes:

(i) Operating constants of last radio stage (total plate current and plate voltage).

(ii) Radio frequency transmission line meter reading.

(iii) Frequency monitor reading.

(5) A log must be kept of all operation during the experimental period. If the entries required above are not applicable thereto, then the entries shall be made so as to fully describe the operation.

(c) Where an antenna structure(s) is required to be illuminated see § 17.38, *Recording of tower light inspections in the station record*, of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 3.582 Logs; retention of. Logs of noncommercial educational FM broadcast stations shall be retained by the licensee or permittee for a period of two 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.

§ 3.583 Logs; by whom kept. Each log shall be kept by the person or persons competent to do so, having actual knowledge of the facts required, who shall sign the log when starting duty and again when going off duty. The logs shall be made available upon request by an authorized representative of the Commission.

§ 3.584 Log form. The log shall be kept in an orderly manner, in suitable form, and in such detail that the data required for the particular class of station concerned are readily available. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log.

§ 3.585 Correction of logs. No log or portion thereof shall be erased, obliterated, or willfully destroyed within the period of retention provided by the rules. Any necessary correction may be made only by the person originating the entry who shall strike out the erroneous portion, initial the correction made, and indicate the date of correction.

§ 3.586 Rough logs. Rough logs may be transcribed into condensed form, but in such case the original log or memoranda and all portions thereof shall be preserved and made a part of the complete log.

§ 3.587 **Station identification.** (a) A licensee of a noncommercial educational FM broadcast station shall make at least the following station identification announcements (call letters and location): (1) at the beginning and ending of each time of operation; and (2) within 2 minutes of each hour and each half hour during operation: *Provided,*

(b) Such identification announcement need not be made on the hour or half hour when to make such announcement would interrupt a single continuous program of longer duration than 30 minutes. In such cases the identification announcement shall be made at the beginning of the program, at the first interruption of the continuity, and at the conclusion of the program.

(c) In making the identification announcement, the call letters shall be given only on the channel of the station identified thereby.

§ 3.588 **Mechanical reproductions.** (a) No mechanically reproduced program consisting of a speech, news event, news commentator, forum, panel discussion, or special event in which the element of time is of special significance, or any other program in which the element of time is of special significance and presentation of which would create, either intentionally or otherwise, the impression or belief on the part of the listening audience that the event or program being broadcast is in fact occurring simultaneously with the broadcast, shall be broadcast without an appropriate announcement being made either at the beginning or end of such reproduction or at the beginning or end of the program in which such reproduction is used that it is a mechanical reproduction or a mechanically reproduced program: *Provided, however,* That each such program of one minute or less need not be announced as such.

(b) The exact form of identifying announcement is not prescribed, but the language shall be clear and in terms commonly used and understood. Any other program mechanically reproduced or series of mechanical reproductions, including a mechanical reproduction used for background music, sound effects, station identification, program identification (theme music of short duration) or identification of sponsorship of the program proper, need not be announced as provided in paragraph (a) of this section, but the licensee shall not attempt affirmatively to create the impression that any program being broadcast by mechanical reproduction consists of live talent.

(c) The requirements of paragraph (a) of this section are waived with respect to network programs, transcribed and rebroadcast at a later hour because of the time zone differential between the place where the program originates and where it is rebroadcast, this waiver being applicable whether the off-the-line recording is made by the network itself at one of its key stations or by an individual station, but only when the off-the-line recording is for broadcast at an hour not exceeding the time zone differential between the place where the program originates and where it is rebroadcast. Each station which broadcasts network programs at a later hour in accordance with this waiver shall make an appropriate announcement at least once each day between the hours of 10:00 a.m. and 10:00 p.m., stating that some or all of the network programs which are broadcast by that station are delayed broadcasts by means of transcription. This waiver provision also applies during the annual periods in which daylight saving time will be effective with respect to network programs transcribed and rebroadcast one hour later because of the time differential resulting from the adoption of daylight saving time in some areas.

§ 3.589 [Reserved.]

§ 3.590 **Broadcasts by candidates for public office.** (a) *Definitions.* A "legally qualified candidate" means any person who has publicly announced that he is a candidate for nomination by a convention of a political party or for nomination or election in a primary, special, or general election, municipal, county, state or national, and who meets the qualifications prescribed by the applicable laws to hold the office for which he is a candidate, so that he may be voted for by the electorate directly or by means of delegates or electors, and who–

(1) Has qualified for a place on the ballot or

(2) Is eligible under the applicable law to be voted for by sticker, by writing in his name on the ballot, or other method and (i) has been duly nominated by a political party which is commonly known and regarded as such, or (ii) makes a

substantial showing that he is a bona fide candidate for nomination or office, as the case may be.

(b) *General requirements.* No station licensee is required to permit the use of its facilities by any legally qualified candidate for public office, but if any licensee shall permit any such candidate to use its facilities, it shall afford equal opportunities to all other such candidates for that office to use such facilities: *Provided,* That such licensee shall have no power of censorship over the material broadcast by any such candidate.

(c) *Practices.* No licensee shall make any discrimination in practices, regulations, facilities, or services for or in connection with the service rendered pursuant to this part, or make or give any preference to any candidate for public office or subject any such candidate to any prejudice or disadvantage; nor shall any licensee make any contract or other agreement which shall have the effect of permitting any legally qualified candidate for any public office to broadcast to the exclusion of other legally qualified candidates for the same public office.

(d) *Records; inspection.* Every licensee shall keep and permit public inspection of a complete record of all requests for broadcast time made by or on behalf of candidates for public office, together with an appropriate notation showing the disposition made by the licensee of such requests. Such records shall be retained for a period of two years.

(e) A request for equal opportunities must be submitted to the licensee within one week of the day on which the prior use occurred.

(f) A candidate requesting such opportunities of the licensee, or complaining of non-compliance to the Commission shall have the burden of proving that he and his opponent are legally qualified candidates for the same public office.

§ 3.591 Rebroadcast. (a) The term "rebroadcast" means reception by radio of the program of a radio station, and the simultaneous or subsequent retransmission of such program by a broadcast station. The broadcasting of a program relayed by a remote pick-up broadcast station or studio transmitter link is not considered a rebroadcast. In case a program is transmitted from its point of origin to a broadcast station entirely by telephone facilities in which a section of such transmission is by radio, the broadcasting of this program is not considered a rebroadcast.

NOTE: As used in this section, program includes any complete program or part thereof.

(b) The licensee of a noncommercial educational FM broadcast station may, without further authority of the Commission, rebroadcast the program of a United States standard, FM, noncommercial educational, or international broadcast station, provided the Commission is notified of the call letters of each station rebroadcast and the licensee certifies that express authority has been received from the licensee of the station originating the program.

NOTE 1: The notice and certification of consent shall be given within 3 days of any single rebroadcast, but in case of the regular practice of rebroadcasting certain programs several times during a license period, notice and certification of consent shall be given for the ensuing license period with the application for renewal of license, or at the beginning of such rebroadcast practice if begun during a license period.

NOTE 2: See § 3.503(c).

(c) No licensee of a noncommercial educational FM broadcast station shall rebroadcast the program of any United States radio station not designated in paragraph (b) of this section without written authority having first been obtained from the Commission upon application (informal) accompanied by written consent or certification of consent of the licensee of the station originating the program.

NOTE: By Order No. 82, dated and effective June 24, 1941, until further order of the Commission, § 3.591(c) is suspended only insofar as it requires prior written authority of the Commission for the rebroadcasting of programs originated for the express purpose by U.S. Government radio stations.

SUBPART D [RESERVED]

SUBPART E—TELEVISION BROADCAST STATIONS

General

§ 3.601 Scope of subpart. This subpart contains the rules and regulations (including engineering standards) governing television broadcast stations, including noncommercial educational television broadcast stations, in the United States, its Territories and possessions.

§ 3.602 Other pertinent rules. Other pertinent provisions of the Commission's rules and regulations relating to the television broadcast service are included in the following parts of this chapter:

Part 1—Practice and procedure.
Part 2—Frequency allocations and radio treaty matters; general rules and regulations.
Part 4—Experimental and auxiliary broadcast services.
Part 17—Construction, marking, and lighting of antenna towers and/or their supporting structures.

§ 3.603 Numerical designation of television channels. (a)

Channel No.	Frequency band (megacycles)	Channel No.	Frequency band (megacycles)	Channel No.	Frequency band (megacycles)	Channel No.	Frequency band (megacycles)
2	54–60	23	524–530	44	650–656	64	770–776
3	60–66	24	530–536	45	656–662	65	776–782
4	66–72	25	536–542	46	662–668	66	782–788
5	76–82	26	542–548	47	668–674	67	788–794
6	82–88	27	548–554	48	674–680	68	794–800
7	174–180	28	554–560	49	680 686	69	800–806
8	180–186	29	560–566	50	686–692	70	806–812
9	186–192	30	566–572	51	692–698	71	812–818
10	192–198	31	572–578	52	698–704	72	818–824
11	198–204	32	578–584	53	704–710	73	824–830
12	204–210	33	584–590	54	710–716	74	830–836
13	210–216	34	590–596	55	716–722	75	836–842
14	470–476	35	596–602	56	722–728	76	842–848
15	476–482	36	602–608	57	728–734	77	848–854
16	482–488	37	608–614	58	734–740	78	854–860
17	488–494	38	614–620	59	740–746	79	860–866
18	494–500	39	620–626	60	746–752	80	866–872
19	500–506	40	626–632	61	752–758	81	872–878
20	506–512	41	632–638	62	758–764	82	878–884
21	512–518	42	638–644	63	764–770	83	884–890
22	518–524	43	644–650				

(b) In Alaska and Hawaii the frequency bands 76–82 Mc and 82–88 Mc are allocated for non-Broadcast use. These frequency bands (Channels 5 and 6) will not be assigned in Alaska or Hawaii for use by television broadcast stations.

Channel Utilization

§ 3.606 Table of assignments. (a) *General.* The following table of assignments contains the channels assigned to the listed communities in the United States, its Territories, and possessions. Channels designated with an asterisk are assigned for use by noncommercial educational broadcast stations only. A station on a channel

identified by a plus or minus mark is required to operate with its carrier frequencies offset 10 kc above or below, respectively, the normal carrier frequencies.

(b) *Table of assignments.*

	Channel No.
Alabama:	
Andalusia	°2 -, 29
Anniston	70+
Auburn	°56
Bessemer	54
Birmingham	6–, °10–, 13 -, 42+, 48
Brewton	23+
Clanton	14
Cullman	60+
Decatur	23–
Demopolis	18
Dothan	9+, 19–
Enterprise	40+
Eufaula	44
Florence	15
Fort Payne	19
Gadsden	21+, 37–
Greenville	49–
Guntersville	40–
Huntsville	31+
Jasper	17
Mobile	5+, 10+, °42, 48+
Montgomery	12, 20, °26+, 32
Mumford	°7–
Opelika	22–
Selma	8–, 58+
Sheffield	47–
Sylacauga	24–
Talladega	64
Thomasville	27–
Troy	38–
Tuscaloosa	45, 51–
Tuskegee	16–
University	°74+
Alaska:	
Anchorage	2 -, °7–, 11, 13–
Fairbanks	2+, 4+, 7+, °9+, 11+, 13+
Juneau	°3, 8, 10
Ketchikan	2, 4, °9
Seward	4–, 9–
Sitka	13
Arizona:	
Ajo	14–
Bisbee	15
Casa Grande	18–
Clifton	25–
Coolidge	30+
Douglas	3–
Eloy	24
Flagstaff	9, 13
Globe	34+
Holbrook	14
Kingman	6–
Mesa	12–
Miami	28+
Morenci	31
Nogales	17–
Phoenix	3+, 5–, °8+, 10–
Prescott	15
Safford	21
Tucson	4–, °6+, 9–, 13–
Williams	25
Winslow	16–
Yuma	11–, 13+
Arkansas:	
Arkadelphia	34+
Batesville	30–
Benton	40
Blytheville	64+, 74
Camden	50
Conway	62
El Dorado	10–, 26–
Fayetteville	°13 -, 41–
Forrest City	22+
Fort Smith	5 -, °16, 22, 39
Harrison	24
Helena	54
Hope	15–
Hot Springs	9+, 52+
Jonesboro	8, 39+
Little Rock	°2–, 4, 11+, 17 -, 23+
Magnolia	28+
Malvern	46
Morrilton	43–
Newport	28
Paragould	58
Pine Bluff	7–, 36
Russellville	19
Searcy	33
Springdale	35–
Stuttgart	14+
California:	
Alturas	9
Bakersfield	10 -, 29
Bishop	19
Brawley	25+
Chico	12–
Corona	52
Delano	37+
El Centro	16, 56
Eureka	3–, 6–, 13–
Fresno	12+, °18–, 24, 47, 53
Hanford	21
Los Angeles	2, 4, 5, 7, 9, 11, 13, 22, °28, 34
Madera	59
Merced	34–, 66
Modesto	14+, 58
Monterey. (*See* Salinas.)	
Napa	62
Oakland. (*See* San Francisco.)	
Oxnard	32
Palm Springs	14
Petaluma	68
Pittsburg	16
Port Chicago	70
Porterville	55
Red Bluff	15

	Channel No.
California—(*Continued*)	
Redding	7
Riverside	40, 46
Sacramento	3, °6, 10, 40–, 46+
Salinas-Monterey	8+, 35
San Bernardino	18, °24–, 30
San Buenaventura	38–
San Diego	8, 10, °15+, 21–, 27, 33, 39
San Francisco-Oakland	2+, 4–, 5+, 7–, °9+, 20–, 26–, 32+, 38, 44–
San Jose	11+, 48, °54, 60
San Luis Obispo	6+
Santa Barbara	3–, 20, 26
Santa Cruz	56
Santa Maria	44
Santa Paula	16+
Santa Rosa	50
Stockton	13+, 36, °42, 64
Tulare	27+
Ukiah	18
Visalia	43, 49
Watsonville	22–
Yreka City	19
Yuba City	52–
Colorado:	
Alamosa	3–, 19+
Boulder	°12, 22+
Canon City	36
Colorado Springs	11, 13, °17+, 23+
Craig	19
Delta	24–
Denver	2, 4–, °6–, 7, 9–, 20, 26+
Durango	6+, 15
Fort Collins	44+
Fort Morgan	15+
Grand Junction	5–, 21+
Greeley	50
La Junta	24
Lamar	12–, 18–
Leadville	14+
Longmont	32
Loveland	38
Montrose	10+, 18
Pueblo	5, °8, 28+, 34–
Salida	25
Sterling	3, 25–
Trinidad	21–
Walsenburg	30–
Connecticut:	
Bridgeport	43–, 49–, °71
Hartford	3+, 18–, °24
Meriden	65–
New Britain	30+
New Haven	8+, 59+
New London	26+, 81
Norwalk. (*See* Stamford.)	
Norwich	57+, °63–
Stamford-Norwalk	27
Waterbury	53
Delaware:	
Dover	40
Wilmington	12, °59–, 83+

	Channel No.
District of Columbia:	
Washington	4–, 5–, 7+, 9, 14–, 20+, °26–, 50–
Florida:	
Belle Glade	27+
Bradenton	28–
Clearwater	32+, 50
Daytona Beach	2–, 53
De Land	44+
Fort Lauderdale	17–, 39
Fort Myers	11+
Fort Pierce	19
Gainesville	°5–, 20+
Jacksonville	4+, °7, 12–, 30+, 36–
Key West	14+, 20
Lake City	33+
Lakeland	16+, 22+
Lake Wales	14
Leesburg	26–
Marianna	17+
Melbourne	37–
Miami	°2, 4, 6, 7–, 10+, 23–, 33
Ocala	15+
Orlando	6–, 9, 18, °24–, 47
Palatka	17
Panama City	7+, °30, 36+
Pensacola	3–, 15–, °21, 46
Quincy	54+
St. Augustine	25+
St. Petersburg. (*See* Tampa.)	
Sanford	35+
Sarasota	34+
Tallahassee	°11–, 24, 51
Tampa-St. Petersburg	°3, 8–, 10–, 13–, 38
West Palm Beach	5, 12, °15, 21+
Georgia:	
Albany	10, 25
Americus	31
Athens	°8, 60–
Atlanta	2, 5–, 11+, °30, 36
Augusta	6+, 12+
Bainbridge	35–
Brunswick	28+, 34–
Cairo	45+
Carrollton	33
Cartersville	63–
Cedartown	53–
Columbus	4, 28, °34
Cordele	43
Dalton	25+
Douglas	32–
Dublin	15
Elberton	24+
Fitzgerald	53+
Fort Valley	18+
Gainesville	52
Griffin	39+
La Grange	50
Macon	13+, °41+, 47+
Marietta	57+
Milledgeville	51+
Moultrie	48–

	Channel No.
Newnan	61+
Rome	59
Savannah	3+, °9–, 11
Statesboro	22
Swainsboro	20–
Thomasville	6, 27
Tifton	14–
Toccoa	35
Valdosta	37+
Vidalia	26
Waycross	8+, 16
Hawaiian Islands:	
Hilo, Hawaii	2, °4, 7, 9, 11, 13
Honolulu, Oahu	2+, 4–, °7+, 9–, 11+, 13–
Lihue, Kauai	3+, °8–, 10+, 12–
Wailuku, Maui	3, 8, °10, 12
Idaho:	
Blackfoot	33
Boise	2, °4+, 7
Burley	15–
Caldwell	9–
Emmett	26–
Gooding	23
Idaho Falls	3, 8+
Jerome	17
Kellogg	33–
Lewiston	3–
Moscow	12–, °15
Nampa	6, 12+
Payette	14+
Pocatello	6–, 10
Preston	41
Rexburg	27+
Rupert	21
Sandpoint	23–
Twin Falls	11, 13–
Wallace	27–
Weiser	20–
Illinois:	
Alton	48
Aurora	75
Belleville	54+
Bloomington	15–
Cairo	24–
Carbondale	34, °61–
Centralia	32+, 59+
Champaign-Urbana	3+, °12–, 21, 27, 33
Chicago	2–, 5, 7, 9+, °11, 20, 26, 32, 38, 44
Danville	24
Decatur	17, 23+
De Kalb	°67
Dixon	47+
Elgin	83
Freeport	23
Galesburg	77
Harrisburg	22
Jacksonville	49–
Joliet	48+
Kankakee	14
Kewanee	60–
La Salle	35
Lincoln	53+
Macomb	61+
Marion	40
Mattoon	46–
Moline. (*See* Davenport, Iowa.)	
Mt. Vernon	38–
Olney	16–
Pekin	69+
Peoria	19, 25+, 31+, °37–, 43+
Quincy	10–, 21+
Rockford	13+, 39+, °45+
Rock Island. (*See* Davenport, Iowa.)	
Springfield	20+, 26–, 36–, °66+
Streator	65–
Urbana. (*See* Champaign.)	
Vandalia	28–
Waukegan	79+
Indiana:	
Anderson	26+, 61
Angola	77
Bedford	68
Bloomington	4, °30–, 36
Columbus	42–
Connersville	38+
Elkhart. (*See* South Bend.)	
Evansville	7, °9+, 14–, 50–
Fort Wayne	15+, 21+, °27+, 33–, 69
Gary	50, °66
Hammond	56–
Indianapolis	6, 8–, 13–, °20–, 39, 67–
Jasper	19+
Kokomo	29+
Lafayette	18, °47, 59
Lebanon	79+
Logansport	51
Madison	25–
Marion	31
Michigan City	62+
Muncie	49, 55+, °71
Plymouth	34–
Princeton	52+
Richmond	32–
Shelbyville	58+
South Bend-Elkhart	16, 22, 28+, °52
Tell City	78
Terre Haute	2+, 10, °57+, 63–, 73+
Vincennes	44+
Washington	60+
Iowa:	
Algona	37+
Ames	5, 25–
Atlantic	45–
Boone	19–
Burlington	32–, 38+
Carroll	39
Cedar Rapids	2, 9–, 20–, °26+
Centerville	31–
Charles City	18–
Cherokee	14
Clinton	64
Creston	43

	Channel No.
Iowa—(*Continued*)	
Davenport-Rock Island-Moline, Ill.	4+, 6+, 8, °30+, 42–, 68
Decorah	44+
Des Moines	8–, °11+, 13–, 17+, 23–
Dubuque	56+, 62–
Estherville	24+
Fairfield	54
Fort Dodge	21
Fort Madison	50+
Grinnell	71
Iowa City	°12+, 24–
Keokuk	44–
Knoxville	33–
Marshalltown	49
Mason City	3+, 35–
Muscatine	58
Newton	65+
Oelwein	28
Oskaloosa	52+
Ottumwa	15+, 63
Red Oak	32+
Shenandoah	20+
Sioux City	4–, 9, °30, 36–
Spencer	42+
Storm Lake	34+
Waterloo	7+, 16–, °22–, 46+
Webster City	27
Kansas:	
Abilene	31+
Arkansas City	49
Atchison	60+
Chanute	50–
Coffeyville	33–
Colby	22–
Concordia	47–
Dodge City	6+, 23
El Dorado	55+
Emporia	39–
Fort Scott	27
Garden City	9, 11+
Goodland	10, 31
Great Bend	2, 28
Hays	7–, 20–
Hutchinson	12, 18
Independence	20
Iola	44+
Junction City	29+
Larned	15–
Lawrence	°11, 17–
Leavenworth	54–
Liberal	14
McPherson	26–
Manhattan	°8, 23+
Newton	14+
Olathe	52–
Ottawa	21–
Parsons	46–
Pittsburg	7+, 38–
Pratt	36+
Salina	34
Topeka	13+, 42, °48+
Wellington	24–
Wichita	3–, 10–, 16–, °22+
Winfield	43+
Kentucky:	
Ashland	59–
Bowling Green	13, 17+
Campbellsville	40+
Corbin	16
Danville	35+
Elizabethtown	23
Frankfort	43–
Glasgow	28+
Harlan	73+
Hazard	19–
Hopkinsville	20
Lexington	18+, 27–, 64, 70+
Louisville	3–, 11+, °15, 21–, 41–, 51–
Madisonville	26
Mayfield	63
Maysville	24+
Middlesborough	57, 63+
Murray	33–
Owensboro	56–, 62
Paducah	6+, 43, 72
Pikeville	14–
Princeton	45–
Richmond	60
Somerset	29–
Winchester	37+
Louisiana:	
Abbeville	27+
Alexandria	5, 62+, 74
Bastrop	53+
Baton Rouge	2, 18–, 28, °34, 40–
Bogalusa	69, 78
Crowley	76
De Ridder	70
Ennice	64–
Franklin	46+
Hammond	57
Houma	11, 30+
Jackson	59
Jennings	48
Lafayette	10, 38–, 67–
Lafayette-Lake Charles	3
Lake Charles	7–, °14, 25, 60+
Minden	30
Monroe	8+, °13, 43+
Morgan City	36+
Natchitoches	17+
New Iberia	15+
New Orleans	4+, 6+, °8, 12, 20–, 26, 32+, 61
Oakdale	54+
Opelousas	58
Ruston	20
Shreveport	3–, 12
Thibodaux	24
Winnfield	22–
Maine:	
Auburn	23+
Augusta	10–, 29+
Bangor	2–, 5+, °16–

	Channel No.
Bar Harbor	22–
Bath	65
Belfast	41–
Biddeford	59
Calais	7–, 20–
Dover-Foxcroft	18+
Fort Kent	17+
Foxcroft. (*See* Dover.)	
Houlton	24
Lewiston	8–, 17
Millinocket	14+
Orono	°12–
Portland	6–, 13+, °47–, 53+
Presque Isle	8, 10+, 19
Rockland	25–
Rumford	55–
Van Buren	15–
Waterville	35+
Maryland:	
Annapolis	53–
Baltimore	2+, 11–, 13+, 18, °24+, 72–
Cambridge	22+
Cumberland	17+, 30–
Frederick	62
Hagerstown	52, 68+
Salisbury	16+
Massachusetts:	
Amherst	°82
Barnstable	25+
Boston	°2+, 4–, 5–, 7+, 38, 44+, 56
Brockton	62
Easthampton	61
Fall River	46–, 68
Greenfield	32+, 58–
Holyoke. (*See* Springfield.)	
Lawrence	72
Lowell	78
New Bedford	6+, 28–, 34+
North Adams	19, °80+
Pittsfield	64+
Springfield-Holyoke	22, 40
Worcester	14, 20
Michigan:	
Alma	41+
Alpena	9+, °11, 30
Ann Arbor	20+, °26–
Bad Axe	46–
Battle Creek	58–, 64–
Bay City	5–, 63–, °73+
Benton Harbor	40+
Big Rapids	39
Cadillac	13–, 45
Calumet	5
Cheboygan	4+, 36+
Coldwater	24–
Detroit	2+, 4, 7–, 50–, °56, 62
East Lansing	60+
East Tawas	25–
Escanaba	3+, °49
Flint	12–, 16–, °22–, 28
Gladstone	40–
Grand Rapids	8+, °17+, 23–
Houghton	19, °25
Iron Mountain	8–, 27
Iron River	33–
Ironwood	12+, 31–
Jackson	48
Kalamazoo	3–, 46, °74
Lansing	6–, 54
Ludington	18+
Manistee	15
Manistique	14+
Marquette	6–, 13+, 17, °35
Midland	19+
Mount Pleasant	47–
Muskegon	29–, 35+
Parma-Onondaga	10–
Petoskey	31
Pontiac	44+
Port Huron	34+
Rogers City	24
Saginaw	51–, 57–
Sault Ste. Marie	8, 10+, 28–, °34
Traverse City	7+, 20–, °26+
West Branch	21
Minnesota:	
Albert Lea	57–
Alexandria	7, 36
Austin	6–, 51+
Bemidji	9, 24–
Brainerd	12–
Cloquet	44
Crookston	21–
Detroit Lakes	18+
Duluth-Superior, Wis.	3, 6+, °8, 10+, 32, 38
Ely	16
Fairmont	40+
Faribault	20
Fergus Falls	16–
Grand Rapids	20–
Hastings	29+
Hibbing	13–
International Falls	11
Little Falls	14+
Mankato	12, 15–
Marshall	22+
Minneapolis-St. Paul	°2–, 4, 5–, 9+, 11–, 17, 23+
Montevideo	19
New Ulm	43–
Northfield	26
Owatonna	45
Red Wing	63–
Rochester	10, 55–
St. Cloud	33
St. Paul. (*See* Minneapolis.)	
Stillwater	39–
Thief River Falls	15
Virginia	26+
Wadena	27+
Willmar	31+
Winona	61
Worthington	32
Mississippi:	
Biloxi	13+, °44+, 50–

	Channel No.
Mississippi—(*Continued*)	
Brookhaven	37+
Canton	16
Clarksdale	32
Columbia	35+
Columbus	4–, 28–
Corinth	41
Greenville	21–, 27
Greenwood	6, 24+
Grenada	44
Gulfport	56–
Hattiesburg	9, 17–
Jackson	3+, 12+, °19+, 25–, 47
Kosciusko	52–
Laurel	33–
Laurel-Pachuta	7
Louisville	46–
McComb	31–
Meridian	11–, 30–, °36–
Natchez	29+
Pachuta. (*See* Laurel-Pachuta.)	
Pascagoula	22
Picayune	14–
Starkville	34–
State College	°2+
Tupelo	9–, 38
University	°20+
Vicksburg	41+
West Point	56+
Yazoo City	49
Missouri:	
Cape Girardeau	12, 18+, 69
Carthage	56–
Caruthersville	27–
Chillicothe	14–
Clinton	49–
Columbia	8+, 16+, 22–
Farmington	52
Festus	25–
Fulton	24+
Hannibal	7–, 27+
Jefferson City	13, 33+
Joplin	12+, 30+
Kansas City	4, 5+, 9+, °19+, 25+, 65
Kennett	21
Kirksville	3–, 18
Lebanon	23
Marshall	40+
Maryville	26
Mexico	45
Moberly	35+
Monett	14
Nevada	18–
Poplar Bluff	15+
Rolla	46
St. Joseph	2–, 30–, °36
St. Louis	2, 4–, 5–, °9, 11–, 30, 42+
Sedalia	6–, 28+
Sikeston	37
Springfield	3+, 10, °26+, 32
West Plains	20–
Montana:	
Anaconda	2+
Billings	2, 8, °11
Bozeman	°9, 22–
Butte	4, 6+, °7–, 15+
Cut Bank	20+
Deer Lodge	25+
Dillon	20
Glasgow	16
Glendive	5+, 18–
Great Falls	3+, 5+, °23–
Hamilton	17+
Hardin	4+
Havre	9+, 11+
Helena	10+, 12
Kalispell	9–
Laurel	14+
Lewistown	13
Livingston	16–
Miles City	3–, °6, 10
Missoula	8–, °11–, 13–, 21+
Polson	18
Red Lodge	18+
Shelby	14–
Sidney	14
Whitefish	16+
Wolf Point	20–
Nebraska:	
Alliance	13–, 21
Beatrice	40
Broken Bow	14–
Columbus	49+
Fairbury	35
Falls City	38
Fremont	52
Grand Island	11–, 21+
Hastiugs	5–, 27–
Hay Springs	4+
Hayes Center	6
Kearney	13, 19
Lexingtou	23–
Lincoln	10+, °12–, 18+, 24
McCook	8–, 17
Nebraska City	50
Norfolk	33+
North Platte	2–, 9+
Omaha	3, 6+, 7, °16, 22, 28–
Scottsbluff	10–, 16+
York	15
Nevada:	
Boulder City	4+
Carlin	14
Carson City	37
Elko	10–
Ely	3–, 6+
Fallon	29–
Goldfield	5–
Hawthorne	31
Henderson	2–
Las Vegas	8–, °10+, 13–
Lovelock	18+
McGill	8+
Reno	4, 8, °21+, 27–
Tonopah	9–
Winnemucca	7+
Yerington	33

	Channel No.
New Hampshire:	
Berlin	26
Claremont	37
Concord	75+
Durham	°11
Hanover	°27+
Keene	45–
Laconia	43
Littleton	24–
Manchester	9–, 48+
Nashua	54
Portsmouth	15
Rochester	51
New Jersey:	
Andover	°69
Asbury Park	58
Atlantic City	46, 52+
Bridgeton	64–
Camden	°80
Freehold	°74
Hammonton	°70
Montclair	°77
Newark	13–
New Brunswick	°19–, 47+
Paterson	37+
Trenton	41+
Wildwood	48–
New Mexico:	
Alamogordo	17
Albuquerque	4+, °5+, 7+, 13+
Artesia	21+
Atrisco-Five Points	18+
Belen	24+
Carlsbad	6–, 23
Clayton	27–
Clovis	12+, 35
Deming	14+
Farmington	12+, 17–
Five Points. (*See* Atrisco.)	
Gallup	3, °8–, 10
Hobbs	46
Hot Springs	19
Las Cruces	22–
Las Vegas	14–
Lordsburg	23+
Los Alamos	20–
Lovington	27
Portales	22+
Raton	46–, °52
Roswell	°3+, 8, 10–
Santa Fe	2+, °9+, 11–
Silver City	°10+, 12
Socorro	15+
Tucumcari	25+
New York:	
Albany-Schenectady-Troy	6, 13, °17+, 23–, 35, 41
Amsterdam	52–
Batavia	33–
Binghamton	12–, 40–, °46+, 56+
Buffalo	17, °23
Buffalo-Niagara Falls	2, 4–, 7+, 29+
Carthage	7–
Clymer	37
Cortland	72
Dunkirk	46
Elmira	18+, 24–, 30
Glens Falls	39+
Gloversville	29–
Hornell	50
Ithaca	°14+, 20–
Jamestown	58+
Kingston	66–
Lake Placid	5
Malone	20+, °66
Massena	14–
Middletown	60
New York	2, 4, 5+, 7, 9+, 11+, °25, 31–
Niagara Falls. (*See* Buffalo-Niagara Falls.)	
Ogdensburg	24+
Olean	54+
Oneonta	62–
Oswego	31
Patchogue	75
Plattsburg	28+
Poughkeepsie	21–, °83
Rochester	5–, 10+, 15–, °21, 27+
Rome. (*See* Utica.)	
Saranac Lake	18
Schenectady. (*See* Albany.)	
Syracuse	3–, 8, °43+
Troy. (*See* Albany.)	
Utica-Rome	2–, °25+, 54–
Vail Mills	10–
Watertown	48
North Carolina:	
Ahoskie	53
Albermarle	20
Asheville	13–, °56–, 62+, 78
Burlington	63
Burnsville	18
Chapel Hill	°4+
Charlotte	3, 9+, 36+, °42+
Durham	11+, °40–, 46+, 73–
Elizabeth City	31+
Fayetteville	18–, 54–
Gastonia	48
Goldsboro	34, 72
Greensboro	2–, °51–, 57–
Greenville	9–
Henderson	52–
Hendersonville	27
Hickory	30–
High Point	15+
Jacksonville	16
Kannapolis	59+
Kinston	45
Laurinburg	41–
Lumberton	21+
Mount Airy	55
New Bern	12+
Raleigh	5, °22–, 28–
Roanoke Rapids	30+
Rocky Mount	50+
Salisbury	80
Sanford	38

	Channel No.
North Carolina—(*Continued*)	
Shelby	39
Southern Pines	49
Statesville	64–
Washington	7
Wilmington	3–, 6, 29–, °35+
Wilson	56
Winston-Salem	12, 26+, °32–
North Dakota:	
Bismarck	5, 12–, 18, °24
Bottineau	16+
Carrington	26–
Devils Lake	8+, 14–
Dickinson	2+, 4, °17
Fargo	6, 11+, °34–, 40
Grafton	17
Grand Forks	°2, 10
Harvey	22+
Jamestown	7–, 42
Lisbon	23
Minot	°6+, 10–, 13+
New Rockford	20+
Rugby	38–
Valley City	4–, 32–
Wahpeton	45+
Williston	8–, 11–, °34+
Ohio:	
Akron	49+, °55–, 61+
Ashtabula	15
Athens	62–
Bellefontaine	63
Bowling Green	°70
Cambridge	26
Canton	29
Chillicothe	56+
Cincinnati	5–, 9, 12, °48–, 54–, 74–
Cleveland	3, 5+, 8, 19, °25+, 65+
Columbus	4–, 6+, 10+, °34, 40–
Coshocton	20
Dayton	2, 7+, °16+, 22+
Defiance	43
Findlay	53
Fremont	59+
Gallipolis	72
Hamilton-Middletown	65
Lancaster	28–
Lima	35–, 73
Lorain	31–
Mansfield	36+
Marion	17–
Massillon	23+
Middletown. (*See* Hamilton.)	
Mount Vernon	58
Newark	60–
Oxford	°14+
Piqua	44–
Portsmouth	30
Sandusky	42+
Springfield	52–, 76
Steubenville. (*See* Wheeling, W. Va.)	
Tiffin	47+
Toledo	11–, 13, °30+, 79
Warren	67+
Youngstown	21–, 27, 73–
Youngstown, Ohio-New Castle, Pa.	45–
Zanesville	18–, 50+
Oklahoma:	
Ada	10+, 50+
Altus	36
Alva	30
Anadarko	58–
Ardmore	12–, 55–
Bartlesville	62–
Blackwell	51–
Chickasha	64
Claremore	15
Clinton	32–
Duncan	39–
Durant	27–
Elk City	8+, 15+, 26+
El Reno	56+
Enid	5, 21, °27+
Frederick	44
Guthrie	48
Guymon	20+
Hobart	23+
Holdenville	14–
Hugo	21+
Lawton	7+, °28+, 34–
McAlester	47
Miami	58+
Muskogee	°45+, 66+
Norman	31–, °37–
Oklahoma City	4–, 9–, °13, 19+, 25–
Okmulgee	26
Pauls Valley	61
Ponca City	40–
Pryor Creek	54
Sapulpa	42–
Seminole	59
Shawnee	53–
Stillwater	29–, °69
Tulsa	2+, 6, 8–, °11–, 17+, 23
Vinita	28–
Woodward	35+
Oregon:	
Albany	55+
Ashland	14–
Astoria	30–
Baker	37+
Bend	15–
Brookings	8+
Burns	16
Coos Bay	11
Corvallis	°7–, 49–
Eugene	9+, 13, 20+, 26
Grants Pass	30
Klamath Falls	2–, 17
La Grande	13+
Lebanon	43+
McMinnville	46–
Medford	5
North Bend	16+
Pendleton	28
Portland	2, 6+, 8–, °10, 12, 21–, 27+

	Channel No.
Roseburg	4+, 23+
Salem	3+, °18, 24+, 66
Springfield	37–
The Dalles	32
Pennsylvania:	
Allentown	39, 67
Altoona	10–, 23–
Bethlehem	51–
Bradford	80–
Butler	43–
Chambersburg	46–
Du Bois	31+
Easton	57–
Emporium	42–
Erie	12, 35+, °41–, 66+
Harrisburg	27–, 55+, 71+
Hazleton	63
Johnstown	6, 19+, 56–
Lancaster	8–, 21+
Lebanon	15+
Lewistown	75–
Lock Haven	32
Meadville	62+
New Castle. (*See* Youngstown, Ohio.)	
Oil City	64
Philadelphia	3, 6–, 10, 17–, 23+, 29, °35–
Pittsburgh	2, 4+, 11, °13–, 16, 47, 53+
Reading	33+, 61+
Scranton	16–, 22–, 44
Shamokin	65
Sharon	39+
Shinglehouse	26–
State College	°48+
Sunbury	38
Uniontown	11
Washington	63–
Wilkes-Barre	28, 34
Williamsport	36–
York	43, 49
Rhode Island:	
Providence	10–, 12+, 16, °36+
South Carolina:	
Aiken	54
Anderson	40, 58–
Camden	14
Charleston	2+, 4, 5+, °13, 17+
Clemson	°68
Columbia	10, °19+, 25–, 67+
Conway	23–
Florence	8–, 60
Georgetown	27–
Greenville	4–, 23+, °29
Greenwood	21–
Lake City	55+
Lancaster	31–
Laurens	45–
Marion	43–
Newberry	70
Orangeburg	44–
Rock Hill	61–
Spartanburg	7+, 17–, 74–
Sumter	47
Union	65–
South Dakota:	
Aberdeen	9–, 17+
Belle Fourche	23+
Brookings	°8, 25
Hot Springs	17+
Huron	12+, 15+
Lead	5–, 26
Madison	46
Mitchell	5+, 20–
Mobridge	27–
Pierre	10+, °22+
Rapid City	3+, 7+, 15–
Reliance	6–
Sioux Falls	11, 13+, 38+, °44–
Sturgis	20
Vermillion	°2+, 41
Watertown	3–, 35+
Winner	18–
Yankton	17–
Tennessee:	
Athens	14+
Bristol, Tenn.-Bristol, Va.	5+, 46–
Chattanooga	3+, 9, 12–, 43+, 49+, °55–
Clarksville	53
Cleveland	38+
Columbia	39–
Cookeville	24, °69
Crossville	°77
Covington	19–
Dyersburg	46+
Elizabethton	22+
Fayetteville	27+
Gallatin	48+
Harriman	67
Humboldt	25
Jackson	7+, 16+
Johnson City	11–, 34+
Kingsport	28
Knoxville	6, 10+, °20+, 26–
Lawrenceburg	50+
Lebanon	58
Lexington	°11
McMinnville	46
Maryville	51
Memphis	3, 5+, °10+, 13+, 42, 48–
Morristown	54+
Murfreesboro	18–
Nashville	°2–, 4+, 5, 8+, 30+, 36+
Oak Ridge	32+
Paris	51+
Pulaski	44–
Shelbyville	56
Sneedville	°2+
Springfield	42
Tullahoma	68–
Union City	55
Texas:	
Abilene	9+, 33–
Alice	34+

	Channel No.
Texas—(*Continued*)	
Alpine	12–
Amarillo	°2–, 4, 7, 10
Athens	25+
Austin	7+, 18–, 24, °70–
Ballinger	25
Bay City	33
Beaumont-Port Arthur	4–, 6–, 12–, 31+, °37
Beeville	38–
Big Spring	4–, 34+
Bonham	43
Borger	33
Brady	15–
Breckenridge	14+
Brenham	52–
Brownfield	15
Brownsville	36
Brownsville-Harlingen-Weslaco [1]	4+, 5–
Brownwood	19
Bryan	54–
Bryan-College Station (*also see* College Station)	3+
Childress	40
Cleburne	57
Coleman	21–
College Station (*also see* Bryan-College Station)	°48–
Conroe	20+
Corpus Christi	6+, 10–, °16+, 22, 43
Corsicana	47+
Crockett	56
Crystal City	28+
Cuero	25–
Dalhart	16
Dallas	4+, 8, °13+, 23, 29, 73
Del Rio	16–
Denison	52
Denton	°2, 17
Eagle Pass	26
Edinburg	26–
El Campo	27
El Paso	4, °7, 9, 13, 20+, 26+
Falfurrias	52
Floydada	45
Fort Stockton	22
Fort Worth	5+, 11–, 20–, °26–
Gainesville	49–
Galveston	35–, 41–, °47–
Gonzales	64+
Greenville	69–
Harlingen (*also see Brownsville-*Harlingen-Weslaco)	23
Hebbronville	58
Henderson	42+
Hereford	19–
Hillsboro	63
Houston	2–, °8–, 11+, 13–, 23+, 29–, 39–
Huntsville	15
Jacksonville	36–
Jasper	49+
Kermit	14
Kilgore	59–
Kingsville	40
Lamesa	28
Lampasas	40–
Laredo	8, 13, °15+
Levelland	38–
Littlefield	32
Longview	32, 38+
Lubbock	5–, 11, 13–, °20, 26
Lufkin	9, 46–
McAllen	20–
McKinney	65–
Marfa	19+
Marshall	16
Mercedes	32
Mexia	50–
Midland	2+, 18
Mineral Wells	38
Mission	14
Monahans	9–
Mount Pleasant	35
Nacogdoches	19–, 40+
New Braunfels	62–
Odessa	7–, 24–
Orange	43–
Pampa	17–
Paris	33+
Pearsall	31
Pecos	16+
Perryton	22
Plainview	29+
Port Arthur. (*See* Beaumont.)	
Quanah	42
Raymondville	42
Rosenberg	17–
San Angelo	3–, 8+, 17+, °23–
San Antonio	4, 5, °9–, 12+, 35+, 41+
San Benito	48
San Marcos	53+
Seguin	14–
Seymour	24+
Sherman	46+
Snyder	30+
Stephenville	32+
Sulphur Springs	41
Sweetwater	12
Taylor	58+
Temple	6, 16, 22+
Terrell	53
Texarkana	6+, °18, 24–
Tyler	7, 61+, 72
Uvalde	20
Vernon	18+
Victoria	19+
Waco	10+, °28–, 34
Waxahachie	45–
Weatherford	51
Weslaco. (*See* Brownsville-Harlingen-Weslaco.)	
Wichita Falls	3, 6–, °16+, 22–

[1] These assignments may be utilized in any community lying within the area of the triangle formed by Brownsville, Harlingen and Weslaco.

	Channel No.
Utah:	
Brigham	36–
Cedar City	5
Logan	12–, 30, °46
Ogden	9+, °18–, 24
Price	6
Provo	11+, 22, °28
Richfield	13+
St. George	13+
Salt Lake City	2–, 4–, 5+, °7–, 20+, 26
Tooele	44
Vernal	3+
Vermont:	
Bennington	74+
Brattleboro	77+
Burlington	3, °16+, 22+
Montpelier	57
Newport	46
Rutland	49+
St. Albans	34–
St. Johnsbury	30
Virginia:	
Blacksburg	°60+
Bristol. (*See* Bristol, Tenn.)	
Charlottesville	°45+, 64+
Covington	44+
Danville	24–
Emporia	25+
Farmville	19
Fredericksburg	47
Front Royal	39–
Harrisonburg	3–, 34–
Lexington	54
Lynchburg	13, 16–
Marion	50
Martinsville	35–
Newport News. (*See* Norfolk-Portsmouth-Newport News.)	
Norfolk-Portsmouth	27
Norfolk-Portsmouth-Newport News	3+, 10+, 13–, 15, °21–, 33
Norton	52+
Petersburg	8, 41
Portsmouth. (*See* Norfolk-Portsmouth and *also see* Norfolk-Portsmouth-Newport News.)	
Pulaski	37–
Richmond	6+, 12–, °23, 29+
Roanoke	7–, 10, 27+, °33–
South Boston	14+
Staunton	36
Waynesboro	42
Williamsburg	17
Winchester	28+
Washington:	
Aberdeen	58
Anacortes	34
Bellingham	12+, 18+, 24–
Bremerton	44, 50
Centralia	17
Clarkston	34+, 40+
Ellensburg	49, °65
Ephrata	16–, 43
Everett	22–, 28–
Grand Coulee	37
Hoquiam	52
Kelso	39
Kennewick	31
Kennewick-Richland-Pasco	°41
Longview	33
Moses Lake	61
Okanogan. (*See* Omak.)	
Olympia	60
Omak-Okanogan	°35–
Pasco (*also see* Kennewick-Richland-Pasco)	19–
Port Angeles	16+
Pullman	°10–, 24
Richland (*also see* Kennewick-Richland-Pasco)	25
Seattle	4, 5+, 7, °9, 20, 26+
Spokane	2–, 4–, 6–, °7+
Tacoma	11+, 13–, °56, 62
Walla Walla	5–, 8, °22
Wenatchee	°45, 55, 67
Yakima	23+, 29+, °47
West Virginia:	
Beckley	4, 21, 66
Bluefield	6–, 41+
Charleston	8+, °43+, 49–
Clarksburg	12+, 22, 69–
Elkins	40+
Fairmont	35
Hinton	31
Huntington	3+, 13+, °53–
Logan	23–
Martinsburg	58–
Morgantown	°24
Parkersburg	15–
Welch	25
Weston	5, 32
Wheeling	°57+
Wheeling-Steubenville, Ohio	7, 9+, 51+
Williamson	17
Wisconsin:	
Adams	°58+
Appleton	42+
Ashland	15+
Beaver Dam	37
Beloit	57
Chilton	°24+
Eau Claire	13, °19+, 25+
Fond du Lac	54+
Green Bay	2+, 5+, 70+
Janesville	63+
Kenosha	61–
La Crosse	8+, °32+, 38–, 72
Madison	3, °21–, 27–, 33+
Manitowoc	65
Marinette	11+, 32–, °38+
Milwaukee	4–, °10+, 12, 19–, 25, 31–
Oshkosh	48–
Park Falls	°18
Portage	17–

	Channel No.
Wisconsin—(*Continued*)	
Prairie du Chien	34
Racine	49–, 55
Rhinelander	22
Rice Lake	21+
Richland Center	15, °66–
Sheboygan	59–
Shell Lake	°30–
Sparta	50
Stevens Point	20+, 26–
Sturgeon Bay	44–
Superior. (*See* Duluth, Minn.)	
Wausau	7–, 9, 16+, °46–
Whitefish Bay	6
Wisconsin Rapids	14–
Wyoming:	
Buffalo	29
Casper	2+, 6+
Cheyenne	5+
Cody	24–
Douglas	14
Evanston	14–
Gillette	31–
Green River	16
Greybull	40
Lander	17–
Laramie	°8+, 18+
Lovell	36+
Lusk	19–
Newcastle	28+
Powell	30+
Rawlins	11–
Riverton	10+
Rock Springs	13
Sheridan	9–, 12+
Thermopolis	15
Torrington	27
Wheatland	24+
Worland	34
U. S. TERRITORIES AND POSSESSIONS	
Guam:	
Agana	8, 10
Puerto Rico:	
Arecibo-Aguadilla	12+
Caguas	11–
Fajardo	13+
Mayaguez	3+, 5–
Ponce	7+, 9–
San Juan	2+, 4–, °6+
Virgin Islands:	
Charlotte Amalie	10–
Christiansted	8+

§ 3.607 Availability of channels. (a) Subject to the provisions of paragraph (b) of this section, applications may be filed to construct television broadcast stations only on the channels assigned in the Table of Assignments (§ 3.606(b)) and only in communities listed therein. Applications which fail to comply with this requirement, whether or not accompanied by a petition to amend the Table, will not be accepted for filing: *Provided, however,* That applications specifying channels which accord with publicly announced Commission Orders changing the Table of Assignments will be accepted for filing even though such applications are tendered before the effective dates of such channel changes.

(b) A channel assigned to a community listed in the Table of Assignments is available upon application in any unlisted community which is located within 15 miles of the listed community. In addition, a channel assigned to a community listed in the Table of Assignments and not designated for use by noncommercial educational stations only, is available upon application in any other community within 15 miles thereof which, although listed in the Table, is assigned only a channel designated for use only by noncommercial educational stations. Where channels are assigned to two or more communities listed in combination in the Table of Assignments the provisions of this paragraph shall apply separately to each community so listed. The distance between communities shall be determined by the distance between the respective coordinates thereof as set forth in the publication of the United States Department of Commerce entitled "Air Line Distance Between Cities in the United States." (This publication may be purchased from the Government Printing Office, Washington, D.C.) If said publication does not contain the coordinates of either or both communities, the coordinates of the main post office in either or both of such communities shall be used. The method to be followed in making the measurements is set forth in § 3.611(d).

§ 3.608 International agreements Authorizations issued by the Commission for television broadcast facilities will be subject to the provisions of any agreements entered into by the United States with Canada and Mexico concerning television assignments and authorizations. Where, pursuant to such an agreement, timely objection is received from the foreign country involved to an authorization granted by

the Commission, the Commission may, on its own motion, set aside such authorization pending consideration of such objection. Upon receipt of such objection, the Commission will notify the person to whom such authorization has been issued.

§ 3.609 **Zones.** (a) For the purpose of allocation and assignment, the United States is divided into three zones as follows:

(1) Zone I consists of that portion of the United States located within the confines of the following lines drawn on the United States Albers Equal Area Projection Map (based on standard parallels 29½° and 45½°; North American datum): Beginning at the most easterly point on the State boundary line between North Carolina and Virginia; thence in a straight line to a point on the Virginia, West Virginia boundary line located at North Latitude 37° 49′ and West Longitude 80° 12′ 30″; thence westerly along the southern boundary lines of the States of West Virginia, Ohio, Indiana and Illinois to a point at the junction of the Illinois, Kentucky, and Missouri State boundary lines; thence northerly along the western boundary line of the State of Illinois to a point at the junction of the Illinois, Iowa, and Wisconsin State boundary lines; thence easterly along the northern State boundary line of Illinois to the 90th meridian; thence north along this meridian to the 43.5° parallel; thence east along this parallel to the 71st meridian; thence in a straight line to the intersection of the 69th meridian and the 45th parallel; thence east along the 45th parallel to the Atlantic Ocean. When any of the above lines pass through a city, the city shall be considered to be located in Zone I. (See Figure 1 of § 3.699.)

(2) Zone II consists of that portion of the United States which is not located in either Zone I or Zone III, and Puerto Rico, Alaska, Hawaiian Islands and the Virgin Islands.

(3) Zone III consists of that portion of the United States located south of a line, drawn on the United States Albers Equal Area Projection Map (based on standard parallels 29½° and 45½°; North American datum), beginning at a point on the east coast of Georgia and the 31st parallel and ending at the United States-Mexican border, consisting of arcs drawn with a 150 mile radius to the north from the following specified points:

	North latitude	*West longitude*
(*a*)	29°40′00″	83°24′00″
(*b*)	30°07′00″	84°12′00″
(*c*)	30°31′00″	86°30′00″
(*d*)	30°48′00″	87°58′30″
(*e*)	30°00′00″	90°38′30″
(*f*)	30°04′30″	93°19′00″
(*g*)	29°46′00″	95°05′00″
(*h*)	28°43′00″	96°30′30″
(*i*)	27°52′30″	97°32′00″

When any of the above arcs pass through a city, the city shall be considered to be located in Zone II. (See Figure 2 of § 3.699.)

§ 3.610 **Separations.** (a) The provisions of this section relate to assignment separations and station separations. Petitions to amend the Table of Assignments (§ 3.606(b)) (other than those also expressly requesting amendment of this section or § 3.609) will be dismissed and all applications for new television broadcast stations or for changes in the transmitter sites of existing stations will not be accepted for filing if they fail to comply with the requirements specified in paragraphs (b), (c) and (d) of this section:

NOTE: Licensees and permittees of television broadcast stations which were operating on April 14, 1952, pursuant to one or more separations below those set forth in § 3.610 may continue to so operate, but in no event may they further reduce the separations below the minimum. As the existing separations of such stations are increased, the new separations will become the required minimum separations until separations are reached which comply with the requirements of § 3.610. Thereafter, the provisions of said section shall be applicable.

(b) Minimum co-channel assignment and station separations:
(1)

Zone	Channels 2–13	Channels 14–83
	Miles	*Miles*
I	170	155
II	190	175
III	220	205

(2) The minimum co-channel mileage separation between a station in one zone and a station in another zone shall be that of the zone requiring the lower separation.

(c) Minimum assignment and station adjacent channel separations applicable to all zones: *

(1) Channels 2–13 Channels 14–83
60 miles 55 miles

(2) Due to the frequency spacing which exists between Channels 4 and 5, between Channels 6 and 7, and between Channels 13 and 14, the minimum adjacent channel separations specified above shall not be applicable to these pairs of channels (see § 3.603).

(d) In addition to the requirements of paragraphs (a), (b) and (c) of this section, the minimum assignment and station separations between stations on Channels 14–83, inclusive, as set forth in Table IV of § 3.698 must be met in either rule-making proceedings looking towards the amendment of the Table of Assignments (§ 3.606(b)) or in licensing proceedings. No channel listed in column (1) of Table IV of § 3.698 will be assigned to any city, and no application for an authorization to operate on such a channel will be granted unless the mileage separations indicated at the top of columns (2)–(7), inclusive, are met with respect to each of the channels listed in those columns and parallel with the channel in column (1).

(e) The zone in which the transmitter of a television station is located or proposed to be located determines the applicable rules with respect to co-channel mileage separations where the transmitter is located in a different zone from that in which the channel to be employed is located.

§ 3.611 Reference points and distance computations. (a) In considering petitions to amend the Table of Assignments (§ 3.606(b)), the following reference points shall be used by the Commission in determining assignment separations between communities:

(1) Where transmitter sites for the pertinent channels have been authorized in communities involved in a petition to amend the Table of Assignments, separations between such communities shall be determined by the distance between the coordinates of the authorized transmitter sites in the respective communities as set forth in the Commission's authorizations therefor.

(2) Where an authorized transmitter site is available for use as a reference point in one community but not in the other for the pertinent channels, separations shall be determined by the distance between the coordinates of the transmitter site as set forth in the Commission's authorization therefor and the coordinates of the other community as set forth in the publication of the United States Department of Commerce entitled "Air Line Distances Between Cities in the United States." If said publication does not contain the coordinates for said other community, the coordinates of the main post office thereof shall be used.

(3) Where no authorized transmitter sites are available for use as reference points in both communities for the pertinent channels, the distance between the two communities listed in the above publication shall be used. If said publication does not contain such distance, the separation between the two communities shall be determined by the distance between the coordinates thereof as set forth in said publication.

* See Doc. 13340 for proposed revision of VHF adjacent channel separations.

Where such coordinates are not contained in said publication, the coordinates of the main post offices of said communities shall be used.

(4) Where the distance between the reference point in a community to which a channel is proposed to be assigned and the reference point in another community or communities does not meet the minimum separation requirements of § 3.610, the channel may be assigned to such community upon a showing that a transmitter site is available that would meet the minimum separation requirements of § 3.610 and the minimum field intensity requirements of § 3.685. In such cases, where a station is not authorized in the community or communities to which measurements from the proposed channel assignment must be made pursuant to § 3.610, a showing should also be made that the distance between suitable transmitter sites in such other community or communities and the proposed transmitter site for the new channel meet the Commission's minimum spacing and coverage requirements.

(b) Station separations in licensing proceedings shall be determined by the distance between the coordinates of the proposed transmitter site in one community and

(1) The coordinates of an authorized transmitter site for the pertinent channel in the other community; or, where such transmitter site is not available for use as a reference point,

(2) The coordinates of the other community as set forth in the above-described publication of the United States Department of Commerce; or, if not contained therein,

(3) The coordinates of the main post office of such other community.

(4) In addition, where there are pending applications in other communities which, if granted, would have to be considered in determining station separations, the coordinates of the transmitter sites proposed in such applications must be used to determine whether the requirements with respect to minimum separations between the proposed stations in the respective cities have been met.

(c) In measuring assignment and station separations involving cities listed in the Table in combination, where there is no authorized transmitter site in any of the combination cities on the channel involved, separation measurements shall be made from the reference point which will result in the lowest separation.

(d) The distance between reference points is considered to be the length of the hypotenuse of a right triangle, one side of which is the difference in latitude of the reference points and the other side the difference in longitude of the two reference points, and shall be computed as follows: (This method is appropriate for determining distances up to 220 miles, and for such distances will normally be more accurate than using spherical trigonometry without correction for the spheroidal shape of the earth. However, its accuracy deteriorates rapidly at distances beyond 300 miles and this method should not be used to compute greater distances.)

(1) Determine the difference in latitude and the difference in longitude between the two reference points. Convert these two differences into degrees and decimal parts of a degree in accordance with Table I of § 3.698.

(2) Determine the middle latitude of the two reference points to the nearest second of latitude (average the latitudes of the two points).

(3) Multiply the difference in latitude by the number of miles per degree of latitude difference obtained from Table II of § 3.698 for the appropriate middle latitude (interpolate linearly). This determines the North-South distance in statute miles.

NOTE: In determining necessary distance computations for the Territories, the appropriate mileage per degree may be obtained by linear interpolation of the data given on pages 122 and 123 of the tables in publication H. O. No. 9 (Bowditch-American Practical Navigator—1943 Edition) of the U.S. Navy Dept., Hydrographic Office. This publication may be purchased from the Government Printing Office, Washington, D.C.

(4) Multiply the difference in longitude by the number of miles per degree of longitude difference obtained from Table III of § 3.698, for the appropriate middle latitude (interpolate linearly). This determines the East-West distance in statute miles.

(5) Determine the distance between the two reference points by the square root of the sum of the squares of the distances obtained in subparagraphs (3) and (4) of this paragraph, i.e.

$$D = (L_a^2 + L_o^2)^{1/2}$$

where D = distance in statute miles
L_a = North-South distance in miles from (3) above
L_o = East-West distance in miles from (4) above

In computing the above, sufficient decimal figures shall be used to determine the distance to the nearest mile.

§ 3.612 Protection from interference. Permittees and licensees of television broadcast stations are not protected from any interference which may be caused by the grant of a new station or of authority to modify the facilities of an existing station in accordance with the provisions of this subpart. The nature and extent of the protection from interference accorded to television broadcast stations is limited solely to the protection which results from the minimum assignment and station separation requirements and the rules with respect to maximum powers and antenna heights set forth in this subpart.

NOTE: The nature and extent of the protection from interference accorded to television broadcast stations which were authorized prior to April 14, 1952, and which were operating on said date is limited not only as specified above but is further limited by any smaller separations existing between such stations on said date. Where, as a result of the adoption of the Table of Assignments, or of changes in transmitter sites made by such stations after said date, separations smaller than the required minimum are increased but still remain lower than the required minimum, protection accorded such stations will be limited to the new separations.

§ 3.613 Main studio location. (a) The main studio of a television broadcast station shall be located in the principal community to be served. Where the principal community to be served is a city, town, village or other political subdivision, the main studio shall be located within the corporate boundaries of such city, town, village or other political subdivision. Where the principal community to be served does not have specifically defined political boundaries, applications will be considered on a case-to-case basis in the light of the particular facts involved to determine whether the main studio is located within the principal community to be served.

(b) In cases where an adequate showing is made that there is good cause for locating a main studio outside the principal community to be served and that to do so would not be inconsistent with the operation of the station in the public interest, the Commission will permit the use of a main studio location other than that specified in paragraph (a) of this section. The licensee or permittee of a television broadcast station shall not move his main studio outside the principal community in which it is located without first securing a modification of construction permit or license. Such licensee or permittee shall notify the Commission promptly of any change of the location of the main studio within the community. In any case where the main studio is located outside the principal community to be served, the licensee or permittee of a television broadcast station shall not move his main studio without first securing a modification of construction permit or license.

§ 3.614 Power and antenna height requirements. (a) *Minimum requirements.* Applications will not be accepted for filing if they specify less than −10 dbk (100 watts) visual effective radiated power in any horizontal direction. No minimum antenna height above average terrain is specified.

(b) *Maximum power.* Applications will not be accepted for filing if they specify a power in excess of that provided for in this paragraph. Except as provided in subparagraph (1) of this paragraph, the maximum effective radiated powers of television broadcast stations operating on the channels set forth below with antenna heights not in excess of 2,000 feet above average terrain shall be as follows:

Channel Nos.	Maximum visual effective radiated power in db. above one kilowatt (dbk.)
2–6	20 dbk. (100 kw.)
7–13	25 dbk. (316 kw.)
14–83	37 dbk. (5000 kw.)[1]

[1] The maximum visual effective radiated power of television broadcast stations operating on Channels 14–83 within 250 miles of the Canadian-USA border may not be in excess of 30 dbk (1000 kw).

(1) In Zone I, on Channels 2–13, inclusive, the maximum powers specified above for these channels may be used only with antenna heights not in excess of 1,000 feet above average terrain. Where antenna heights exceeding 1,000 feet above average terrain are used on Channels 2–13, or antenna heights exceeding 2,000 feet above average terrain are used on Channels 14–83, the maximum power shall be based on the chart designated as Figure 3 of § 3.699.

NOTE: This limitation shall not apply to any licensee or permittee in Zone I who received an authorization after March 22, 1951, to relocate its transmitter site and construct a new tower and antenna to a height in excess of 1000 feet above average terrain and who constructed or who had substantially completed construction of said tower and antenna prior to April 14, 1952. In such case, maximum power may be utilized at the height above average terrain specified in the authorization. The limitation shall apply, however, where the tower or other principal supporting structure had been constructed prior to the date of such authorization.

(2) In Zones II and III, the maximum powers which may be used by television broadcast stations operating on the respective channels set forth in the above table with antenna heights exceeding 2,000 feet above average terrain shall be based on the chart designated as Figure 4 of § 3.699.

(3) The effective radiated power in any horizontal or vertical direction may not exceed the maximum values permitted by this section and Figures 3 and 4 of § 3.699.

(4) The maximum effective radiated power in any direction above the horizontal plane shall be as low as the state of the art permits and may not exceed the effective radiated power in the horizontal direction in the same vertical plane.

(c) *Determination of applicable rules.* The zone in which the transmitter of a television station is located or proposed to be located determines the applicable rules with respect to maximum antenna heights and powers for VHF stations when the transmitter is located in Zone I and the channel to be employed is located in Zone II, or the transmitter is located in Zone II and the channel to be employed is located in Zone I.

§ 3.615 Administrative changes in authorizations. In the issuance of television broadcast station authorizations, the Commission will specify the transmitter output power and effective radiated power to the nearest 0.1 dbk. Powers specified by kilowatts shall be obtained by converting dbk to kilowatts to 3 significant figures. Antenna heights above average terrain will be specified to the nearest 10 feet. Midway figures will be authorized in the lower alternative.

Applications and Authorizations

§ 3.620 Cross reference. See § 1.300 to 1.364, Subpart D of Part 1 of this chapter, for general requirements as to applications, filing of applications and description of application forms, other forms and information to be filed with the Commission, the manner in which applications are processed, and provisions applying to action on applications.

§ 3.621 Noncommercial educational stations. In addition to the other provisions of this subpart, the following shall be applicable to noncommercial educational television broadcast stations:

(a) Except as provided in paragraph (b) of this section, noncommercial educational broadcast stations will be licensed only to nonprofit educational organizations upon a showing that the proposed stations will be used primarily to serve the educational needs of the community; for the advancement of educational programs; and to furnish a nonprofit and noncommercial television broadcast service.

(1) In determining the eligibility of publicly supported educational organizations, the accreditation of their respective state departments of education shall be taken into consideration.

(2) In determining the eligibility of privately controlled educational organizations, the accreditation of state departments of education or recognized regional and national educational accrediting organizations shall be taken into consideration.

(b) Where a municipality or other political subdivision has no independently constituted educational organization such as, for example, a board of education having autonomy with respect to carrying out the municipality's educational program, such municipality shall be eligible for a noncommercial educational television broadcast station. In such circumstances, a full and detailed showing must be made that a grant of the application will be consistent with the intent and purpose of the Commission's Rules relating to such stations.

(c) Noncommercial educational television broadcast stations may transmit educational, cultural and entertainment programs, and programs designed for use by schools and school systems in connection with regular school courses, as well as routine and administrative material pertaining thereto.

(d) An educational station may not broadcast programs for which a consideration is received, except programs produced by or at the expense of or furnished by others than the licensee for which no other consideration than the furnishing of the program is received by the licensee. The payment of line charges by another station or network shall not be considered as being prohibited by this paragraph.

(e) To the extent applicable to programs broadcast by a noncommercial educational station produced by or at the expense of or furnished by others than the licensee of said station, the provisions of § 3.654 relating to announcements regarding sponsored programs shall be applicable, except that no announcements (visual or aural) promoting the sale of a product or service shall be transmitted in connection with any program; provided, however, that where a sponsor's name or product appears on the visual image during the course of a simultaneous or rebroadcast program, either on the backdrop or in similar form, the portions of the program showing such information need not be deleted.

§ 3.622 Applications for sharing television channels. Separate applications shall be filed by each applicant for the voluntary sharing of television channels. Such applications shall be accompanied by copies of the time-sharing agreements under which the applicants propose to operate.

§ 3.623 In order to minimize harmful interference at the National Radio Astronomy Observatory site located at Green Bank, Pocahontas County, West Virginia, and at the Naval Radio Research Observatory at Sugar Grove, Pendleton County, West Virginia, an applicant for authority to construct a new television broadcast station or for authority to make changes in the frequency, power, antenna height, or antenna directivity of an existing station within the area bounded by 39°15′ N on the north, 78°30′ W on the east, 37°30′ N on the south and 80°30′ W on the west shall, at the time of filing such application with the Commission, simultaneously notify the Director, National Radio Astronomy Observatory, P.O. Box #2, Green Bank, West Virginia, in writing, of the technical particulars of the proposed station. Such notification shall include the geographical coordinates of the antenna, antenna height, antenna directivity if any, proposed frequency, type of emission, and power. In addition, the applicant shall indicate in his application to the Commission the date notification was made to the Observatory. After receipt of such applications, the Commission will allow a period of twenty (20) days for comments or objections in response to the notifications indicated. If an objection to the proposed operation is received during the twenty-day period from the National Radio Astronomy Observatory for itself or on behalf of the Naval Radio Research Observatory, the Commission

will consider all aspects of the problem and take whatever action is deemed appropriate.

§ 3.628 **Equipment tests.** (a) During the process of construction of a television broadcast station, the permittee, after notifying the Commission and Engineer in Charge of the radio district in which the station is located may, without further authority of the Commission, conduct equipment tests for the purpose of such adjustments and measurements as may be necessary to assure compliance with the terms of the construction permit, the technical provisions of the application therefor, and the rules and regulations.

(b) The Commission may notify the permittee to conduct no tests or may cancel, suspend, or change the date for the beginning of equipment tests as and when such action may appear to be in the public interest, convenience, and necessity.

(c) Equipment tests may be continued so long as the construction permit shall remain valid.

(d) Inspection of a station will ordinarily be required during the equipment test period and before the commencement of program tests. After construction and after adjustments and measurements have been completed to show compliance with the terms of the construction permit, the technical provisions of the application therefor, and the rules and regulations, the permittee should notify the Engineer in Charge of the radio district in which the station is located that it is ready for inspection.

(e) The authorization for tests embodied in this section shall not be construed as constituting a license to operate but as a necessary part of construction.

§ 3.629 **Program tests.** (a) Upon completion of construction of a television broadcast station in accordance with the terms of the construction permit, the technical provisions of the application therefor, and the rules and regulations, and when an application for station license has been filed showing the station to be in satisfactory operating condition, the permittee may request authority to conduct program tests: *Provided,* That such request shall be filed with the Commission at least ten (10) days prior to the date on which it is desired to begin such operation and that the Engineer in Charge of the radio district in which the station is located is notified. (All data necessary to show compliance with the terms and conditions of the construction permit must be filed with the license application.)

(b) Program tests shall not commence until specific Commission authority is received. The Commission reserves the right to change the date of the beginning of such tests or to suspend or revoke the authority for program tests as and when such action may appear to be in the public interest, convenience, and necessity.

(c) Unless sooner suspended or revoked, the program test authority continues valid during Commission consideration of the application for license and during this period further extension of the construction permit is not required. Program test authority shall be automatically terminated by final determination upon the application for station license.

(d) All operation under program test authority shall be in strict compliance with the rules governing television broadcast stations and in strict accordance with representations made in the application for license pursuant to which the tests were authorized.

(e) The granting of program test authority shall not be construed as approval by the Commission of the application for station license.

§ 3.630 **Normal license period.** (a) All television broadcast station licenses will be issued for a normal license period of three years. Licenses will be issued to expire at the hour of 3:00 a.m., e.s.t., in accordance with the following schedule and at three-year intervals thereafter.

(1) For stations located in Delaware and Pennsylvania, August 1, 1957.

(2) For stations located in Maryland, District of Columbia, Virginia, West Virginia, October 1, 1957.

(3) For stations located in North Carolina, South Carolina, December 1, 1957.

(4) For stations located in Florida, Puerto Rico, and Virgin Islands, February 1, 1958.

(5) For stations located in Alabama and Georgia, April 1, 1958.

(6) For stations located in Arkansas, Louisiana, and Mississippi, June 1, 1958.
(7) For stations located in Tennessee, Kentucky, and Indiana, August 1, 1958.
(8) For stations located in Ohio and Michigan, October 1, 1958.
(9) For stations located in Illinois and Wisconsin, December 1, 1958.
(10) For stations located in Iowa and Missouri, February 1, 1956.
(11) For stations located in Minnesota, North Dakota, South Dakota, Montana, and Colorado, April 1, 1956.
(12) For stations located in Kansas, Oklahoma, Nebraska, June 1, 1956.
(13) For stations located in Texas, August 1, 1956.
(14) For stations located in Wyoming, Nevada, Arizona, Utah, New Mexico, and Idaho, October 1, 1956.
(15) For stations located in California, December 1, 1956.
(16) For stations located in Washington, Oregon, Alaska, Guam and Hawaii, February 1, 1960.
(17) For stations located in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, April 1, 1957.
(18) For stations located in New Jersey and New York, June 1, 1957.

§ 3.632 Emergency weather warnings. Upon receipt of notification of an Emergency Weather Warning of a condition of immediate danger to life and property from the United States Weather Bureau, all television broadcast stations may, at their option, broadcast CONELRAD Attention Signals (two five-second carrier breaks and fifteen seconds of 1,000 CPS tone sound carrier only) followed by the Emergency Weather Warning as outlined in CONELRAD Manual BC-3 (Revised), Appendix A.

§ 3.635 Use of common antenna site. No television license or renewal of a television license will be granted to any person who owns, leases, or controls a particular site which is peculiarly suitable for television broadcasting in a particular area and (a) which is not available for use by other television licensees; and (b) no other comparable site is available in the area; and (c) where the exclusive use of such site by the applicant or licensee would unduly limit the number of television stations that can be authorized in a particular area or would unduly restrict competition among television stations.

§ 3.636 Multiple ownership. (a) No license for a television broadcast station shall be granted to any party (including all parties under common control) if:

(1) Such party directly or indirectly owns, operates, or controls another television broadcast station which serves substantially the same area; or

(2) Such party, or any stockholder, officer or director of such party, directly or indirectly owns, operates, controls, or has any interest in, or is an officer or director of any other television broadcast station if the grant of such license would result in a concentration of control of television broadcasting in a manner inconsistent with public interest, convenience, or necessity. In determining whether there is such a concentration of control, consideration will be given to the facts of each case with particular reference to such factors as the size, extent and location of area served, the number of people served, and the extent of other competitive service to the areas in question. The Commission, however, will in any event consider that there would be such a concentration of control contrary to the public interest, convenience or necessity for any party or any of its stockholders, officers or directors to have a direct or indirect interest in, or be stockholders, officers, or directors of, more than seven television broadcast stations, no more than five of which may be in the VHF band.

(b) Paragraph (a) of this section is not applicable to noncommercial educational stations.

NOTE 1: The word "control" as used herein is not limited to majority stock ownership, but includes actual working control in whatever manner exercised.

NOTE 2: In applying the provisions of paragraph (a) of this section to the stockholders of a corporation which has more than 50 voting stockholders, only those stockholders need be considered who are officers or directors or who directly or indirectly own 1 percent or more of the outstanding voting stock.

§ 3.637 Alternate main transmitters. The licensee of a television broadcast station may be licensed for alternate main transmitters provided that a technical need for such alternate transmitters is shown and that the following conditions are met:

(a) Both transmitters are located at the same place.

(b) Both transmitters shall have the same power rating.

(c) Both transmitters shall meet the construction, installation, operation and performance requirements of this subpart.

§ 3.638 Auxiliary transmitter. Upon showing that a need exists for the use of auxiliary transmitters in addition to the regular transmitters of a television station, a license therefor may be issued: *Provided,* That:

(a) Auxiliary transmitters may be installed either at the same location as the main transmitters or at another location.

(b) A licensed operator shall be in control whenever auxiliary transmitters are placed in operation.

(c) The auxiliary transmitters shall be maintained so that they may be put into immediate operation at any time for the following purposes:

(1) The transmission of the regular programs upon the failure of the main transmitters.

(2) The transmission of regular programs during maintenance or modification work on the main transmitters necessitating discontinuance of their operation for a period not to exceed 5 days.

NOTE: This includes the equipment changes which may be made without authority as set forth elsewhere in the rules and regulations or as authorized by the Commission by letter or by construction permit. Where such operation is required for periods in excess of 5 days, request therefor shall be in accordance with § 1.324 of the Commission's rules.

(3) Upon request by a duly authorized representative of the Commission.

(d) The auxiliary transmitters shall be tested at least once each week to determine that they are in proper operating condition and that they are adjusted to the proper frequency, except that in the case of operation in accordance with paragraph (c) of this section during any week, the test in that week may be omitted provided the operation under paragraph (c) of this section is satisfactory. A record shall be kept of the time and result of each test. Such records shall be retained for a period of two years.

(e) The auxiliary transmitters shall be equipped with satisfactory control equipment which will enable the maintenance of the frequency emitted by the station within the limits prescribed by the regulations in this subpart.

(f) The operating power of an auxiliary transmitter may be less than the authorized power of the main transmitters, but in no event shall it be greater thau such power.

§ 3.639 Changes in equipment and antenna system. Licensees of television broadcast stations shall observe the following provisions with regard to changes in equipment and antenna system:

(a) No changes in equipment shall be made:

(1) That would result in the emission of signals outside of the authorized channel.

(2) That would result in the external performance of the transmitter being in disagreement with that prescribed in this subpart.

(b) Specific authority, upon filing formal application therefor (FCC Form 301 or such other form as is provided therefor), is required for any of the following changes:

(1) Changes involving an increase or decrease in the power rating of the transmitters.

(2) A replacement of the transmitters as a whole.

(3) Change in the location of the transmitting antenna.

(4) Change in antenna system, including transmission line.

(5) Change in the power delivered to the antenna.

(6) Change in frequency control and/or modulation system.

(c) Other changes, except as above provided for in this section or in the provisions of this subpart, may be made at any time without the authority of the Commission, provided that the Commission shall be promptly notified thereof and such changes shall be shown in the next application for renewal of license.

§ 3.640 Acceptability of broadcast transmitters for licensing. (a) In order to facilitate the filing of, and action on, applications for station authorizations, trans-

mitters will be accepted for licensing by the Commission under one of the following conditions:

(1) A transmitter may be type-accepted upon the request of any manufacturer of transmitters built in quantity by following the type acceptance procedure set forth in Part 2 of this chapter, provided that the data and information submitted indicates that the transmitter meets the requirements of § 3.687. If accepted, such transmitter will be included on the Commission's "Radio Equipment List, Part A, Television Broadcast Equipment." Applicants specifying transmitters included on such a list need not submit detailed descriptions and diagrams where the correct type number is specified, provided that the equipment proposed is identical with that accepted. Copies of this list are available for inspection at the Commission's office in Washington, D.C., and at each of its field offices.

(2) An application specifying a transmitter not included on the Radio Equipment List, Part A, may be accepted upon the request of a prospective licensee submitting with the application for construction permit a complete description of the transmitter, including the circuit diagram, listing of all tubes used, function of each, multiplication in each stage, plate current and voltage applied to each tube, a description of the oscillator circuit together with any devices installed for the purpose of frequency stabilization and the means of varying output power to compensate for power supply voltage variations. However, if this data has been filed with the Commission by a manufacturer in connection with a request for type acceptance, it need not be submitted with the application for construction permit but may be referred to as "on file." Measurement data for type acceptance made in accordance with subparagraph (1) of this paragraph shall be submitted with the license application.

(3) A transmitter shown on an instrument of authorization by manufacturer and type number, or as a composite, and which was in use prior to June 30, 1955, may continue to be used by the licensee, his successors or assignees, provided such transmitter continues to comply with the rules and regulations.

(b) Additional rules with respect to withdrawal of type-acceptance, modification of type-accepted equipment and limitations on the findings upon which type acceptance is based are set forth in Part 2 of this chapter.

General Operating Requirements

§ 3.651 Time of operation. (a) All television broadcast stations will be licensed for unlimited time operation. Each such station shall maintain a regular program operating schedule as follows: not less than 2 hours daily in any five broadcast days per week and not less than a total of 12 hours per week during the first 18 months of the station's operation; not less than 2 hours daily in any 5 broadcast days per week and not less than a total of 16 hours, 20 hours and 24 hours per week for each successive 6-month period of operation, respectively; and not less than 2 hours in each of the 7 days of the week and not less than a total of 28 hours per week thereafter. "Operation" includes the period during which a station is operated pursuant to special temporary authority or during program tests, as well as during the license period. Time devoted to test patterns, or to aural presentations accompanied by the incidental use of fixed visual images which have no substantial relationship to the subject matter of such aural presentations, shall not be considered in computing periods of program service. If, in the event of an emergency due to causes beyond the control of a licensee, it becomes impossible to continue operation, the Commission and the Engineer in Charge of the radio district in which the station is located shall be notified in writing immediately after the emergency develops and immediately after the emergency ceases and operation is resumed.

(b) Noncommercial educational television broadcast stations are not required to operate on a regular schedule and no minimum number of hours of operation is specified; but the hours of actual operation during a license period shall be taken into consideration in considering the renewal of noncommercial educational television broadcast licenses.

(c) (1) The aural transmitter of a television station shall not be operated separately from the visual transmitter except for the following purposes:

(i) For actual tests of station equipment or actual experimentation in accordance with § 3.666; and

(ii) For emergency "fills" in case of visual equipment failure or unscheduled and unavoidable delays in presenting visual programs. In such situations the aural transmitter may be used to advise the audience of difficulties and to transmit for a short period program material of such nature that the audience will be enabled to remain tuned to the station; for example, music or news accompanying a test pattern or other visual presentation.

(2) During periods of transmission of a test pattern on the visual transmitter of a television station, aural transmission shall consist only of a single tone or series of variable tones. During periods when still pictures or slides are employed to produce visual transmissions which are accompanied by aural transmissions, the aural and visual transmissions shall be integral parts of a program or announcement and shall have a substantial relationship to each other: *Provided*, That nothing herein shall preclude the transmission of a test pattern, still pictures or slides for the following purposes and periods:

(i) To accompany aural announcements of the station's program schedule and aural news broadcasts or news commentaries, for a total period not to exceed one hour in any broadcast day.

(ii) To accompany aural transmissions for a period of time not to exceed fifteen minutes immediately prior to the commencement of a programming schedule.

Examples. (1) Duplication of AM or FM programs on the aural transmitter of a television station while the same program is broadcast on the visual transmitter (i.e., a "simulcast") is consistent with this paragraph.

(2) Duplication of AM or FM programs on the aural transmitter of a television station while a test pattern is broadcast on the visual transmitter is not consistent with this paragraph, except for the specific purposes and periods specified in paragraph (c)(2).

(3) A travel lecture in which the words of the lecturer are broadcast simultaneously with still pictures or slides of scenes illustrating the lecture, and a newscast in which the words of the newscaster are broadcast simultaneously with still pictures or slides of the news events, are examples of programs in which the aural and visual transmissions are integral parts of the same program having a substantial relationship to each other, within the meaning of paragraph (c)(2). Mood music unrelated to the visual transmission is not consistent with this paragraph.

(4) The broadcast of a test pattern accompanied by a musical composition for the purpose of demonstration, sale, installation or orientation of television receivers, or receiving antennas is not consistent with this paragraph.

(5) Music accompanying the transmission of a test pattern upon which is visually imposed a moving text consisting of continuous program material, such as a running newscast or news commentary, is consistent with this paragraph.

(6) Music accompanying the transmission of a test pattern upon which is visually imposed a clock indicating the time of day, or a text that is changed at spaced intervals, is not consistent with this paragraph.

§ 3.652 Station identification. (a) A licensee of a television broadcast station shall make station identification announcement (call letters and location) at the beginning and ending of each time of operation and during the operation on the hour. The announcement at the beginning and ending of each time of operation shall be by both aural and visual means. Other announcements may be by either aural or visual means.

(b) Identification announcements during operation need not be made when to make such announcement would interrupt a single consecutive speech, play, religious service, symphony concert, or any type of production. In such cases, the identification announcement shall be made at the first interruption of the entertainment continuity and at the conclusion thereof.

§ 3.653 Mechanical reproductions. (a) No mechanically reproduced program, whether visual or aural, consisting of a speech, news event, news commentator, forum, panel discussion, or special event in which the element of time is of special significance, or any other program in which the element of time is of special significance and presentation of which would create, either intentionally or otherwise, the impression or belief on the part of the listening audience that the event or program being broad-

cast is in fact occurring simultaneously with the broadcast, shall be broadcast without an appropriate announcement being made either at the beginning or end of such reproduction or at the beginning or end of the program in which such reproduction is used that it is a mechanical reproduction or a mechanically reproduced program: *Provided, however,* That each such program of one minute or less need not be announced as such.

(b) The exact form of identifying announcement is not prescribed, but the language shall be clear and in terms commonly used and understood. Any other program mechanically reproduced or series of mechanical reproductions, including a mechanical reproduction used for background music, sound effects, station identification, program identification (theme music of short duration) or identification of sponsorship of the program proper, need not be announced as provided in paragraph (a) of this section, but the licensee shall not attempt affirmatively to create the impression that any program being broadcast by mechanical reproduction consists of live talent.

(c) The requirements of paragraph (a) of this section are waived with respect to network programs, transcribed and rebroadcast at a later hour because of the time zone differential between the place where the program originates and where it is rebroadcast, this waiver being applicable whether the off-the-line recording is made by the network itself at one of its key stations or by an individual station, but only when the off-the-line recording is for broadcast at an hour not exceeding the time zone differential between the place where the program originates and where it is rebroadcast. Each station which broadcasts network programs at a later hour in accordance with this waiver shall make an appropriate announcement at least once each day between the hours of 10:00 a.m. and 10:00 p.m., stating that some or all of the network programs which are broadcast by that station are delayed broadcasts by means of transcription. This waiver provision also applies during the annual periods in which daylight saving time will be effective with respect to network programs transcribed and rebroadcast one hour later because of the time differential resulting from the adoption of daylight saving time in some areas.

§ 3.654 Sponsored programs, announcement. (a) In the case of each program for the broadcasting of which money, services, or other valuable consideration is either directly or indirectly paid or promised to, or charged or received by, any television broadcast station, the station broadcasting such program shall make, or cause to be made, an appropriate announcement that the program is sponsored, paid for, or furnished, either in whole or in part.

(b) In the case of any political program or any program involving the discussion of public controversial issues for which any films, records, transcriptions, talent, scripts, or other material or services of any kind are furnished, either directly or indirectly, to a station as an inducement to the broadcasting of such program, an announcement shall be made both at the beginning and conclusion of such program on which such material or services are used that such films, records, transcriptions, talent, scripts, or other material or services have been furnished to such station in connection with the broadcasting of such program: *Provided, however,* That only one such announcement need be made in the case of any such program of 5 minutes' duration or less, which announcement may be made either at the beginning or conclusion of the program.

(c) The announcement required by this section shall fully and fairly disclose the true identity of the person or persons by whom or in whose behalf such payment is made or promised, or from whom or in whose behalf such services or other valuable consideration is received, or by whom the material or services referred to in paragraph (b) of this section are furnished. Where an agent or other person contracts or otherwise makes arrangements with a station on behalf of another, and such fact is known to the station, the announcement shall disclose the identity of the person or persons in whose behalf such agent is acting instead of the name of such agent.

(d) In the case of any program, other than a program advertising commercial products or services, which is sponsored, paid for or furnished, either in whole or in part, or for which material or services referred to in paragraph (b) of this section are furnished, by a corporation, committee, association or other unincorporated group,

the announcement required by this section shall disclose the name of such corporation, committee, association or other unincorporated group. In each such case the station shall require that a list of the chief executive officers or members of the executive committee or of the board of directors of the corporation, committee, association or other unincorporated group shall be made available for public inspection at one of the television broadcast stations carrying the program.

(e) In the case of programs advertising commercial products or services, an announcement stating the sponsor's corporate or trade name or the name of the sponsor's product, shall be deemed sufficient for the purposes of this section and only one such announcement need be made at any time during the course of the program.

§ 3.655 Rebroadcast. (a) The term "rebroadcast" as used below means reception by radio of the program of a television broadcast station, and the simultaneous or subsequent retransmission of such program by a broadcast station. The broadcasting of a program relayed by an auxiliary broadcast station licensed to the television broadcast station is not considered a rebroadcast. (As used in this section, program includes any complete program or part thereof.)

(b) The licensee of a television broadcast station may, without further authority of the Commission, rebroadcast the program of a United States television broadcast station, provided the Commission is notified of the call letters of each station rebroadcast and the licensee certifies that express authority has been received from the licensee of the station originating the program.

NOTE: The notice and certification of consent shall be given within 3 days of any single rebroadcast, but in case of the regular practice of rebroadcasting certain programs of a television broadcast station several times during a license period, notice and certification of consent shall be given for the ensuing license period with the application for renewal of license, or at the beginning of such rebroadcast practice if begun during a license period.

(c) No licensee of a television broadcast station shall rebroadcast the program of any United States radio station not designated in paragraph (b) of this section without written authority having first been obtained from the Commission upon application (informal) accompanied by written consent or certification of consent of the licensee of the station originating the program.

NOTE: By Order No. 82, dated and effective June 24, 1941, until further order of the Commission, § 3.655(c) is suspended only insofar as it requires prior written authority of the Commission for the rebroadcasting of programs originated for that express purpose by U.S. Government radio stations.

§ 3.656 Lotteries. (a) An application for construction permit, license, renewal of license, or any other authorization for the operation of a broadcast station, will not be granted where the applicant proposes to follow or continue to follow a policy or practice of broadcasting or permitting "the broadcasting of, any advertisement of or information concerning any lottery, gift enterprise, or similar scheme, offering prizes dependent in whole or in part upon lot or chance, or any list of the prizes drawn or awarded by means of any such lottery, gift enterprise, or scheme, whether said list contains any part or all of such prizes." (See 18 U. S. C. 1304.)

(b) The determination whether a particular program comes within the provisions of paragraph (a) of this section depends on the facts of each case. However, the Commission will in any event consider that a program comes within the provisions of paragraph (a) of this section if in connection with such program a prize consisting of money or thing of value is awarded to any person whose selection is dependent in whole or in part upon lot or chance, if as a condition of winning or competing for such prize, such winner or winners are required to furnish any money or thing of value or are required to have in their possession any product sold, manufactured, furnished or distributed by a sponsor of a program broadcast on the station in question.

§ 3.657 Broadcasts by candidates for public office. (a) *Legally qualified candidate.* A "legally qualified candidate" means any person who has publicly announced that he is a candidate for nomination by a convention of a political party or for nomination or election in a primary, special, or general election, municipal, county, state or national, and who meets the qualifications prescribed by the applicable laws to

hold the office for which he is a candidate, so that he may be voted for by the electorate directly or by means of delegates or electors, and who:

(1) Has qualified for a place on the ballot, or

(2) Is eligible under the applicable law to be voted for by sticker, by writing in his name on the ballot, or other method, and (i) has been duly nominated by a political party which is commonly known and regarded as such, or (ii) makes a substantial showing that he is a bona fide candidate for nomination or office, as the case may be.

(b) *General requirements.* No station licensee is required to permit the use of its facilities by any legally qualified candidate for public office, but if any licensee shall permit any such candidate to use its facilities, it shall afford equal opportunities to all other such candidates for that office to use such facilities: *Provided,* That such licensee shall have no power of censorship over the material broadcast by any such candidate.

(c) *Rates and practices.* (1) The rates, if any, charged all such candidates for the same office shall be uniform and shall not be rebated by any means direct or indirect. A candidate shall, in each case, be charged no more than the rate the station would charge if the candidate were a commercial advertiser whose advertising was directed to promoting its business within the same area as that encompassed by the particular office for which such person is a candidate. All discount privileges otherwise offered by a station to commercial advertisers shall be available upon equal terms to all candidates for public office.

(2) In making time available to candidates for public office no licensee shall make any discrimination between candidates in charges, practices, regulations, facilities, or services for or in connection with the service rendered pursuant to this part, or make or give any preference to any candidate for public office or subject any such candidate to any prejudice or disadvantage; nor shall any licensee make any contract or other agreement which shall have the effect of permitting any legally qualified candidate for any public office to broadcast to the exclusion of other legally qualified candidates for the same public office.

(d) *Inspection of records.* Every licensee shall keep and permit public inspection of a complete record of all requests for broadcast time made by or on behalf of candidates for public office, together with an appropriate notation showing the disposition made by the licensee of such requests, and the charges made, if any, if request is granted. Such records shall be retained for a period of two years.

(e) A request for equal opportunities must be submitted to the licensee within one week of the day on which the prior use occurred.

(f) A candidate requesting such equal opportunities of the licensee, or complaining of non-compliance to the Commission shall have the burden of proving that he and his opponent are legally qualified candidates for the same public office.

§ 3.658 **Affiliation agreements.** (a) *Exclusive affiliation of station.* No license shall be granted to a television broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization under which the station is prevented or hindered from, or penalized for, broadcasting the programs of any other network organization. (The term "network organization" as used herein includes national and regional network organizations. See ch. VII, J, of Report on Chain Broadcasting.)

(b) *Territorial exclusivity.* No license shall be granted to a television broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization which prevents or hinders another broadcast station located in the same community from broadcasting the network's programs not taken by the former station, or which prevents or hinders another broadcast station located in a different community from broadcasting any program of the network organization. This section shall not be construed to prohibit any contract, arrangement, or understanding between a station and a network organization pursuant to which the station is granted the first call in its community upon the programs of the network organization. As employed in this paragraph, the term "community" is defined as the community specified in the instrument of authorization as the location of the station.

(c) *Term of affiliation.* No license shall be granted to a television broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization which provides, by original terms, provisions for renewal, or otherwise for the affiliation of the station with the network organization for a period longer than 2 years: *Provided,* That a contract, arrangement, or understanding for a period up to 2 years may be entered into within 6 months prior to the commencement of such period.

(d) *Option time.* No license shall be granted to a television broadcast station which options for network programs any time subject to call on less than 56 days' notice, or more time than a total of 3 hours within each of four segments of the broadcast day, as herein described. The broadcast day is divided into four segments, as follows: 8 a.m. to 1 p.m.; 1 p.m. to 6 p.m.; 6 p.m. to 11 p.m.; 11 p.m. to 8 a.m. (These segments are to be determined for each station in terms of local time at the location of the station but may remain constant throughout the year regardless of shifts from standard to daylight saving time or vice versa.) Such options may not be exclusive as against other network organizations and may not prevent or hinder the station from optioning or selling any or all of the time covered by the option, or other time, to other network organizations.

NOTE 1: As used in this section, an option is any contract, arrangement, or understanding, express or implied, between a station and a network organization which prevents or hinders the station from scheduling programs before the network agrees to utilize the time during which such programs are scheduled, or which requires the station to clear time already scheduled when the network organization seeks to utilize the time.

NOTE 2: All time options permitted under this section must be specified clock hours, expressed in terms of any time system set forth in the contract agreed upon by the station and network organization. Shifts from daylight saving to standard time or vice versa may or may not shift the specified hours correspondingly as agreed by the station and network organization.

(e) *Right to reject programs.* No license shall be granted to a television broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization which (1), with respect to programs offered pursuant to an affiliation contract, prevents or hinders the station from rejecting or refusing network programs which the station reasonably believes to be unsatisfactory or unsuitable; or which (2) with respect to network programs so offered or already contracted for, prevents the station from rejecting or refusing any program which, in its opinion, is contrary to the public interest, or from substituting a program of outstanding local or national importance.

(f) *Network ownership of stations.* No license shall be granted to a network organization, or to any person directly or indirectly controlled by or under common control of a network organization, for a television broadcast station in any locality where the existing television broadcast stations are so few or of such unequal desirability (in terms of coverage, power, frequency, or other related matters) that competition would be substantially restrained by such licensing. (The word "control" as used in this section, is not limited to full control but includes such a measure of control as would substantially affect the availability of the station to other networks.)

(g) *Dual network operation.* No license shall be issued to a television broadcast station affiliated with a network organization which maintains more than one network of television broadcast stations: *Provided,* That this section shall not be applicable if such networks are not operated simultaneously, or if there is no substantial overlap in the territory served by the group of stations comprising each such network.

(h) *Control by networks of station rates.* No license shall be granted to a television broadcast station having any contract, arrangement, or understanding, express or implied, with a network organization under which the station is prevented or hindered from, or penalized for, fixing or altering its rates for the sale of broadcast time for other than the network's programs.

§ 3.659 Special rules relating to contracts providing for reservation of time upon sale of a station. No license, renewal of license, assignment of license, or transfer

of control of a corporate licensee shall be granted or authorized to a television broadcast station which has a contract, arrangement or understanding, express or implied, pursuant to which, as consideration or partial consideration for the assignment of license or transfer of control, the assignor of a station license or the transferor of stock, where transfer of a corporate licensee is involved, or the nominee of such assignor or transferor retains any right of reversion of the license or any right to the reassignment of the license in the future, or reserves the right to use the facilities of the station for any period whatsoever.

§ 3.660 Station license, posting of. The original of each station license shall be posted in the transmitter room.

§ 3.661 Operator requirements. One or more licensed radio-telephone first class operators shall be on duty at the place where the transmitting apparatus of each station is located and in actual charge thereof whenever it is being operated. The original license (or FCC Form 759) of each station operator shall be posted at the place where he is on duty. The licensed operator on duty and in charge of a television broadcast transmitter may, at the discretion of the licensee, be employed for other duties or for the operation of another station or stations in accordance with the class of operator's license which he holds and by the rules and regulations governing such stations. However, such duties shall in nowise interfere with the operation of the broadcast transmitter.

§ 3.662 Antenna structure, marking and lighting. Where an antenna structure(s) is required to be painted or lighted see § 17.37, *Inspection of tower lights and associated control equipment;* § 17.39, *Cleaning and repainting;* § 17.40, *Time when lights shall be exhibited;* § 17.41, *Spare lamps;* and § 17.42, *Lighting equipment;* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 3.663 Logs; maintenance of. The licensee or permittee of each television station shall maintain program and operating logs and shall require entries to be made as follows:

(a) In the program log:

(1) An entry of the time each station identification announcement (call letters and location) is made.

(2) An entry briefly describing each program broadcast, such as "music," "drama," "speech," etc., together with the name or title thereof and the sponsor's name, with the time of the beginning and ending of the complete program. If a mechanical reproduction, either visual or aural, is used, the entry shall show the exact nature thereof and the time it is announced as a mechanical reproduction. If a speech is made by a political candidate, the name and political affiliations of such speaker shall be entered.

(3) An entry showing that each sponsored program broadcast has been announced as sponsored, paid for, or furnished by the sponsor; or that the broadcast is under the auspices of a nonprofit educational organization other than the licensee or permittee.

(4) An entry showing, for each program of network origin, the name of the network originating the program.

(b) In the operating log:

(1) An entry of the time the station begins to supply power to the antenna, and the time it stops.

(2) An entry of the time the program begins and ends.

(3) An entry of each interruption to the carrier wave, its cause, and duration.

(4) An entry of the following each 30 minutes:

(i) Operating constants of last radio stage of the aural transmitter (total plate current and plate voltage).

(ii) Transmission line meter readings for both transmitters.

(iii) Frequency monitor readings.

(5) Log of experimental operation during experimental period (if regular operation is maintained during this period, the above logs shall be kept).

(i) A log must be kept of all operation during the experimental period. If the

entries required above are not applicable thereto, then the entries shall be made so as to describe the operation fully.

(c) Where an antenna structure(s) is required to be illuminated see § 17.38, *Recording the tower light inspections in the station record*, of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 3.664 Logs; retention of, etc. (a) *Logs; retention of.* Logs of television broadcast stations shall be retained by the licensee or permittee for a period of two 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.

(b) *Logs, by whom kept.* Each log shall be kept by the person or persons competent to do so, having actual knowledge of the facts required, who shall sign the log when starting duty and again when going off duty. The logs shall be made available upon request by an authorized representative of the Commission.

(c) *Log form.* The log shall be kept in an orderly manner, in suitable form, and in such detail that the data required for the particular class of station concerned are readily available. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log.

(d) *Correction of logs.* No log or portion thereof shall be erased, obliterated, or wilfully destroyed within the period of retention provided by the rules. Any necessary correction may be made only by the person originating the entry who shall strike out the erroneous portion, initial the correction made, and indicate the date of correction.

(e) *Rough logs.* Rough logs may be transcribed into condensed form, but in such case the original log or memoranda and all portions thereof shall be preserved and made a part of the complete log.

§ 3.665 Station inspection. The licensee of a television broadcast station shall make the station available for inspection by representatives of the Commission at any reasonable hour.

§ 3.666 Experimental operation. Television broadcast stations may (upon informal application) conduct technical experimentation directed to the improvement of technical phases of operation and for such purposes may utilize a signal other than the standard television signal subject to the following conditions:

(a) That the licensee complies with the provisions of § 3.651 with regard to the minimum number of hours of transmission with a standard television signal.

(b) That no transmissions are radiated outside of the authorized channel and subject to the condition that no interference is caused to the transmissions of a standard television signal by other television broadcast stations.

(c) No charges either direct or indirect shall be made by the licensee of a television broadcast station for the production or transmission of programs when conducting technical experimentation.

§ 3.667 Discontinuance of operation. The licensee of each station shall notify the Commission in Washington, D.C., and the Engineer in Charge of the radio district where such station is located of permanent discontinuance of operation at least two days before operation is discontinued. The licensee shall, in addition, immediately forward the station license and other instruments of authorization to the Washington, D.C., office of the Commission for cancellation.

§ 3.668 Frequency tolerance. (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.

TV Technical Standards

§ 3.681 Definitions.

Amplitude modulation (AM). A system of modulation in which the envelope of the transmitted wave contains a component similar to the wave form 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. See § 3.684(d).)

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.

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 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 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.

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 half-tones, 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 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 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.

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.

§ 3.682 Transmission standards and changes. (a) *Transmission standards.* (1) The width of the television broadcast channel shall be six megacycles per second.

(2) The visual carrier frequency shall be nominally 1.25 mc above the lower boundary of the channel.

(3) The aural center frequency shall be 4.5 mc higher than the visual carrier frequency.

(4) The visual transmission amplitude characteristic shall be in accordance with the chart designated as Fig. 5 of § 3.699.

(5) The chrominance subcarrier frequency shall be 3.579545 mc ± 10 cycles per second with a maximum rate of change not to exceed one tenth cycle per second per second.

(6) For monochrome and color transmissions the number of scanning lines per frame shall be 525, interlaced two to one in successive fields. The horizontal scanning frequency shall be $\frac{2}{455}$ times the chrominance subcarrier frequency; this corre-

sponds nominally to 15,750 cycles per second (with an actual value of 15,734.264 ± 0.044 cycles per second). The vertical scanning frequency is $\frac{2}{525}$ times the horizontal scanning frequency; this corresponds nominally to 60 cycles per second (the actual value is 59.94 cycles per second). For monochrome transmissions only, the nominal values of line and field frequencies may be used.

(7) The aspect ratio of the transmitted television picture shall be 4 units horizontally to 3 units vertically.

(8) During active scanning intervals, the scene shall be scanned from left to right horizontally and from top to bottom vertically, at uniform velocities.

(9) A carrier shall be modulated within a single television channel for both picture and synchronizing signals. For monochrome transmission, the two signals comprise different modulation ranges in amplitude, in accordance with the charts designated as Figures 5 and 7 of § 3.699. For color transmission, the two signals comprise different modulation ranges in amplitude except where the chrominance penetrates the synchronizing region and the burst penetrates the picture region, in accordance with the charts designated as Figures 5 and 6 of § 3.699.

(10) A decrease in initial light intensity shall cause an increase in radiated power (negative transmission).

(11) The reference black level shall be represented by a definite carrier level, independent of light and shade in the picture.

(12) The blanking level shall be transmitted at 75 ± 2.5 percent of the peak carrier level.

(13) The reference white level of the luminance signal shall be 12.5 ± 2.5 percent of the peak carrier level.

(14) The signals radiated shall have horizontal polarization.

(15) An effective radiated power of the aural transmitter not less than 50 percent nor more than 70 percent of the peak radiated power of the visual transmitter shall be employed.

(16) The peak-to-peak variation of transmitter output within one frame of video signal due to all causes, including hum, noise, and low-frequency response, measured at both scanning synchronizing peak and blanking level, shall not exceed 5 percent of the average scanning synchronizing peak signal amplitude. This provision is subject to change but is considered the best practice under the present state of the art. It will not be enforced pending a further determination thereof.

(17) The reference black level shall be separated from the blanking level by the setup interval, which shall be 7.5 ± 2.5 percent of the video range from blanking level to the reference white level.

(18) For monochrome transmission, the transmitter output shall vary in substantially inverse logarithmic relation to the brightness of the subject. No tolerances are set at this time. This provision is subject to change but is considered the best practice under the present state of the art. It will not be enforced pending a further determination thereof.

(19) The color picture signal shall correspond to a luminance component transmitted as amplitude modulation of the picture carrier and a simultaneous pair of chrominance components transmitted as the amplitude modulation sidebands of a pair of suppressed subcarriers in quadrature.

(20) Equation of complete color signal.

(i) The color picture signal has the following composition:

$$E_M = E_Y' + \{E_Q' \sin(\omega t + 33°) + E_I' \cos(\omega t + 33°)\}$$

where $E_Q' = 0.41(E_B' - E_Y') + 0.48(E_R' - E_Y')$

$E_I' = -0.27(E_B' - E_Y') + 0.74(E_R' - E_Y')$

$E_Y' = 0.30E_R' + 0.59E_G' + 0.11E_B'$

For color-difference frequencies below 500 kc (see (iii) below), the signal can be represented by:

$$E_M = E_Y' + \left\{\frac{1}{1.14}\left[\frac{1}{1.78}(E_B' - E_Y')\sin\omega t + (E_R' - E_Y')\cos\omega t\right]\right\}$$

(ii) The symbols in subdivision (i) of this subparagraph have the following significance:

E_M is the total video voltage, corresponding to the scanning of a particular picture element, applied to the modulator of the picture transmitter.

E_Y' is the gamma-corrected voltage of the monochrome (black-and-white) portion of the color picture signal, corresponding to the given picture element.

NOTE: Forming of the high frequency portion of the monochrome signal in a different manner is permissible and may in fact be desirable in order to improve the sharpness on saturated colors.

E_Q' and E_I' are the amplitudes of two orthogonal components of the chrominance signal corresponding respectively to narrow-band and wide-band axes.

E_R', E_G', and E_B' are the gamma-corrected voltages corresponding to red, green, and blue signals during the scanning of the given picture element.

ω is the angular frequency and is 2π times the frequency of the chrominance subcarrier.

The portion of each expression between brackets in (i) represents the chrominance subcarrier signal which carries the chrominance information.

The phase reference in the E_M equation in (i) is the phase of the burst + 180°, as shown in Figure 8 of § 3.699. The burst corresponds to amplitude modulation of a continuous sine wave.

(iii) The equivalent bandwidth assigned prior to modulation to the color difference signals E_Q' *and* E_I' are as follows:

Q-channel bandwidth:
At 400 kc less than 2 db down.
At 500 kc less than 6 db down.
At 600 kc at least 6 db down.
I-channel bandwidth:
At 1.3 mc less than 2 db down.
At 3.6 mc at least 20 db down.

(iv) The gamma corrected voltages E_R', E_G', and E_B' are suitable for a color picture tube having primary colors with the following chromaticities in the CIE system of specification:

	x	y
Red (R)	0.67	0.33
Green (G)	0.21	0.71
Blue (B)	0.14	0.08

and having a transfer gradient (gamma exponent) of 2.2 associated with each primary color. The voltages E_R', E_G', and E_B' may be respectively of the form $E_R^{1/\epsilon}$, $E_G^{1/\epsilon}$, and $E_B^{1/\gamma}$ although other forms may be used with advances in the state of the art.

NOTE: At the present state of the art it is considered inadvisable to set a tolerance on the value of gamma and correspondingly this portion of the specification will not be enforced.

(v) The radiated chrominance subcarrier shall vanish on the reference white of the scene.

NOTE: The numerical values of the signal specification assume that this condition will be reproduced as CIE Illuminant C ($x = 0.310$, $y = 0.316$).

(vi) E_Y', E_Q', E_I', and the components of these signals shall match each other in time to 0.05 μsecs.

(vii) The angles of the subcarrier measured with respect to the burst phase, when reproducing saturated primaries and their complements at 75 percent of full amplitude, shall be within ±10° and their amplitudes shall be within ±20 percent of the

values specified above. The ratios of the measured amplitudes of the subcarrier to the luminance signal for the same saturated primaries and their complements shall fall between the limits of 0.8 and 1.2 of the values specified for their ratios. Closer tolerances may prove to be practicable and desirable with advance in the art.

(21) The interval beginning with the last 12 μsecs of line 17 and continuing through line 20 of the vertical blanking interval of each field may be used for the transmission of test signals subject to the conditions set forth below. Test signals may include signals used to supply reference modulation levels so that variations in light intensity of the scene viewed by the camera will be faithfully transmitted; signals designed to check the performance of the overall transmission system or its individual components; and cue and control signals related to the operation of the television broadcast station. Figures 6 and 7 of § 3.699 identify the numbered lines referred to in this subparagraph.

(i) Modulation of the television transmitter by such signals shall be confined to the area between the reference white level and the blanking level except where such test signals are composed of chrominance subcarrier frequencies, in which case their negative excursions may extend into the synchronizing peak amplitude. In no case may the modulation excursions produced by test signals extend beyond peak-of-sync level.

(ii) The use of test signals shall not result in significant degradation of the program transmissions of the television broadcast station nor create emission components in excess of those permitted for normal program transmissions.

(iii) Test signals may not be transmitted during that portion of each line devoted to horizontal blanking.

(iv) A guard interval of no less than one-half line shall be maintained at all times between the last test signal and the beginning of the first picture scanning line.

(b) *Changes in transmission standards.* The Commission will consider the question whether a proposed change or modification of transmission standards adopted for television would be in the public interest, convenience and necessity, upon petition being filed by the person proposing such change or modification, setting forth the following:

(1) The exact character of the change or modification proposed;

(2) The effect of the proposed change or modification upon all other transmission standards that have been adopted by the Commission for television broadcast stations;

(3) The experimentation and field tests that have been made to show that the proposed change or modification accomplishes an improvement and is technically feasible;

(4) The effect of the proposed change or modification in the adopted standards upon operation and obsolescence of receivers;

(5) The change in equipment required in existing television broadcast stations for incorporating the proposed change or modification in the adopted standards; and

(6) The facts and reasons upon which the petitioner bases his conclusion that the proposed change or modification would be in the public interest, convenience, and necessity.

Should a change or modification in the transmission standards be adopted by the Commission, the effective date thereof will be determined in the light of the considerations mentioned in subparagraph (4) of this paragraph.

§ 3.683 Field intensity contours. (a) In the authorization of television broadcast stations, two field intensity contours are considered. These are specified as Grade A and Grade B and indicate the approximate extent of coverage over average terrain in the absence of interference from other television stations. Under actual conditions, the true coverage may vary greatly from these estimates because the terrain over any specific path is expected to be different from the average terrain on which the field strength charts were based. The required field intensities, F (50, 50), in decibels above one microvolt per meter (dbu) for the Grade A and Grade B contours are as follows:

	Grade A (dbu)	Grade B (dbu)
Channels 2–6	68*	47*
Channels 7–13	71*	56*
Channels 14–83	71*	64

*See Doc. 13340 for proposed revision of these values, and to change the service grades to Principal City and Normal service.

NOTE: It should be realized that the F (50, 50) curves when used for Channels 14–83 are not based on measured data at distances beyond about 30 miles. Theory would indicate that the field intensities for Channels 14–83 should decrease more rapidly with distance beyond the horizon than for Channels 2–6, and modification of the curves for Channels 14–83 may be expected as a result of measurements to be made at a later date. For these reasons, the curves should be used with appreciation of their limitations in estimating levels of field intensity. Further, the actual extent of service will usually be less than indicated by these estimates due to interference from other stations. Because of these factors, the predicted field intensity contours give no assurance of service to any specific percentage of receiver locations within the distances indicated. In licensing proceedings these variations will not be considered.

(b) The field intensity contours provided for herein shall be considered for the following purposes only:

(1) In the estimation of coverage resulting from the selection of a particular transmitter site by an applicant for a television station.

(2) In connection with problems of coverage arising out of application of § 3.636.

(3) [Reserved.]

(4) In determining compliance with § 3.685(a) concerning the minimum field intensity to be provided over the principal community to be served.

§ 3.684 Prediction of coverage. (a) All predictions of coverage made pursuant to this paragraph shall be made without regard to interference and shall be made only on the basis of estimated field intensities. The peak power of the visual signal is used in making predictions of coverage.

(b) Predictions of coverage shall be made only for the same purposes as relate to the use of field intensity contours as specified in § 3.683(b).

(c) In predicting the distance to the field intensity contours, the F (50, 50) field intensity charts (Figures 10 and 11 of § 3.699) shall be used. If the 50 percent field intensity is defined as that value exceeded for 50 percent of the time, these F (50, 50) charts give the estimated 50 percent field intensities exceeded at 50 percent of the locations in decibels above one microvolt per meter. The charts are based on an effective power of one kilowatt radiated from a half-wave dipole in free space, which produces an unattenuated field strength at one mile of about 103 db above one microvolt per meter (137.6 millivolts per meter). To use the charts for other powers, the sliding scale associated with the charts should be trimmed and used as the ordinate scale. This sliding scale is placed on the charts with the appropriate gradation for power in line with the horizontal 40 db line on the charts. The right edge of the scale is placed in line with the appropriate antenna height gradations, and the charts then become direct reading (in μv/m and in db above 1 μv/m) for this power and antenna height. Where the antenna height is not one of those for which a scale is provided, the signal strength or distance is determined by interpolation between the curves connecting the equidistant points. Dividers may be used in lieu of the sliding scale. In predicting the distance to the Grade A and Grade B field intensity contours, the effective radiated power to be used is that in the horizontal plane in the pertinent direction. In predicting other field intensities over areas not in the horizontal plane, the effective radiated power to be used is the power in the direction of such areas; the appropriate vertical plane radiation pattern must, of course, be considered in determining this power.

(d) The antenna height to be used with these charts is the height of the radiation center of the antenna above the average terrain along the radial in question. In determining the average elevation of the terrain, the elevations between 2 and 10

miles from the antenna site are employed. Profile graphs shall be drawn for 8 radials beginning at the antenna site and extending 10 miles therefrom. The radials should be drawn for each 45 degrees of azimuth starting with True North. At least one radial must include the principal community to be served even though such community may be more than 10 miles from the antenna site. However, in the event none of the evenly spaced radials include the principal community to be served and one or more such radials are drawn in addition to the 8 evenly spaced radials, such additional radials shall not be employed in computing the antenna height above average terrain. Where the 2 to 10 mile portion of a radial extends in whole or in part over large bodies of water as specified in paragraph (e) of this section or extends over foreign territory but the Grade B intensity contour encompasses land area within the United States beyond the 10 mile portion of the radial, the entire 2 to 10 mile portion of the radial shall be included in the computation of antenna height above average terrain. However, where the Grade B contour does not so encompass United States land area and (1) the entire 2 to 10 mile portion of the radial extends over large bodies of water or foreign territory, such radial shall be completely omitted from the computation of antenna height above average terrain, and (2) where a part of the 2 to 10 mile portion of a radial extends over large bodies of water or over foreign territory, only that part of the radial extending from the 2 mile sector to the outermost portion of land area within the United States covered by the radial shall be employed in the computation of antenna height above average terrain. The profile graph for each radial should be plotted by contour intervals of from 40 to 100 feet and, where the data permits, at least 50 points of elevation (generally uniformly spaced) should be used for each radial. In instances of very rugged terrain where the use of contour intervals of 100 feet would result in several points in a short distance, 200- or 400-foot contour intervals may be used for such distances. On the other hand, where the terrain is uniform or gently sloping the smallest contour interval indicated on the topographic map (see paragraph (g) of this section) should be used, although only relatively few points may be available. The profile graphs should indicate the topography accurately for each radial, and the graphs should be plotted with the distance in miles as the abscissa and the elevation in feet above mean sea level as the ordinate. The profile graphs should indicate the source of the topographical data employed. The graph should also show the elevation of the center of the radiating system. The graph may be plotted either on rectangular coordinate paper or on special paper which shows the curvature of the earth. It is not necessary to take the curvature of the earth into consideration in this procedure, as this factor is taken care of in the charts showing signal intensities. The average elevation of the 8-mile distance between 2 and 10 miles from the antenna site should then be determined from the profile graph for each radial. This may be obtained by averaging a large number of equally spaced points, by using a planimeter, or by obtaining the median elevation (that exceeded for 50 percent of the distance) in sectors and averaging those values.

NOTE 1: This paragraph does not apply to any application designated for hearing in which the engineering portions have been heard or the engineering exhibits exchanged prior to June 1, 1953, the effective date of the amendment of this subsection unless the subsection as amended would materially affect the outcome of the hearing.

NOTE 2: The Commission will, upon a proper showing by an existing station that the application of this rule will result in an unreasonable power reduction in relation to other stations in close proximity, consider requests for adjustment in power on the basis of a common average terrain figure for the stations in question as determined by the Commission.

(e) In instances where it is desired to determine the area in square miles within the Grade A and Grade B field intensity contours, the area may be determined from the coverage map by planimeter or other approximate means; in computing such areas, exclude (1) areas beyond the borders of the United States, and (2) large bodies of water, such as ocean areas, gulfs, sounds, bays, large lakes, etc., but not rivers.

(f) In cases where the terrain in one or more directions from the antenna site

departs widely from the average elevation of the 2 to 10 mile sector, the prediction method may indicate contour distances that are different from what may be expected in practice. For example, a mountain ridge may indicate the practical limit of service although the prediction method may indicate otherwise. In such cases the prediction method should be followed, but a supplemental showing may be made concerning the contour distances as determined by other means. Such supplemental showing should describe the procedure employed and should include sample calculations. Maps of predicted coverage should include both the coverage as predicted by the regular method and as predicted by a supplemental method. When measurements of area are required, these should include the area obtained by the regular prediction method and the area obtained by the supplemental method. In directions where the terrain is such that negative antenna heights or heights below 100 feet for the 2 to 10 mile sector are obtained, a supplemental showing of expected coverage must be included together with a description of the method employed in predicting such coverage. In special cases, the Commission may require additional information as to terrain and coverage.

(g) In the preparation of the profile graphs previously described, and in determining the location and height above sea level of the antenna site, the elevation or contour intervals shall be taken from the United States Geological Survey Topographic Quadrangle Maps, United States Army Corps of Engineers maps or Tennessee Valley Authority maps, whichever is the latest, for all areas for which such maps are available. If such maps are not published for the area in question, the next best topographic information should be used. Topographic data may sometimes be obtained from State and municipal agencies. Data from Sectional Aeronautical Charts (including bench marks) or railroad depot elevations and highway elevations from road maps may be used where no better information is available. In cases where limited topographic data is available, use may be made of an altimeter in a car driven along roads extending generally radially from the transmitter site. Ordinarily the Commission will not require the submission of topographical maps for areas beyond 15 miles from the antenna site, but the maps must include the principal community to be served. If it appears necessary, additional data may be requested. United States Geological Survey Topographic Quadrangle Maps may be obtained from the Department of the Interior, Geological Survey, Washington, D.C. Sectional Aeronautical Charts are available from the Department of Commerce, Coast and Geodetic Survey, Washington, D.C.

§ 3.685 **Transmitter location and antenna system.** (a) The transmitter location shall be chosen so that, on the basis of the effective radiated power and antenna height above average terrain employed, the following minimum field intensity in decibels above one microvolt per meter (dbu) will be provided over the entire principal community to be served (see explanation on page 1–209):

Channels 2–6	Channels 7–13	Channels 14–83
74 dbu	77 dbu	80 dbu

(b) Location of the antenna at a point of high elevation is necessary to reduce to a minimum the shadow effect on propagation due to hills and buildings which may reduce materially the intensity of the station's signals. In general, the transmitting antenna of a station should be located at the most central point at the highest elevation available. To provide the best degree of service to an area, it is usually preferable to use a high antenna rather than a low antenna with increased transmitter power. The location should be so chosen that line-of-sight can be obtained from the antenna over the principal community to be served; in no event should there be a major obstruction in this path. The antenna must be constructed so that it is as clear as possible of surrounding buildings or objects that would cause shadow problems. It is recognized that topography, shape of the desired service area, and population distribution may make the choice of a transmitter location difficult. In such cases, consideration may be given to the use of a directional antenna system,

although it is generally preferable to choose a site where a nondirectional antenna may he employed.

(c) In cases of questionable antenna locations it is desirable to conduct propagation tests to indicate the field intensity expected in the principal community to be served and in other areas, particularly where severe shadow problems may be expected. In considering applications proposing the use of such locations, the Commission may require site tests to be made. Such tests should be made in accordance with the measurement procedure hereafter described, and full data thereon must be supplied to the Commission. Test transmitters should employ an antenna having a height as close as possible to the proposed antenna height, using a balloon or other support if necessary and feasible. Information concerning the authorization of site tests may be obtained from the Commission upon request.

(d) Present information is not sufficiently complete to establish "blanket areas" of television broadcast stations. A "blanket area" is that area adjacent to a transmitter in which the reception of other stations is subject to interference due to the strong signal from this station. The authorization of station construction in areas where blanketing is found to be excessive will be on the basis that the applicant will assume full responsibility for the adjustment of reasonable complaints arising from excessively strong signals of the applicant's station or take other corrective action.

(e) A directional antenna is considered to be an antenna that is designed or altered for the purpose of obtaining a noncircular radiation pattern. Directional antennas may not be used for the purpose of reducing minimum mileage separation requirements but may be employed for the purpose of improving service or for the purpose of using a particular site; however, directional antennas with a ratio of minimum to maximum radiation in the horizontal plane of more than 10 decibels will not be permitted.

(f) Applications proposing the use of directional antenna systems must be accompanied by the following:

(1) Complete description of the proposed antenna system.

(2) Orientation of array with respect to True North; time phasing of fields from elements (degrees leading or lagging); space phasing of elements (in feet and degrees); and ratio of fields from elements.

(3) Horizontal and vertical plane radiation patterns showing the free space field intensity in millivolts per meter at 1 mile and the effective radiated power, in dbk, for each direction. The method by which the radiation patterns were computed or measured shall be fully described, including formulas used, equipment employed, sample calculations and tabulations of data. Sufficient vertical plane patterns shall be included to indicate clearly the radiation characteristics of the antenna above and below the horizontal plane. The horizontal plane pattern shall be plotted on polar coordinate paper with reference to True North. The vertical plane patterns shall be plotted on rectangular coordinate paper with reference to the horizontal plane.

(4) Name, address, and qualifications of the engineer making the calculations.

(g) Applications proposing the use of television broadcast antennas within 200 feet of other television broadcast antennas operating on a channel within 20 percent in frequency of the proposed channel, or proposing the use of television broadcast antennas on Channels 5 or 6 within 200 feet of FM broadcast antennas, must include a showing as to the expected effect, if any, of such proximate operation.

(h) Where simultaneous use of antennas or antenna structures is proposed, the following provisions shall apply:

(1) In cases where it is proposed to use a tower of a standard broadcast station as a supporting structure for a television broadcast antenna, an appropriate application for changes in the radiating system of the standard broadcast station must be filed by the licensee thereof. A formal application (FCC Form 301) will be required if the proposal involves substantial change in the physical height or radiation characteristics of the standard broadcast antennas; otherwise an informal application will be acceptable. (In case of doubt, an informal application (letter) together with complete engineering data should be submitted.) An application may be required for other classes of stations when the tower is to be used in connection with a television station.

(2) When the proposed television antenna is to be mounted on a tower in the vicinity of a standard broadcast directional array and it appears that the operation of the directional antenna system may be affected, an engineering study must be filed with the television application concerning the effect of the television antenna on the directional pattern. Readjustment and field intensity measurements of the standard broadcast station may be required following construction of the television antenna.

(i) The provisions of Part 17 of this chapter shall govern the construction, marking and lighting requirements of antenna structures used by television broadcast stations. In the event a common tower is used by two or more licensees or permittees for antenna and/or antenna supporting purposes, the licensee or permittee who is owner of the tower shall assume full responsibility for the installation and maintenance of any painting and/or lighting requirements. In the event of shared ownership, one licensee or permittee shall assume such responsibility and advise the Commission accordingly.

§ 3.686 Measurements for rule making purposes and upon request of the Commission. (a) Except as provided for in § 3.612, television broadcast stations shall not be protected against any type of interference or propagation effect. Persons desiring to submit testimony, evidence, or data to the Commission for the purpose of showing that the technical standards contained in this subpart do not properly reflect any given types of interference or propagation effects may do so only in appropriate rule making proceedings to amend such technical standards. Persons making field intensity measurements for formal submission to the Commission in rule making proceedings, or making such measurements upon the request of the Commission, should comply with the procedure for making such measurements as outlined below.

(b) Measurements made to determine field intensities of television broadcast stations should be made with mobile equipment along roads which are as close and similar as possible to the radials showing topography which were submitted with the application for construction permit. Cluster and spot measurements may also be submitted, if accompanied by a complete showing of the procedures employed. Suitable measuring equipment and a continuous recording device must be employed, the chart of which is either directly driven from the speedometer of the automobile in which the equipment is mounted or so arranged that distances and identifying landmarks can be readily noted. The measuring equipment must be calibrated against recognized standards of field intensity and so constructed that it will maintain an acceptable accuracy of measurement while in motion or when stationary. The equipment should be so operated that the recorder chart can be calibrated directly in field intensity in order to facilitate analysis of the chart. The receiving antenna must be horizontally polarized and should be nondirectional.

(c) Mobile measurements should be made with a minimum chart speed of 3 inches per mile and preferably 5 or 6 inches per mile. Locations shall be noted on the recorder chart as frequently as necessary to fix definitely the relation between the measured field intensity and the location. The time constant of the equipment should be such as to permit adequate analysis of the charts, and the time constant employed shall be shown. Measurements should be made to a point on each radial well beyond the particular contour under investigation.

(d) While making field intensity measurements either the visual or the aural transmitter may be used. If the visual transmitter is used, it is recommended that a black picture be transmitted or that the transmitter be operated at black level without synchronization peaks. Operation at a power somewhat less than black level is permissible but too great a reduction in power is not recommended due to the difficulty of recording weak signals. In any event, an appropriate factor shall be used to convert the readings obtained to the field strength that would exist on synchronization peaks while operating at the authorized power.

(e) After the measurements are completed, the recorder chart should be divided into not less than 15 sections on each equivalent radial from the station. The field intensity in each section of the chart should be analyzed to determine the field intensity received 50 percent of the distance (median field) throughout the section, and this median field intensity associated with the corresponding sector of the

radial. The field intensity figures must be corrected for a receiving antenna elevation of 30 feet and for any directional effects of the automobile and receiving antenna not otherwise compensated. This data should be plotted for each radial, using log-log coordinate paper with distance as the abscissa and field intensity as the ordinate. A smooth curve should be drawn through these points (of median fields for all sectors) and this curve used to determine the distance to the desired contour. The distances obtained for each radial may then be plotted on the map of predicted coverage or on polar coordinate paper (excluding water areas, etc.) to determine the service and interference areas of a station.

(f) In certain cases the Commission may desire more information or recordings and in these instances special instructions will be issued.

(g) Data obtained in conjunction with field intensity measurements shall be submitted to the Commission in affidavit form in triplicate, including the following:

(1) Map or maps showing the roads or points where measurements were made, the service and/or interference areas determined by the prediction method and by the measurements, and any unusual terrain characteristics existing in these areas. The maps, preferably of a type showing topography in the area, should show the Grade A and Grade B field intensity contours.

(2) If a directional transmitting antenna is employed, a diagram on polar coordinate paper showing the predicted free space field intensity in millivolts per meter at 1 mile in all directions.

(3) A full description of the procedures and methods employed, including the type of equipment, the method of installation and operation, and calibration procedures.

(4) Complete data obtained during the survey, including calibration. (Only the original or one photostatic copy of the recording tapes, or representative samples, need to be submitted.)

(5) Antenna system and power employed during the survey.

(6) Name, address, and qualifications of the engineer or engineers making the measurements.

§ 3.687 Transmitters and associated equipment. (a) *Visual transmitter.* (1) For monochrome transmission only, the overall attenuation characteristics of the transmitter, measured in the antenna transmission line after the vestigial sideband filter (if used), shall not be greater than the following amounts below the ideal demodulated curve. (See Figure 11 of § 3.699.)

2 db at 0.5 mc.	6 db at 3.0 mc.
2 db at 1.25 mc.	12 db at 3.5 mc.
3 db at 2.0 mc.	

The curve shall be substantially smooth between these specified points, exclusive of the region from 0.75 to 1.25 mc. Output measurements shall be made with the transmitter operating into a dummy load of pure resistance and the demodulated voltage measured across this load. The ideal demodulated curve is that shown in Figure 11 of § 3.699.

(2) For color transmission, the standard given by subparagraph (1) of this paragraph applies except as modified by the following: A sine wave of 3.58 mc introduced at those terminals of the transmitter which are normally fed the composite color picture signal shall produce a radiated signal having an amplitude (as measured with a diode on the R. F. transmission line supplying power to the antenna), which is down 6 ± 2 db with respect to a signal produced by a sine wave of 200 kc. In addition, the amplitude of the signal shall not vary by more than ±2 db between the modulating frequencies of 2.1 and 4.18 mc.

(3) The field strength or voltage of the lower sideband, as radiated or dissipated and measured as described in subparagraph (4) of this paragraph, shall not be greater than −20 db for a modulating frequency of 1.25 mc or greater and in addition, for color, shall not be greater than −42 db for a modulating frequency of 3.579545 mc (the color subcarrier frequency). For both monochrome and color, the field strength or voltage of the upper sideband as radiated or dissipated and

measured as described in subparagraph (4) of this paragraph shall not be greater than −20 db for a modulating frequency of 4.75 mc or greater.

NOTE: Field strength measurements are desired. It is anticipated that these may not yield data which are consistent enough to prove compliance with the attenuation standards prescribed above. In that case, measurements with a dummy load of pure resistance, together with data on the antenna characteristics, shall be taken in place of over-all field measurements.

(4) The attenuation characteristics of a visual transmitter shall be measured by application of a modulating signal to the transmitter input terminals in place of the normal composite television video signal. The signal applied shall be a composite signal composed of a synchronizing signal to establish peak output voltage plus a variable frequency sine wave voltage occupying the interval between synchronizing pulses. (The "synchronizing signal" referred to in this section means either a standard synchronizing wave form or any pulse that will properly set the peak.) The axis of the sine wave in the composite signal observed in the output monitor shall be maintained at an amplitude 0.5 of the voltage at synchronizing peaks. The amplitude of the sine wave input shall be held at a constant value. This constant value should be such that at no modulating frequency does the maximum excursion of the sine wave, observed in the composite output signal monitor, exceed the value 0.75 of peak output voltage. The amplitude of the 200 kilocycle sideband shall be measured and designated zero db as a basis for comparison. The modulation signal frequency shall then be varied over the desired range and the field strength or signal voltage of the corresponding sidebands measured. As an alternate method of measuring, in those cases in which the automatic d-c insertion can be replaced by manual control, the above characteristic may be taken by the use of a video sweep generator and without the use of pedestal synchronizing pulses. The d-c level shall be set for midcharacteristic operation.

(5) A sine wave, introduced at those terminals of the transmitter which are normally fed the composite color picture signal, shall produce a radiated signal having an envelope delay, relative to the average envelope delay between 0.05 and 0.20 mc, of zero microseconds up to a frequency of 3.0 mc; and then linearly decreasing to 4.18 mc so as to be equal to −0.17 μsecs at 3.58 mc. The tolerance on the envelope delay shall be ±0.05 μsecs at 3.58 mc. The tolerance shall increase linearly to ±0.1 μsec down to 2.1 mc, and remain at ±0.1 μsec down to 0.2 mc. (Tolerances for the interval of 0.0 to 0.2 mc are not specified at the present time.) The tolerance shall also increase linearly to ±0.1 μsec at 4.18 mc.

(6) The radio frequency signal, as radiated, shall have an envelope as would be produced by a modulating signal in conformity with § 3.682 and Fig. 6 or 7 of § 3.699, as modified by vestigial sideband operation specified in Fig. 5 of § 3.699.

(7) The time interval between the leading edges of successive horizontal pulses shall vary less than one half of one percent of the average interval. However, for color transmissions, § 3.682(a)(5) and § 3.682(a)(6) shall be controlling.

(8) The rate of change of the frequency of recurrence of the leading edges of the horizontal synchronizing signals shall be not greater than 0.15 percent per second, the frequency to be determined by an averaging process carried out over a period of not less than 20, nor more than 100 lines, such lines not to include any portion of the blanking interval. However, for color transmissions, § 3.682(a)(5) and § 3.682(a)(6) shall be controlling.

(9) For color transmission the transfer characteristic (that is the relationship between the transmitter RF output and video signal input) shall be substantially linear between the reference black and reference white levels.

(b) *Aural transmitter.* (1) The transmitter shall operate satisfactorily with a frequency swing of ±25 kilocycles, which is considered 100 percent modulation. It is recommended, however, that the transmitter be designed to operate satisfactorily with a frequency swing of at least ±40 kilocycles.

(2) The transmitting system (from input terminals of microphone pre-amplifier, through audio facilities at the studio, through telephone lines or other circuits be-

tween studio and transmitter, through audio facilities at the transmitter, and through the transmitter, but excluding equalizers for the correction of deficiencies in microphone response) shall be capable of transmitting a band of frequencies from 50 to 15,000 cycles. Pre-emphasis shall be employed in accordance with the impedance-frequency characteristic of a series inductance-resistance network having a time constant of 75 microseconds. (See Figure 12 of § 3.699.) The deviation of the system response from the standard preemphasis curve shall lie between two limits as shown by Figure 12 of § 3.699. The upper of these limits shall be uniform (no deviation) from 50 to 15,000 cycles. The lower limit shall be uniform from 100 to 7,500 cycles, and three db below the upper limit; from 100 to 50 cycles the lower limit shall fall from three db limit at a uniform rate of one db per octave (4 db at 50 cycles); from 7,500 to 15,000 cycles the lower limit shall fall from three db limit at a uniform rate of two db per octave (5 db at 15,000 cycles).

(3) At any modulating frequency between 50 and 15,000 cycles and at modulation percentages of 25 percent, 50 percent, and 100 percent, the combined audio frequency harmonics measured in the output of the system shall not exceed the root-mean-square values given in the following table:

Modulation frequency	*Distortion (percent)*
50 to 100 cycles	3.5
100 to 7,500 cycles	2.5
7,500 to 15,000 cycles	3.0

(i) Measurement shall be made employing 75 microsecond de-emphasis in the measuring equipment and 75 microsecond pre-emphasis in the transmitting equipment, and without compression if a compression amplifier is employed. Harmonics shall be included to 30 kc.

NOTE: Measurements of distortion using de-emphasis in the measuring equipment are not practical at the present time for the range 7,500 to 15,000 cycles for 25 and 50 percent modulation. Therefore, measurements should be made at 100 percent modulation and on at least the following modulating frequencies: 50, 100, 400, 1,000, 5,000, 10,000, and 15,000 cycles. At 25 and 50 percent modulation, measurements should be made on at least the following modulating frequencies: 50, 100, 400, 1,000 and 5,000 cycles.

(ii) It is recommended that none of the three main divisions of the system (transmitter, studio to transmitter circuit, and audio facilities) contribute over one-half of these percentages, since at some frequencies the total distortion may become the arithmetic sum of the distortions of the divisions.

(4) The transmitting system output noise level (frequency modulation) in the band of 50 to 15,000 cycles shall be at least 55 db below the audio frequency level representing a frequency swing of ±25 kc.

NOTE: For the purpose of these measurements, the visual transmitter should be inoperative since the exact amount of noise permissible from that source is not known at this time.

(5) The transmitting system output noise level (amplitude modulation) in the band of 50 to 15,000 cycles shall be at least 50 db below the level representing 100 percent amplitude modulation.

NOTE: For the purpose of these measurements, the visual transmitter should be inoperative since the exact amount of noise permissible from that source is not known at this time.

(6) If a limiting or compression amplifier is employed, precaution should be maintained in its connection in the circuit due to the use of pre-emphasis in the transmitting system.

(7) The percentage of modulation of the aural transmissions shall be maintained as high as possible consistent with good quality of transmission and good broadcast practice and in no case less than 85 percent nor more than 100 percent on peaks of frequent recurrence during any selection which normally is transmitted at the highest level of the program under consideration.

(c) *Requirements applicable to both visual and aural transmitters.* (1) Automatic means shall be provided in the visual transmitter to maintain the carrier frequency within ±1 kilocycle of the authorized frequency; automatic means shall be provided in the aural transmitter to maintain the carrier frequency 4.5 megacycles above the actual visual carrier frequency within ±1 kilocycle.

(2) The transmitters shall be equipped with suitable indicating instruments for the determination of operating power and with other instruments necessary for proper adjustment, operation, and maintenance of the equipment.

(3) Adequate provision shall be made for varying the output power of the transmitters to compensate for excessive variations in line voltage or for other factors affecting the output power.

(4) Adequate provisions shall be provided in all component parts to avoid overheating at the rated maximum output powers.

(d) *Construction.* In general, the transmitters shall be mounted either on racks and panels or in totally enclosed frames protected as required by article 810 of the National Electrical Code (Section 8192(a), (b), and (c)), and as set forth below:

(1) Means shall be provided for making all tuning adjustments, requiring voltages in excess of 350 volts to be applied to the circuit, from the front of the panels with all access doors closed.

(2) Proper bleeder resistors or other automatic means shall be installed across all the capacitor banks to lower any voltage which may remain accessible with access door open to less than 350 volts within two seconds after the access door is opened.

(3) All plate supply and other high voltage equipment, including transformers, filters, rectifiers and motor generators, shall be protected so as to prevent injury to operating personnel.

(i) Commutator guards shall be provided on all high voltage rotating machinery. Coupling guards should be provided on motor generators.

(ii) Power equipment and control panels of the transmitters shall meet the above requirements (exposed 220-volt A.C. switching equipment on the front of the power control panels is not recommended but is not prohibited).

(iii) Power equipment located at a television broadcast station not directly associated with the transmitters (not purchased as part of same), such as power distribution panels, are not subject to the provisions of this subpart.

(4) The following provisions shall be applicable to metering equipment:

(i) All instruments having more than 1,000 volts potential to ground on the movement shall be protected by a cage or cover in addition to the regular case. (Some instruments are designed by the manufacturers to operate safely with voltages in excess of 1,000 volts on the movement. If it can be shown by the manufacturer's rating that the instrument will operate safely at the applied potential, additional protection is not necessary.)

(ii) In case the plate voltmeters are located on the low potential side of the multiplier resistors with the high potential terminal of the instruments at or less than 1,000 volts above ground, no protective case is required. However, it is good practice to protect voltmeters subject to more than 5,000 volts with suitable over-voltage protective devices across the instrument terminals in case the winding opens.

(iii) Transmission line meters and any other radio frequency instrument which may be necessary for the operator to read shall be so installed as to be read easily and accurately without the operator having to risk contact with circuits carying high potential radio frequency energy.

(e) *Wiring and shielding.* (1) The transmitter panels or units shall be wired in accordance with standard practice, such as insulated leads properly cabled and supported, coaxial cables, or rigid bus bar properly insulated and protected.

(2) Wiring between units of the transmitters, with the exception of circuits carrying radio frequency energy or video energy, shall be installed in conduits or approved fiber or metal raceways to protect it from mechanical injury.

(3) Circuits carrying radio frequency or video energy between units shall be coaxial cables, two wire balanced lines, or properly shielded lines.

(4) All stages or units shall be adequately shielded and filtered to prevent interaction and radiation.

(5) The frequency and modulation monitors and associated radio frequency lines to the transmitter shall be thoroughly shielded.

(f) *Auxiliary transmitters.* Auxiliary transmitters may not exceed the power rating of the main transmitters. As a general guide, specifications for auxiliary transmitters should conform as much as possible to those of the main transmitters. No requirements are set forth at this time.

(g) *Installation.* (1) The installation of transmitting equipment shall be made in suitable quarters. (2) Suitable facilities shall be provided for the welfare and comfort of the operator.

(h) An accurate circuit diagram and list of required spare tubes, as furnished by the manufacturer of the equipment, shall be supplied and retained at the transmitter location.

(i) *Operation.* (1) Spurious emissions, including radio frequency harmonics, shall be maintained at as low a level as the state of the art permits. As measured at the output terminals of the transmitter (including harmonic filters, if required) all emissions removed in frequency in excess of 3 Mc above or below the respective channel edge shall be attenuated no less than 60 db. below the visual transmitted power. (The 60 db. value for television transmitters specified in this rule should be considered as a temporary requirement which may be increased at a later date, especially when more higher-powered equipment is utilized. Stations should, therefore, give consideration to the installation of equipment with greater attenuation than 60 db.) In the event of interference caused to any service greater attenuation will be required.

(2) If a limiting or compression amplifier is used in conjunction with the aural transmitter, due operating precautions should be maintained because of pre-emphasis in the transmitting system.

(j) *Studio equipment.* Studio equipment shall be subject to all the above requirements where applicable, except as follows:

(1) If properly covered by an underwriter's certificate, it will be considered as satisfying safety requirements.

(2) Section 8191 of article 810 of the National Electrical Code shall apply for voltages only in excess of 500 volts.

(3) No specific requirements are made relative to the design and acoustical treatment of studios. However, the design of studios, particularly the main studio, shall be compatible with the required performance characteristics of television broadcast stations.

§ 3.688 Indicating instruments. (a) Each television broadcast station shall be equipped with indicating instruments for measuring the direct plate voltage and current of the last radio stage of the visual and aural transmitters and the transmission line radio frequency current, voltage, or power of both transmitters; such instruments shall conform to the specifications therefor set forth in this subpart.

(b) The following requirements and specifications shall apply to indicating instruments used by television broadcast stations in compliance with paragraph (a) of this section:

(1) Length of scale shall be not less than $2\frac{3}{10}$ inches.

(2) Accuracy shall be at least 2 percent of the full scale reading.

(3) Scale shall have at least 40 divisions.

(4) Full scale reading shall be not greater than five times the minimum normal indication.

(5) No specifications are prescribed at this time regarding the peak indicating device required by § 3.689(b).

(c) Any required instrument, the accuracy of which is questionable, shall not be employed. Repairs and calibration of instruments shall be made by the manufacturer, or by an authorized instrument repair service of the manufacturer, or by some other properly qualified or equipped instrument repair service. In any case, the repaired instrument must be supplied with a certificate of calibration.

(d) Recording instruments may be employed in addition to the indicating instruments to record the direct plate current and/or voltage to the last radio stage provided that they do not affect the operation of the circuits or accuracy of the indicating instruments. If the records are to be used in any proceeding before the Commission, as representative of operation, the accuracy must be the equivalent of the indicating instruments and the calibration shall be checked at such intervals as to insure the retention of such accuracy.

(e) The function of each instrument used in the equipment shall be clearly and permanently shown on the instrument itself or on the panel immediately adjacent thereto.

(f) In the event that any one of the indicating instruments required by paragraph (a) of this section 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: *Provided,* That—

(1) Appropriate entries shall be made in the operating 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 a plate voltmeter or plate ammeter in the last radio stage, the operating power shall be maintained by means of the radio frequency transmission line meter.

(4) If conditions beyond the control of the licensee prevent the restoration of the meter to service within the above allowed period, informal request may be filed in accordance with § 1.332(d) of this chapter 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.

§ 3.689 Operating power. (a) *Determination*—(1) *Visual transmitter.* The operating power of the visual transmitter shall be determined at the output terminal of the vestigial sideband filter, if such filter is used; otherwise, at the transmitter output terminal. The average power shall be measured while operating into a dummy load of substantially zero reactance and a resistance equal to the transmission line surge impedance, while transmitting a standard black television picture. The peak power shall be the power obtained by this method, multiplied by the factor 1.68. During this measurement the direct plate voltage and current of the last radio stage and the peak output voltage or current shall be read for use below.

(2) *Aural transmitter.* The operating power of the aural transmitter shall be determined by the indirect method. This 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; that is:

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

(i) The efficiency factor, F, shall be established by the transmitter manufacturer for each type of transmitter for which he submits data to the Commission, and shall be shown in the instruction books supplied to the customer with each transmitter. In the case of composite equipment, the factor F shall be furnished to the Commission by the applicant along with a statement of the basis used in determining such factor.

(b) *Maintenance*—(1) *Visual transmitter.* The peak power shall be monitored by a peak reading device which reads proportionally to voltage, current, or power in the radio frequency transmission line, the meter to be calibrated during the measurement described in paragraph (a) (1) of this section. The operating power as so monitored shall be maintained as near as practicable to the authorized operating power and shall not exceed the limits of 10 percent above and 20 percent below the authorized power except in emergencies. As a further check, both the plate voltage and plate current of the output stage shall be measured with a standard black television picture with the transmitter operating into the antenna. These values must agree substantially with corresponding readings taken under paragraph (a) (1) of this section.

(2) *Aural transmitter.* The operating power of the aural transmitter shall be maintained as near as practicable to the authorized operating power, and shall not exceed the limits of 10 percent above and 20 percent below the authorized power except in emergencies.

(3) *Reduced power.* In the event it becomes impossible to operate with the authorized power, the station may be operated with reduced power for a period of 10 days or less provided the Commission and the Engineer in Charge of the radio district in which the station is located shall be notified in writing immediately thereafter and also upon the resumption of the normal operating power.

Monitoring Equipment

§ 3.690 Frequency monitors. (a) The licensee of each television broadcast station shall have in operation at the transmitter approved frequency monitors independent of the frequency control of the transmitters. (The requirement of this paragraph is postponed until June 1, 1960.)

NOTE: Approved frequency monitors are included on the Commission's "Radio Equipment List, Part A, Television 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 the visual or aural frequency monitor becomes defective, the station may be operated without such equipment 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 operating log of the station to show the date and time the equipment 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 equipment is found to be defective and immediately after the repaired or replacement equipment has been installed and is functioning properly.

(3) During the period when the station is operated without the visual or aural frequency monitor, the respective carrier frequency shall be compared with an external frequency source of known accuracy at sufficiently frequent intervals to insure that the frequency is maintained within the tolerance prescribed in § 3.687(c)(1). An entry shall be made in the station log as to the method used and the results thereof.

(4) If conditions beyond the control of the licensee or permittee prevent the restoration of the monitor or monitoring equipment to service within the period specified above, an informal request in accordance with § 1.332(d) 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 or equipment.

§ 3.691 Modulation monitors. (a) The licensee of each television broadcast station shall have in operation at the transmitter an approved modulation monitor for the aural transmitter. There shall also be employed sufficient monitoring equipment for the visual signal to determine that the signal complies with the requirements of this subpart. (The requirement for use of type-approved aural modulation monitors is postponed until June 1, 1960.)

NOTE: Approved aural modulation monitors are included on the Commission's "Radio Equipment List, Part A, Television 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 the visual monitoring equipment or the aural modulation monitor becomes defective, the station may be operated without such equipment 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 operating log of the station to show the date and time the equipment 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 equipment is found to be defective and immediately after the repaired or replacement equipment has been installed and is functioning properly.

(3) During the period when the station is operated without the aural modulation monitor or the visual monitoring equipment, the licensee shall provide other suitable means for insuring that the aural modulation is maintained within the tolerance prescribed in § 3.687(b)(7) and that the visual signal is maintained in accordance with the requirements of this subpart.

(4) If conditions beyond the control of the licensee or permittee prevent the restoration of the monitor or monitoring equipment to service within the period specified above, an informal request in accordance with § 1.332(d) 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 or equipment.

§ 3.692 General requirements for type approval of frequency and modulation monitors. (a) Any manufacturer desiring to submit a monitor for type approval shall supply the Commission with full specification details (two sworn copies) as well as the test data specified in §§ 3.693 and 3.694. If this information appears to meet the requirements of the rules, shipping instructions will be issued to the manufacturer. The shipping charges to and from the Laboratory at Laurel, Maryland, shall be paid for by the manufacturer. Approval of a monitor will only be given on the basis of the data obtained from the sample monitor submitted to the Commission for test.

(b) In approving a monitor upon the basis of the tests conducted by the Laboratory, the Commission merely recognizes that the type of monitor has the inherent capability of functioning in compliance with the rules, if properly constructed, maintained, and operated. The Commission realizes that the frequency monitor may have limited range over which the visual indicator will determine deviations. Accordingly, it is necessary that adjunct equipment be used to determine major deviations.

(c) Additional rules with respect to withdrawal of type approval, modification of type approved equipment and limitations on the findings upon which type approval is based are set forth in Part 2, Subpart F, of the Commission's Rules.

§ 3.693 Requirements for type approval of frequency monitors. (a) The specifications that frequency monitors shall meet before they will be approved by the Commission are as follows:

(1) The monitor shall have as accuracy of better than 500 cycles for 30 days on VHF operation, or for 10 days on UHF operation, and under ordinary conditions (ambient temperature from 10° centigrade to 40° centigrade above zero, humidity from 10 percent to 95 percent relative humidity, power supply variations from 90 percent to 110 percent, and other conditions which may affect its accuracy) encountered in television broadcast stations throughout the United States.

(2) The range of the indicating device for the aural monitor shall be at least 3000 cycles below to 3000 cycles above the assigned center frequency. Alternatively, the aural monitor may use an indicating device with a similar scale to indicate the difference-frequency between the aural and visual carriers. The range of the indicating device for the visual monitor shall be at least 1500 cycles below to 1500 cycles above the assigned carrier frequency.

(3) The scale of the indicating device shall be calibrated in divisions of not more than 100 cycles.

(4) Means shall be provided for adjustment of the monitor indication to agree with an external standard.

(5) The monitors shall be capable of continuous operation and the circuits shall be such as to permit continuous monitoring of the transmitter carrier frequencies, and the difference-frequency between the visual and aural carriers if this method of measurement is used.

(6) Operation of the monitors shall have no adverse effect on the operation of either the aural or visual transmitters or the signals emitted therefrom and shall be independent of the frequency control of the transmitters.

(7) Means shall be provided for insuring power input level.

(8) General design, construction and operation shall be in accordance with good engineering practice.

(b) Tests to be made for approval of television broadcast frequency monitors. The manufacturer of a monitor shall submit data on the following at the time of requesting approval:

(1) Constancy of oscillator frequency, as measured daily for one month, or more.

(2) Constancy of oscillator frequency when subject to vibration tests which would correspond to the treatment received in shipping, handling and installing the instrument.

(3) Accuracy of reading of the frequency deviation instrument.

(4) Functioning of frequency adjustment device.

(5) Effects on frequency readings, of the changing of tubes, of voltage variations, and of variations of room temperature through a range from 10° to 40°C.

(6) Response of indicating instrument to small changes of frequency.

(7) General information on the effect of tilting or tipping or other tests to determine ability of equipment to withstand shipment.

(c) Various other tests may be made or required, such as effects of variation of input from the transmitter depending upon the character of the apparatus.

(d) Tests shall be conducted in such a manner as to approximate actual operating conditions as nearly as possible. The equipment shall be tested on the highest channel for which it is designed.

§ 3.694 Requirements for type approval of aural modulation monitors. (a) The required aural modulation monitor may or may not be a part of the frequency monitor.

(b) The specifications that the aural modulation monitor shall meet before it will be approved by the Commission are as follows:

(1) Means shall be provided for indicating that the signal input to the modulation monitor is in the range required for proper operations.

(2) A modulation peak indicating device shall be provided that can be set at any pre-determined value from 50 to 120 percent modulation (±25 kc swing is defined as 100 percent modulation) and for either positive or negative swings (i.e., either above or below transmitter center frequency).

(3) A quasi-peak indicator with a meter having the characteristics given below shall be used with a circuit such that peaks of modulation of duration between 40 and 90 milliseconds are indicated to 90 percent of full value and the discharge rate adjusted so that the pointer returns from full reading to within 10 percent of zero within 500 to 800 milliseconds. A switch shall be provided so that this meter will read either positive or negative swings.

(4) When modulation of a magnitude necessary to produce a deflection equivalent to 100 percent modulation is suddenly applied and left on, the indicating instrument shall not deflect beyond 110 percent on the first passage of the 100 percent mark and shall have excursion from the final value of less than 1 percent after one second or more.

(5) The meter scale shall be similar in appearance to that of a standard VU meter. The scale length between 0 and 100 percent modulation markings shall be at least 2.3 inches. In addition to other markings a small marker for 133 percent modulation, designated as such, should be included for the purpose of testing the transmitter with 33.3 kc swing.

(6) The indicated reading in percentage shall be accurate within ±5 (based on 100 percent modulation) at any percentage of modulation up to 100.

(7) The frequency characteristic curve as measured at 50 percent modulation shall not depart from a straight line more than ±½ db from 50 to 15,000 cycles. Distortion shall be kept to a minimum.

(8) The monitor shall not absorb appreciable power from the transmitter.

(9) Operation of the monitor shall have no adverse effect on the operation of the transmitter.

(10) General design, construction, and operation shall be in accordance with good engineering practice.

(c) Tests to be made for approval of television broadcast aural modulation monitors. The manufacturer of a monitor shall submit data on the following at the time of requesting approval:

(1) Audio frequency response of the monitor from 50 to 15,000 cycles in db from the response at 400 cycles.

(2) Distortion in the response.

(3) Input signal power required.

(4) Permissible tolerance on input signal power to keep the meter reading correct within 5 percent units.

(5) Ballistic characteristics of the monitor indicator.

(d) Various other tests may be made or required depending on the character of the apparatus.

(e) Tests shall be conducted in such a manner as to approximate actual operating conditions as nearly as possible. The equipment shall be tested on the highest channel for which it is designed.

§§ 3.695–3.697 [Reserved.]

§ 3.698 Tables.

TABLE

MINUTES TO DECIMAL PARTS OF A DEGREE

Minutes	Degrees	Minutes	Degrees
1	0.01667	31	0.51667
2	.03333	32	.53333
3	.05	33	.55
4	.06667	34	.56667
5	.08333	35	.58333
6	.10	36	.60
7	.11667	37	.61667
8	.13333	38	.63333
9	.15	39	.65
10	.16667	40	.66667
11	.18333	41	.68333
12	.20	42	.70
13	.21667	43	.71667
14	.23333	44	.73333
15	.25	45	.75
16	.26667	46	.76667
17	.28333	47	.78333
18	.30	48	.80
19	.31667	49	.81667
20	.33333	50	.83333
21	.35	51	.85
22	.36667	52	.86667
23	.38333	53	.88333
24	.40	54	.90
25	.41667	55	.91667
26	.43333	56	.93333
27	.45	57	.95
28	.46667	58	.96667
29	.48333	59	.98333
30	.50	60	1.00

TABLE I—(*Continued*)

SECONDS TO DECIMAL PARTS OF A DEGREE

Seconds	Degrees	Seconds	Degrees
1	0.00028	31	0.00861
2	.00056	32	.00889
3	.00083	33	.00917
4	.00111	34	.00994
5	.00139	35	.00972
6	.00167	36	.01
7	.00194	37	.01028
8	.00222	38	.01056
9	.0025	39	.01083
10	.00278	40	.01111
11	.00306	41	.01139
12	.00333	42	.01167
13	.00361	43	.01194
14	.00389	44	.01222
15	.00417	45	.0125
16	.00444	46	.01278
17	.00472	47	.01306
18	.005	48	.01333
19	.00528	49	.01361
20	.00556	50	.01389
21	.00583	51	.01417
22	.00611	52	.01444
23	.00639	53	.01472
24	.00667	54	.015
25	.00694	55	.01528
26	.00722	56	.01556
27	.0075	57	.01583
28	.00778	58	.01611
29	.00806	59	.01639
30	.00833	60	.01667

TABLE II

MILES PER DEGREE OF LATITUDE DIFFERENCE

Middle latitude	Statute miles	Middle latitude	Statute miles
° ′		° ′	
25 0	68.828	38 0	68.968
30	68.833	30	68.974
26 0	68.837	39 0	68.980
30	68.842	30	68.986
27 0	68.847	40 0	68.992
30	68.852	30	68.998
28 0	68.857	41 0	69.004
30	68.862	30	69.011
29 0	68.867	42 0	69.017
30	68.873	30	69.023
30 0	68.878	43 0	69.029
30	68.883	30	69.035
31 0	68.889	44 0	69.041
30	68.894	30	69.047
32 0	68.899	45 0	69.053
30	68.905	30	69.060
33 0	68.911	46 0	69.066
30	68.916	30	69.072
34 0	68.922	47 0	69.078
30	68.928	30	69.084
35 0	68.933	48 0	69.090
30	68.939	30	69.096
36 0	68.945	49 0	69.102
30	68.951	30	69.108
37 0	68.957	50 0	69.115
30	68.962		

Middle latitude degrees	Miles per degree of longitude											
	25	26	27	28	29	30	31	32	33	34	35	36
Minutes												
0	62.728	62.211	61.675	61.120	60.547	59.955	59.345	58.716	58.070	57.406	56.725	56.026
1	62.720	62.202	61.666	61.111	60.537	59.945	59.335	58.706	58.059	57.395	56.713	56.014
2	62.712	62.193	61.657	61.101	60.528	59.935	59.324	58.695	58.048	57.384	56.702	56.002
3	62.703	62.184	61.648	61.092	60.517	59.925	59.314	58.684	58.037	57.373	56.690	55.991
4	62.694	62.176	61.639	61.082	60.508	59.915	59.303	58.674	58.026	57.362	56.678	55.979
5	62.686	62.167	61.630	61.073	60.498	59.905	59.293	58.663	58.015	57.350	56.667	55.967
6	62.677	62.158	61.621	61.064	60.488	59.895	59.282	58.652	58.004	57.339	56.655	55.955
7	62.669	62.149	61.611	61.054	60.478	59.885	59.272	58.642	57.994	57.328	56.644	55.943
8	62.660	62.140	61.602	61.045	60.469	59.875	59.262	58.631	57.983	57.316	56.632	55.931
9	62.652	62.132	61.593	61.035	60.459	59.865	59.252	58.620	57.972	57.305	56.621	55.920
10	62.644	62.123	61.584	61.026	60.449	59.855	59.241	58.610	57.961	57.294	56.610	55.908
11	62.635	62.114	61.575	61.017	60.440	59.845	59.231	58.599	57.950	57.283	56.598	55.896
12	62.627	62.105	61.566	61.007	60.430	59.835	59.221	58.588	57.939	57.271	56.586	55.884
13	62.618	62.096	61.557	60.997	60.420	59.825	59.210	58.578	57.928	57.260	56.575	55.872
14	62.609	62.088	61.547	60.988	60.410	59.814	59.200	58.567	57.917	57.249	56.563	55.860
15	62.601	62.079	61.538	60.979	60.400	59.804	59.189	58.556	57.906	57.238	56.552	55.849
16	62.592	62.070	61.529	60.969	60.390	59.794	59.179	58.546	57.895	57.227	56.540	55.837
17	62.583	62.061	61.520	60.959	60.381	59.784	59.168	58.535	57.884	57.215	56.529	55.825
18	62.575	62.052	61.510	60.950	60.371	59.774	59.158	58.524	57.873	57.204	56.517	55.813
19	62.567	62.044	61.501	60.940	60.361	59.764	59.147	58.514	57.862	57.192	56.505	55.802
20	62.559	62.035	61.492	60.931	60.352	59.754	59.137	58.503	57.851	57.181	56.493	55.790
21	62.550	62.026	61.483	60.921	60.342	59.744	59.127	58.492	57.840	57.170	56.482	55.778
22	62.541	62.017	61.474	60.912	60.332	59.734	59.116	58.481	57.829	57.159	56.470	55.766
23	62.532	62.008	61.465	60.902	60.322	59.723	59.106	58.470	57.818	57.147	56.459	55.754
24	62.524	61.999	61.455	60.893	60.312	59.713	59.095	58.460	57.807	57.136	56.447	55.742
25	62.515	61.990	61.446	60.883	60.302	59.703	59.085	58.449	57.796	57.125	56.435	55.730
26	62.507	61.981	61.437	60.874	60.292	59.693	59.074	58.438	57.785	57.113	56.424	55.718
27	62.498	61.972	61.428	60.865	60.282	59.683	59.064	58.428	57.774	57.102	56.412	55.706
28	62.489	61.963	61.419	60.855	60.273	59.672	59.054	58.417	57.763	57.090	56.401	55.694
29	62.480	61.955	61.409	60.845	60.263	59.662	59.043	58.406	57.752	57.079	56.389	55.682
30	62.472	61.946	61.400	60.836	60.253	59.652	59.033	58.396	57.741	57.068	56.378	55.671
31	62.463	61.937	61.391	60.826	60.243	59.642	59.022	58.385	57.729	57.057	56.366	55.659
32	62.455	61.928	61.381	60.817	60.233	59.632	59.012	58.374	57.718	57.045	56.354	55.647
33	62.446	61.918	61.372	60.807	60.223	59.622	59.001	58.363	57.707	57.034	56.343	55.635
34	62.438	61.909	61.363	60.798	60.213	59.611	58.991	58.352	57.696	57.022	56.331	55.623
35	62.429	61.900	61.354	60.788	60.203	59.601	58.980	58.341	57.685	57.011	56.319	55.611
36	62.420	61.891	61.344	60.778	60.194	59.591	58.970	58.331	57.674	56.999	56.308	55.599
37	62.412	61.882	61.335	60.768	60.184	59.581	58.960	58.320	57.663	56.988	56.296	55.587
38	62.403	61.874	61.325	60.759	60.174	59.571	58.949	58.309	57.652	56.977	56.284	55.575
39	62.395	61.865	61.316	60.750	60.164	59.561	58.939	58.298	57.641	56.966	56.273	55.563
40	62.386	61.856	61.307	60.740	60.154	59.550	58.928	58.288	57.629	56.954	56.261	55.551
41	62.377	61.847	61.298	60.730	60.144	59.540	58.917	58.277	57.618	56.943	56.249	55.539
42	62.369	61.838	61.289	60.721	60.134	59.530	58.907	58.266	57.607	56.931	56.238	55.527
43	62.360	61.829	61.279	60.711	60.124	59.520	58.896	58.255	57.596	56.919	56.226	55.515
44	62.351	61.820	61.270	60.701	60.114	59.510	58.886	58.244	57.585	56.908	56.214	55.503
45	62.342	61.811	61.261	60.692	60.104	59.500	58.875	58.233	57.574	56.897	56.202	55.491
46	62.334	61.802	61.252	60.682	60.094	59.489	58.865	58.223	57.563	56.885	56.191	55.479
47	62.325	61.793	61.242	60.672	60.084	59.479	58.854	58.212	57.552	56.874	56.179	55.467
48	62.316	61.784	61.233	60.663	60.074	59.468	58.843	58.201	57.541	56.863	56.167	55.455
49	62.308	61.775	61.223	60.654	60.065	59.458	58.833	58.190	57.529	56.851	56.156	55.443
50	62.299	61.766	61.214	60.644	60.055	59.448	58.822	58.179	57.518	56.840	56.144	55.431
51	62.290	61.757	61.205	60.634	60.045	59.438	58.812	58.168	57.507	56.829	56.132	55.419
52	62.281	61.748	61.195	60.625	60.035	59.427	58.801	58.157	57.496	56.817	56.120	55.407
53	62.272	61.739	61.186	60.615	60.025	59.417	58.790	58.147	57.485	56.805	56.109	55.395
54	62.264	61.730	61.176	60.605	60.015	59.406	58.780	58.136	57.473	56.794	56.097	55.383
55	62.255	61.721	61.167	60.595	60.005	59.396	58.769	58.125	57.462	56.782	56.085	55.371
56	62.246	61.712	61.158	60.586	59.995	59.386	58.759	58.114	57.451	56.771	56.073	55.359
57	62.237	61.702	61.148	60.576	59.985	59.376	58.748	58.103	57.440	56.759	56.061	55.347
58	62.228	61.693	61.139	60.566	59.975	59.365	58.737	58.092	57.429	56.748	56.050	55.335
59	62.220	61.684	61.129	60.557	59.965	59.355	58.727	58.081	57.418	56.737	56.038	55.323

difference (statute miles)

37	38	39	40	41	42	43	44	45	46	47	48	49
55.311	54.578	53.828	53.063	52.280	51.482	50.669	49.839	48.995	48.135	47.260	46.371	45.468
55.299	54.565	53.816	53.050	52.267	51.469	50.655	49.825	48.980	48.120	47.245	46.356	45.453
55.286	54.553	53.803	53.037	52.254	51.455	50.641	49.811	48.966	48.106	47.231	46.341	45.438
55.274	54.541	53.791	53.024	52.241	51.442	50.627	49.797	48.952	48.091	47.216	46.326	45.422
55.262	54.528	53.778	53.011	52.229	51.429	50.614	49.783	48.937	48.077	47.201	46.311	45.407
55.250	54.516	53.765	52.998	52.215	51.415	50.600	49.769	48.923	48.063	47.187	46.296	45.392
55.238	54.503	53.753	52.985	52.201	51.402	50.586	49.755	48.909	48.048	47.172	46.281	45.377
55.226	54.491	53.740	52.972	52.188	51.388	50.573	49.741	48.895	48.034	47.158	46.266	45.362
55.213	54.479	53.727	52.959	52.175	51.375	50.559	49.727	48.881	48.019	47.143	46.252	45.346
55.201	54.466	53.715	52.946	52.162	51.361	50.545	49.713	48.867	48.005	47.128	46.237	45.331
55.189	54.454	53.702	52.933	52.149	51.348	50.531	49.699	48.852	47.990	47.114	46.222	45.317
55.177	54.441	53.689	52.920	52.135	51.335	50.517	49.685	48.838	47.975	47.099	46.207	45.301
55.165	54.429	53.677	52.907	52.122	51.321	50.504	49.671	48.824	47.961	47.084	46.192	45.286
55.153	54.417	53.664	52.894	52.109	51.307	50.490	49.657	48.809	47.946	47.069	46.177	45.270
55.141	54.404	53.651	52.881	52.096	51.294	50.476	49.643	48.795	47.932	47.054	46.162	45.255
55.128	54.392	53.639	52.868	52.082	51.280	50.462	49.629	48.781	47.917	47.040	46.147	45.240
55.116	54.380	53.626	52.855	52.069	51.267	50.449	49.615	48.767	47.903	47.025	46.132	45.225
55.104	54.367	53.613	52.842	52.056	51.253	50.435	49.601	48.752	47.888	47.010	46.117	45.210
55.093	54.354	53.601	52.830	52.043	51.240	50.421	49.587	48.738	47.874	46.995	46.102	45.194
55.080	54.342	53.588	52.817	52.030	51.226	50.408	49.573	48.724	47.859	46.980	46.087	45.179
55.068	54.330	53.575	52.804	52.016	51.213	50.394	49.559	48.709	47.845	46.966	46.072	45.164
55.056	54.317	53.562	52.791	52.003	51.199	50.380	49.545	48.695	47.830	46.951	46.057	45.149
55.043	54.304	53.549	52.778	51.990	51.185	50.366	49.531	48.681	47.816	46.936	46.042	45.134
55.031	54.292	53.536	52.765	51.977	51.172	50.352	49.517	48.667	47.801	46.921	46.027	45.118
55.019	54.280	53.524	52.752	51.963	51.159	50.338	49.503	48.653	47.787	46.906	46.012	45.103
55.007	54.267	53.511	52.739	51.950	51.145	50.325	49.489	48.638	47.772	46.891	45.997	45.088
54.995	54.255	53.498	52.726	51.936	51.132	50.311	49.475	48.623	47.758	46.877	45.982	45.073
54.983	54.242	53.486	52.713	51.923	51.118	50.297	49.461	48.609	47.743	46.862	45.967	45.057
54.970	54.230	53.473	52.700	51.910	51.104	50.283	49.447	48.595	47.729	46.847	45.952	45.042
54.958	54.217	53.460	52.687	51.897	51.091	50.270	49.433	48.581	47.714	46.832	45.937	45.026
54.946	54.205	53.448	52.674	51.883	51.077	50.256	49.419	48.567	47.699	46.818	45.922	45.011
54.934	54.192	53.435	52.661	51.870	51.064	50.242	49.405	48.552	47.685	46.803	45.906	44.996
54.922	54.180	53.422	52.648	51.857	51.050	50.228	49.391	48.538	47.671	46.788	45.891	44.981
54.909	54.167	53.409	52.635	51.843	51.036	50.214	49.377	48.524	47.656	46.773	45.876	44.965
54.897	54.155	53.396	52.622	51.830	51.023	50.200	49.362	48.509	47.641	46.759	45.861	44.950
54.885	54.142	53.384	52.608	51.817	51.010	50.186	49.348	48.494	47.627	46.744	45.846	44.935
54.872	54.130	53.371	52.595	51.804	50.996	50.173	49.334	48.480	47.612	46.729	45.831	44.920
54.861	54.117	53.358	52.582	51.790	50.982	50.159	49.320	48.466	47.597	46.714	45.816	44.904
54.848	54.104	53.345	52.569	51.777	50.968	50.145	49.306	48.452	47.583	46.699	45.801	44.889
54.836	54.092	53.332	52.556	51.763	50.955	50.131	49.292	48.437	47.568	46.684	45.786	44.874
54.824	54.080	53.320	52.543	51.750	50.942	50.117	49.277	48.423	47.553	46.669	45.771	44.858
54.811	54.067	53.307	52.530	51.736	50.928	50.103	49.263	48.409	47.539	46.654	45.756	44.843
54.799	54.054	53.294	52.517	51.723	50.914	50.089	49.249	48.395	47.524	46.639	45.741	44.827
54.787	54.042	53.281	52.504	51.710	50.901	50.076	49.235	48.380	47.509	46.624	45.726	44.812
54.775	54.030	53.268	52.491	51.697	50.887	50.062	49.221	48.365	47.495	46.609	45.710	44.797
54.762	54.017	53.255	52.478	51.684	50.873	50.048	49.207	48.351	47.480	46.595	45.695	44.782
54.750	54.005	53.243	52.465	51.670	50.860	50.034	49.193	48.336	47.465	46.580	45.680	44.766
54.738	53.992	53.230	52.452	51.657	50.846	50.020	49.179	48.322	47.451	46.565	45.665	44.751
54.726	53.979	53.217	52.438	51.643	50.833	50.006	49.165	48.308	47.436	46.551	45.650	44.736
54.713	53.967	53.204	52.425	51.630	50.819	49.992	49.151	48.293	47.421	46.536	45.635	44.720
54.701	53.955	53.191	52.412	51.616	50.805	49.978	49.136	48.279	47.407	46.521	45.620	44.705
54.688	53.942	53.178	52.399	51.603	50.792	49.965	49.122	48.265	47.392	46.506	45.604	44.689
54.676	53.929	53.165	52.386	51.590	50.778	49.951	49.108	48.250	47.377	46.491	45.589	44.674
54.664	53.917	53.152	52.373	51.576	50.764	49.937	49.094	48.236	47.363	46.476	45.574	44.659
54.652	53.904	53.140	52.359	51.563	50.751	49.923	49.080	48.222	47.348	46.461	45.559	44.643
54.639	53.891	53.127	52.346	51.549	50.737	49.909	49.066	48.207	47.333	46.446	45.544	44.628
54.627	53.879	53.114	52.333	51.536	50.723	49.895	49.051	48.192	47.319	46.431	45.529	44.613
54.614	53.867	53.101	52.320	51.523	50.710	49.881	49.037	48.178	47.304	46.416	45.514	44.597
54.602	53.854	53.088	52.307	51.509	50.696	49.867	49.023	48.163	47.289	46.401	45.499	44.582
54.590	53.841	53.075	52.294	51.496	50.682	49.853	49.009	48.149	47.275	46.386	45.484	44.566

TABLE IV

(1) Channel	(2) 20 miles (IF beat)	(3) 20 miles (inter-modulation)	(4) 55 miles (adjacent channel)	(5) 60 miles (oscil-lator)	(6) 60 miles (sound image)	(7) 75 miles (picture image)
14	22	16–19	15	21	28	29
15	23	17–20	14, 16	22	29	30
16	24	14, 18–21	15, 17	23	30	31
17	25	14–15, 19–22	16, 18	24	31	32
18	26	14–16, 20 23	17, 19	25	32	33
19	27	14–17, 21–24	18, 20	26	33	34
20	28	15–18, 22–25	19, 21	27	34	35
21	29	16–19, 23–26	20, 22	28, 14	35	36
22	30, 14	17–20, 24–27	21, 23	29, 15	36	37
23	31, 15	18–21, 25–28	22, 24	30, 16	37	38
24	32, 16	19 22, 26–29	23, 25	31, 17	38	39
25	33, 17	20–23, 27–30	24, 26	32, 18	39	40
26	34, 18	21–24, 28–31	25, 27	33, 19	40	41
27	35, 19	22–25, 29–32	26, 28	34, 20	41	42
28	36, 20	23–26, 30–33	27, 29	35, 21	42, 14	33
29	37, 21	24–27, 31–34	28, 30	36, 22	43, 15	44, 14
30	38, 22	25–28, 32–35	29, 31	37, 23	44, 16	45, 15
31	39, 23	26–29, 33–36	30, 32	38, 24	45, 17	46, 16
32	40, 24	27–30, 34–37	31, 33	39, 25	46, 18	47, 17
33	41, 25	28–31, 35–38	32, 34	40, 26	47, 19	48, 18
34	42, 26	29–32, 36–39	33, 35	41, 27	48, 20	49, 19
35	43, 27	30–33, 37–40	34, 36	42, 28	49, 21	50, 20
36	44, 28	31–34, 38–41	35, 37	43, 29	50, 22	51, 21
37	45, 29	32–35, 39–42	36, 38	44, 30	51, 23	52, 22
38	46, 30	33–36, 40–43	37, 39	45, 31	52, 24	53, 23
39	47, 31	34–37, 41–44	38, 40	46, 32	53, 25	54, 24
40	48, 32	35–38, 42–45	39, 41	47, 33	54, 26	55, 25
41	49, 33	36–39, 43–46	40, 42	48, 34	55, 27	56, 26
42	50, 34	37–40, 44–47	41, 43	49, 35	56, 28	57, 27
43	51, 35	38–41, 45–48	42, 44	50, 36	57, 29	58, 28
44	52, 36	39–42, 46–49	43, 45	51, 37	58, 30	59, 29
45	53, 37	40–43, 47–50	44, 46	52, 38	59, 31	60, 30
46	54, 38	41–44, 48–51	45, 47	53, 39	60, 32	61, 31
47	55, 39	42–45, 49–52	46, 48	54, 40	61, 33	62, 32
48	56, 40	43–46, 50–53	47, 49	55, 41	62, 34	63, 33
49	57, 41	44–47, 51–54	48, 50	56, 42	63, 35	64, 34
50	58, 42	45–48, 52–55	49, 51	57, 43	64, 36	65, 35
51	59, 43	46–49, 53–56	50, 52	58, 44	65, 37	66, 36
52	60, 44	47–50, 54–57	51, 53	59, 45	66, 38	67, 37
53	61, 45	48–51, 55–58	52, 54	60, 46	67, 39	68, 38
54	62, 46	49–52, 56 59	53, 55	61, 47	68, 40	69, 39
55	63, 47	50–53, 57–60	54, 56	62, 48	69, 41	70, 40
56	64, 48	51–54, 58–61	55, 57	63, 49	70, 42	71, 41
57	65, 49	52 55, 59–62	56, 58	64, 50	71, 43	72, 42
58	66, 50	53–56, 60–63	57, 59	65, 51	72, 44	73, 43
59	67, 51	54–57, 61–64	58, 60	66, 52	73, 45	74, 44
60	68, 52	55–58, 62–65	59, 61	67, 53	74, 46	75, 45
61	69, 53	56 59, 63–66	60, 62	68, 54	75, 47	76, 46
62	70, 54	57–60, 64–67	61, 63	69, 55	76, 48	77, 47
63	71, 55	58–61, 65–68	62, 64	70, 56	77, 49	78, 48
64	72, 56	59–62, 66–69	63, 65	71, 57	78, 50	79, 49
65	73, 57	60–63, 67–70	64, 66	72, 58	79, 51	80, 50
66	74, 58	61–64, 68–71	65, 67	73, 59	80, 52	81, 51
67	75, 59	62–65, 69–72	66, 68	74, 60	81, 53	82, 52
68	76, 60	63–66, 70–73	67, 69	75, 61	82, 54	83, 53
69	77, 61	64–67, 71–74	68, 70	76, 62	83, 55	54
70	78, 62	65–68, 72–75	69, 71	77, 63	56	55

TABLE IV *(Continued)*

(1) Channel	(2) 20 miles (IF beat)	(3) 20 miles (intermodulation)	(4) 55 miles (adjacent channel)	(5) 60 miles (oscillator)	(6) 60 miles (sound image)	(7) 75 miles (picture image)
71	79, 63	66–69, 73–76	70, 72	78, 64	57	56
72	80, 64	67–70, 74–77	71, 73	79, 65	58	57
73	81, 65	68–71, 75–78	72, 74	80, 66	59	58
74	82, 66	69–72, 76–79	73, 75	81, 67	60	59
75	83, 67	70–73, 77–80	74, 76	82, 68	61	60
76	68	71–74, 78–81	75, 77	83, 69	62	61
77	69	72–75, 79–82	76, 78	70	63	62
78	70	73–76, 80–83	77, 79	71	64	63
79	71	74–77, 81–83	78, 80	72	65	64
80	72	75–78, 82–83	79, 81	73	66	65
81	73	76–79, 83	80, 82	74	67	66
82	74	77–80	81, 83	75	68	67
83	75	78–81	82	76	69	68

NOTE: The parenthetical reference beneath the mileage figures in columns 2 through 7, inclusive, indicate, in abbreviated form, the bases for the required mileage separations. For a discussion of these bases, see the "Sixth Report and Order" of the Commission (FCC 52–294). The hyphenated numbers listed in column (3) are both inclusive.

§ 3.699 **Engineering charts.** [See Figures 1 to 12.]

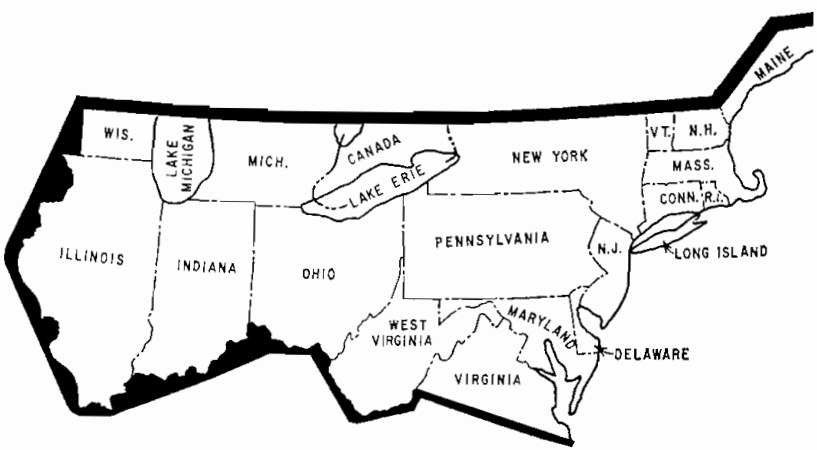


FIGURE 1. Zone I.

FIGURE 2. Zone III.

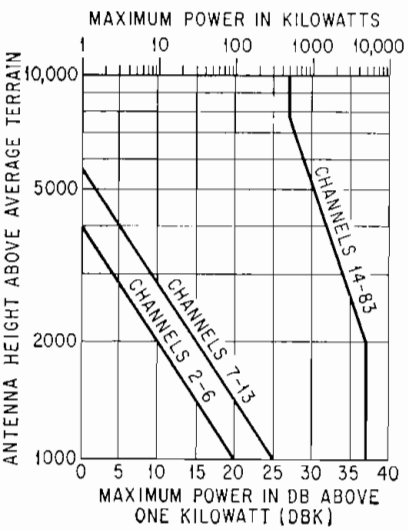


FIGURE 3. Maximum power vs. antenna height for Zone I.

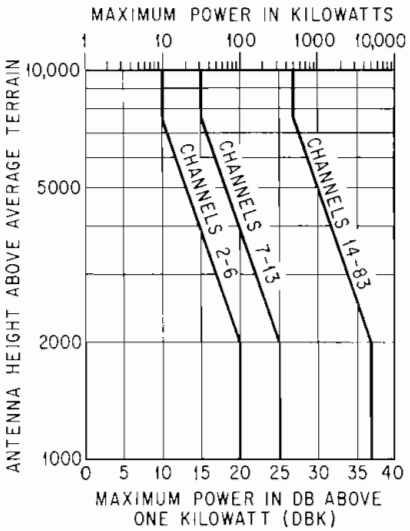


FIGURE 4. Maximum power vs. antenna height for Zones II and III.

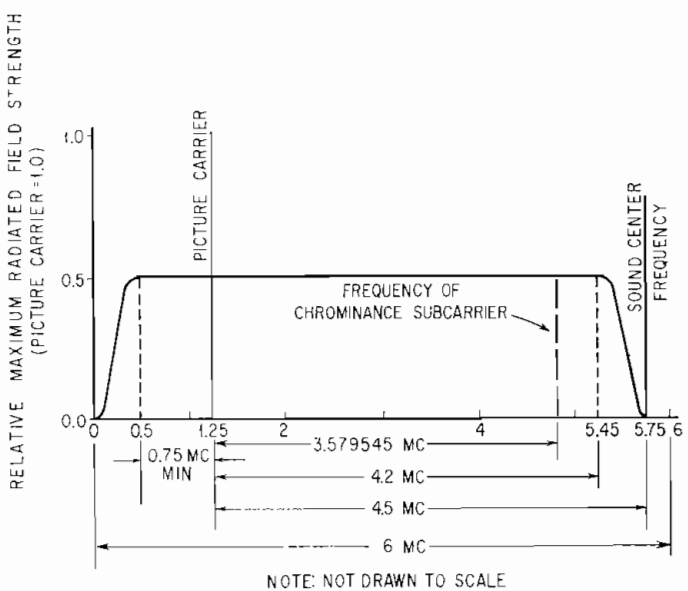
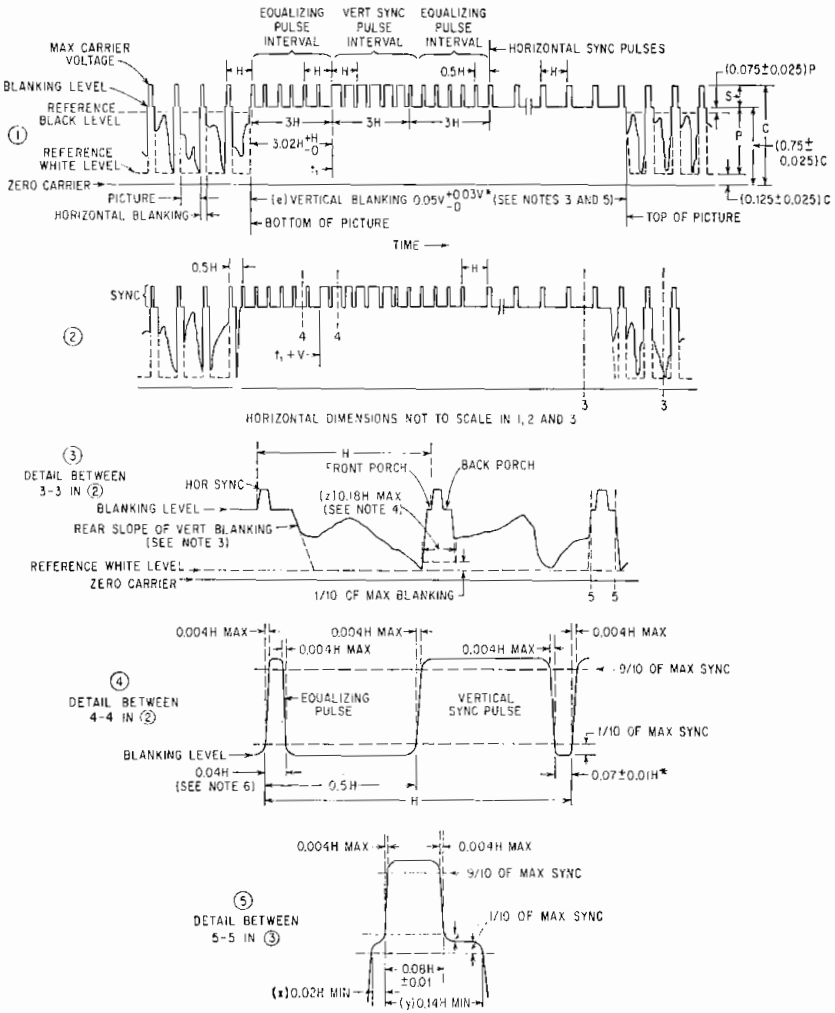


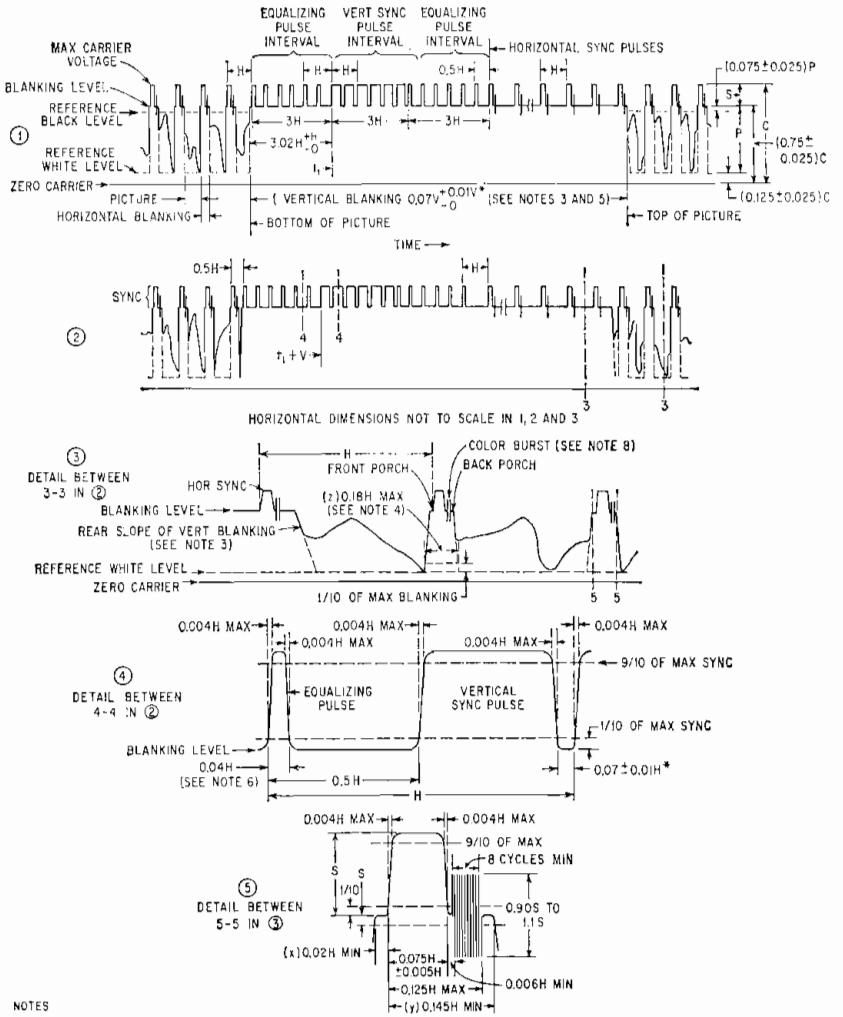
FIGURE 5. Idealized picture transmission amplitude characteristic.



NOTES

1 H = TIME FROM START OF ONE LINE TO START OF NEXT LINE
2 V = TIME FROM START OF ONE FIELD TO START OF NEXT FIELD
3 LEADING AND TRAILING EDGES OF VERTICAL BLANKING SHOULD BE COMPLETE IN LESS THAN 0.1H
4 LEADING AND TRAILING SLOPES OF HORIZONTAL BLANKING MUST BE STEEP ENOUGH TO PRESERVE MINIMUM AND MAXIMUM VALUES OF (x+y) AND (z) UNDER ALL CONDITIONS OF PICTURE CONTENT
*5 DIMENSIONS MARKED WITH ASTERISK INDICATE THAT TOLERANCES GIVEN ARE PERMITTED ONLY FOR LONG TIME VARIATIONS AND NOT FOR SUCCESSIVE CYCLES
6 EQUALIZING PULSE ARE SHALL BE BETWEEN 0.45 AND 0.5 OF AREA OF A HORIZONTAL SYNC PULSE
7 REFER TO TEXT FOR FURTHER EXPLANATIONS AND TOLERANCES

FIGURE 6. Television synchronizing waveform for monochrome transmission only.



NOTES

1. H = TIME FROM START OF ONE LINE TO START OF NEXT LINE.
2. V = TIME FROM START OF ONE FIELD TO START OF NEXT FIELD.
3. LEADING AND TRAILING EDGES OF VERTICAL BLANKING SHOULD BE COMPLETE IN LESS THAN 0.1H.
4. LEADING AND TRAILING SLOPES OF HORIZONTAL BLANKING MUST BE STEEP ENOUGH TO PRESERVE MINIMUM AND MAXIMUM VALUES OF (x+y) AND (z) UNDER ALL CONDITIONS OF PICTURE CONTENT.
*5 DIMENSIONS MARKED WITH ASTERISK INDICATE THAT TOLERANCES GIVEN ARE PERMITTED ONLY FOR LONG TIME VARIATIONS AND NOT FOR SUCCESSIVE CYCLES.
6. EQUALIZING PULSE AREA SHALL BE BETWEEN 0.45 AND 0.5 OF AREA OF A HORIZONTAL SYNC PULSE.
7. COLOR BURST FOLLOWS EACH HORIZONTAL PULSE, BUT IS OMITTED FOLLOWING THE EQUALIZING PULSES AND DURING THE BROAD VERTICAL PULSES
8. COLOR BURSTS TO BE OMITTED DURING MONOCHROME TRANSMISSION.
9. THE BURST FREQUENCY SHALL BE 3.579545MC. THE TOLERANCE ON THE FREQUENCY SHALL BE ±10 CYCLES WITH A MAXIMUM RATE OF CHANGE OF FREQUENCY NOT TO EXCEED 1/10 CYCLE PER SECOND PER SECOND.
10. THE HORIZONTAL SCANNING FREQUENCY SHALL BE 2/455 TIMES THE BURST FREQUENCY.
11. THE DIMENSIONS SPECIFIED FOR THE BURST DETERMINE THE TIMES OF STARTING AND STOPPING THE BURST, BUT NOT ITS PHASE. THE COLOR BURST CONSISTS OF AMPLITUDE MODULATION OF A CONTINUOUS SINE WAVE.
12. DIMENSION "P" REPRESENTS THE PEAK EXCURSION OF THE LUMINANCE SIGNAL FROM BLANKING LEVEL, BUT DOES NOT INCLUDE THE CHROMINANCE SIGNAL. DIMENSION "S" IS THE SYNC AMPLITUDE ABOVE BLANKING LEVEL. DIMENSION "C" IS THE PEAK CARRIER AMPLITUDE
13. REFER TO TEXT FOR FURTHER EXPLANATIONS AND TOLERANCES

FIGURE 7. Television synchronizing waveform for color transmission.

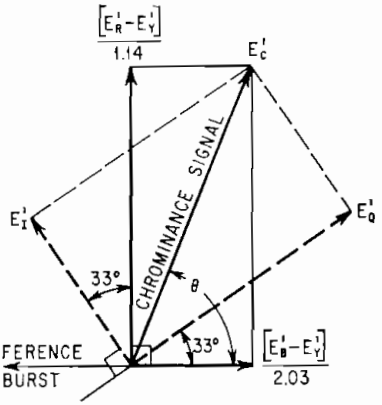


FIGURE 8

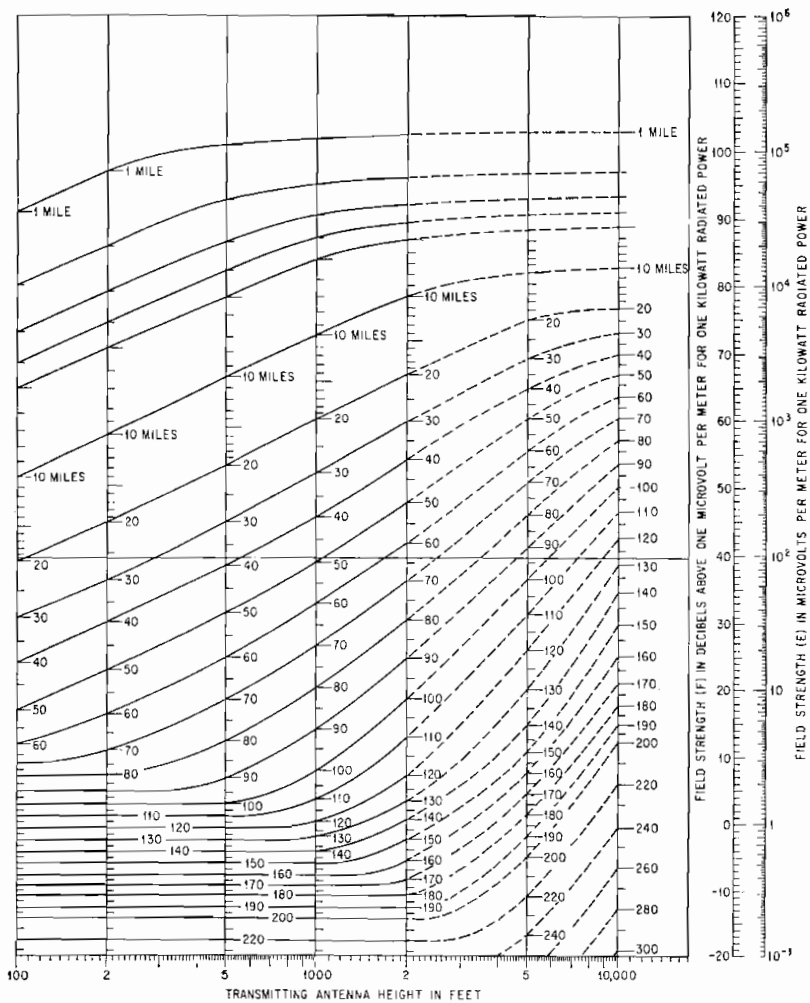


FIGURE 9. Television Channels 2–6, 14–83. Estimated field strength exceeded at 50 percent of the potential receiver locations for at least 50 percent of the time at a receiving antenna height of 30 feet.

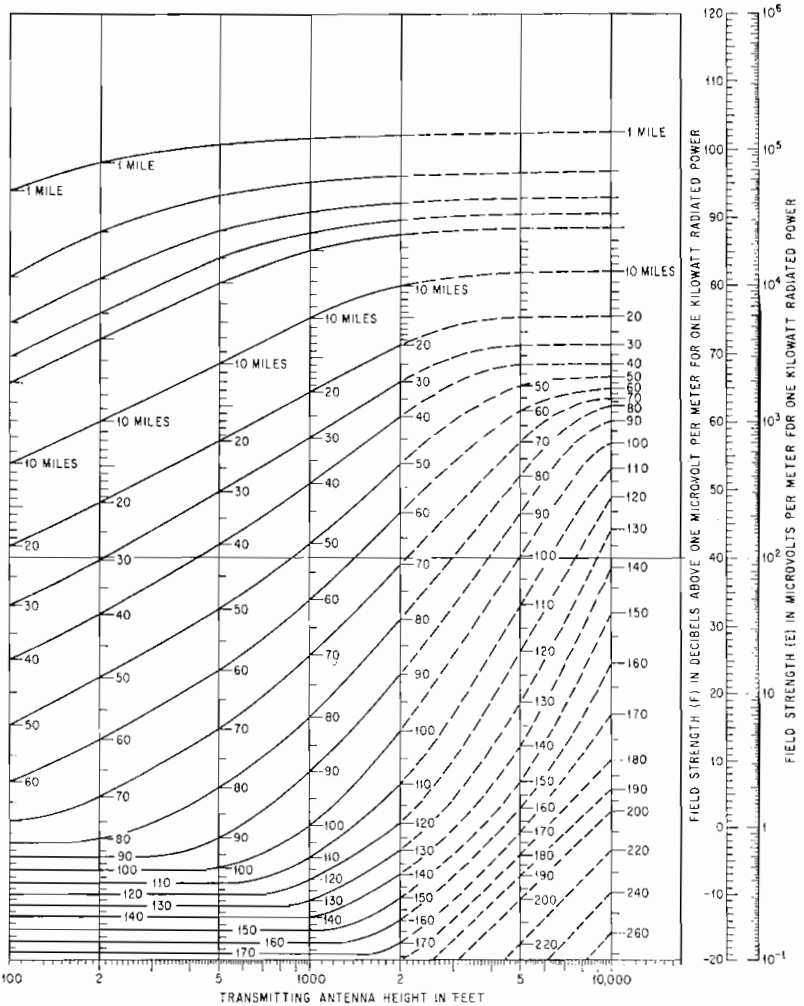


FIGURE 10. Television Channels 7–13. Estimated field strength exceeded at 50 percent of the potential receiver locations for at least 50 percent of the time at a receiving antenna height of 30 feet.

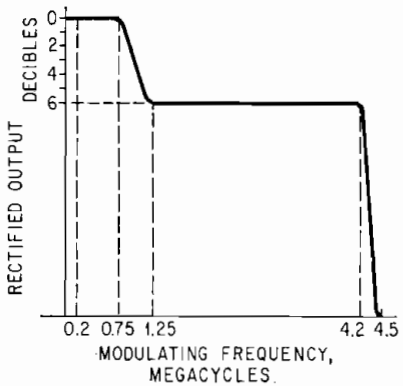


FIGURE 11. Assumed ideal detector output.

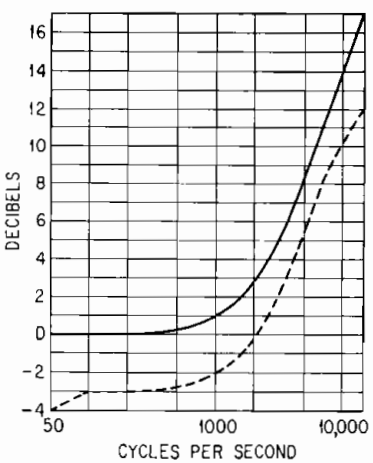


FIGURE. 12. Standard pre-emphasis curve. Time constant 75 microseconds (solid line). Frequency response limits shown by use of solid and dashed lines.

SUBPART F—INTERNATIONAL BROADCAST STATIONS

Definitions and Allocation of Facilities

§ 3.701 Definitions. The following definitions apply to terminology employed in this subpart:

(a) *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.

(b) *Frequency-hour.* One frequency used for one hour.

(c) *Day.* Any twenty-four hour period beginning 0000 EST and ending 2400 EST.

(d) *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.

(e) *Vernal equinox season.* That period of any calendar year starting at 0000 EST on 1 February and ending at 2400 EST on 30 April.

(f) *Summer season.* That period of any calendar year starting at 0000 EST on 1 May and ending at 2400 EST on 31 July.

(g) *Autumnal equinox season.* That period of any calendar year starting at 0000 EST on 1 August and ending at 2400 EST on 31 October.

(h) *Winter season.* That period of any calendar year starting at 0000 EST on 1 November and ending at 2400 EST on 31 January.

(i) *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.

(j) *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.

(k) *Reference month.* The middle month of any season listed in § 3.704 "Daily Frequency Hour Availability Table."

(l) *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.

(m) *Target area.* Geographic area in which the reception of particular programs is specifically intended and in which adequate broadcast coverage is contemplated.

(n) *Contract operation.* Any non-Government 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.

(o) *Private operation.* Any non-Government operation of an International Broadcast station which is not contract operation.

§ 3.702 Assignment and use of frequencies.

NOTE: Paragraphs (c) through (k) do not apply to stations when engaged in contract operations as defined in § 3.701.

(a) Frequencies will be assigned by the Commission from time to time and in accordance with the provisions of this section, to authorized international broadcast stations for use at specified hours and for transmission to specified target areas. Licensees may request the assignment of specific frequencies for transmission during given hours of operation to specified target areas by filing informal requests in triplicate with the Commission no less than 15 days prior to the start of a new season. Such requests will be honored to the extent that interference and propagation conditions permit and that they are otherwise in accordance with the provisions of this section. Requests for changes in frequency or hour assignments at other times during the year or which are received less than 15 days before the start of a new season

will be processed as rapidly as practical. All specific frequency authorizations will be made only on the express understanding that they are subject to immediate cancellation or change without hearing whenever the Commission determines that interference or propagation conditions so require and that each assignment of frequency hours for a given season is unique unto itself and not subject to renewal, with the result that completely new assignments must be secured for the forthcoming season. Where a station is simultaneously engaged in both private and contract broadcasting, as defined in § 3.701, it must receive separate frequency hour authorizations for each of these operations.

(b) Any foreign standard target areas shown in Figure 1 of § 3.792 may be specified by the licensee, in which case field intensity calculations should be based on the transmission path between the corresponding reference points listed in § 3.703. In the event a broadcast is to be directed to more than one target area in the same region, the *primary* target area should be specified and the reasons for selecting that particular target area given, with special reference to the nature and special suitability, if any, of the programming proposed. Field intensity calculations should be based on the transmission path to the standard reference point in § 3.703 for the primary target area. In the event a licensee wishes to specify target areas other than those shown in Figure 1 of § 3.792, adequate justification must be given to show that the use of standard target areas is inappropriate, with special reference given to any specialized programming proposed which appears suitable only for the nonstandard target areas designated. When nonstandard target areas are proposed, special reference points must be specified (by geographical coordinates) and reasonably chosen so as to insure complete and adequate coverage of the target areas.

(c) Frequencies assigned by the Commission will be within the following bands:

	Kilocycles
Band A	5950–6200
Band B	9500–9775
Band C	11700–11975
Band D	15100–15450
Band E	17700–17900
Band F	21450–21750
Band G	25600–26100

(d) No frequency will be assigned which would provide a Delivered Median Field Intensity, either measured or calculated, of less than 150 uv/m—50 percent or 43.5 decibels above one uv/m at the distant foreign target area. (This value of Delivered Median Field Intensity is expected to provide protection against atmospheric and industrial noise for at least 90 percent of each hour during 90 percent of the days of the month.) With each request for frequency assignment, licensees must submit computations which adequately show that this requirement would be met.

NOTE: Standard OWF propagation curves and Delivered Median Field Intensity curves for the various hours and seasons throughout the eleven year sunspot cycle have been computed for transmission paths between standard reference points listed in § 3.703 for the standard target areas shown in Figure 1 of § 3.792. These curves, which were developed and used at the Mexico City High Frequency Broadcasting Conference (1948–1949), are available at the Commission's Washington offices and may be used in calculating the propagation data which licensees are required to provide under these Rules. The methods used in computing these data are described in Chapter 7, paragraph 7.7 of the National Bureau of Standards Circular 462. In lieu of that data, and in all cases where nonstandard target areas are specified as provided in paragraph (b) of this section, licensees must develop their own propagation curves for use in computing values of OWF and Delivered Median Field Intensity for the particular transmission paths involved. In doing so, use may be made of the published propagation data of the National Bureau of Standards known as CRPL Series D, "Basic Radio Propagation Predictions," published monthly in conjunction with National Bureau of Standards Circular 465, "Instructions for the Use of Basic Radio Propagation Predictions." These publications are available from the Superintendent of Documents, Washington 25, D.C. A typical example of a computation for a transmission path between standard target areas is from New York (Area 8) to Buenos

Aires (Area 15). The Delivered Median Field Intensity for the equinox season, sunspot 5, and for the 6 Mc band for the hours 0200 to 0400 GMT is indicated by the appropriate propagation curve as 24 decibels above one microvolt per meter for 1 kw radiated power. The transmitter power output of 20 decibels (100 kw) is added. The transmitting antenna gain of 12 decibels is added. The resultant total (56 decibels) exceeds the level of 43.5 decibels required to deliver a median field intensity of 150 uv/m at the distant target area.

(e) Frequencies assigned will be as near as possible to the Optimum Working Frequency. In no case will they exceed the Maximum Usable Frequency for more than a total of 15 minutes during any period of transmission. With each request for frequency assignment, licensees must submit computations which adequately show that this requirement would be met. (See note in paragraph (d) of this section regarding methods for computation.)

(f) Not more than one frequency will be authorized for use at any one time for any one program transmission except in instances where a program is intended for reception in more than one target area and the intended target areas cannot be served by a single frequency.

(g) No authorization for use of a particular frequency will be issued which fails to provide a minimum co-channel Delivered Median Field Intensity protection ratio of 40 db to the transmissions of other broadcasting stations at the reference point in the target area being served by such stations which, in the opinion of the Commission, have priority of assignment.

(h) Authorization for use of a particular frequency will not be issued which does not provide a minimum adjacent channel Delivered Median Field Intensity protection ratio of 11 db to the transmissions of other international broadcasting stations at the reference points in the target areas being served by such stations which, in the opinion of the Commission, have priority of assignment.

(i) Any frequency authorized to an international broadcast station shall also be available for assignment to other international broadcast stations.

(j) Not more than one frequency shall be used simultaneously under the same authorization and call letter and equipment installation number designation.

(k) Subject to all other pertinent provisions of this subpart, the total maximum number of frequency-hours which will be authorized to all licensees of private international broadcast stations for private operation combined in any frequency band for any pertinent season during any one day will be those in § 3.704 less the number of frequency-hours in these bands scheduled for use by both (1) government international broadcasting stations, and (2) international broadcast stations licensed by the Commission to use frequencies in these bands for contract operations.

(l) In the event the total number of frequency hours in any band scheduled for both (1) government international broadcasting stations, and (2) international broadcast stations licensed by the Commission to use frequencies in these bands for contract operations equals or exceeds 75 percent of the frequency hour figures given in § 3.704, the maximum number of frequency-hours which will be authorized to all licensees of international broadcast stations for private operation in any frequency band for any pertinent season during any one day will be 25 percent of the frequency hours shown in § 3.704.

(m) If the requests for international broadcasting frequency-hours for private operation in any band or bands exceed those available under the terms of these Rules, in the absence of any voluntary agreement for reduction of frequency-hours requested, the Commission will designate all requests for frequency-hours in the band or bands in question for hearing. Pending such hearing the Commission will temporarily assign the available frequency-hours equally among the several applicants: *Provided, however,* That with respect to such temporary allocation:

(1) An existing license shall not, to the extent such frequency-hours are available, receive less than the number of frequency-hours utilized during the preceding season or requested for the forthcoming season, whichever is lesser.

(2) Where the number of frequency-hours available for private international broad-

casting during a forthcoming season are insufficient to permit existing licensees to secure a temporary allocation equal to that previously utilized or requested, whichever is lesser, the allocation shall be pro-rated among such persons in a manner which will give them a share of the available frequency-hours proportionate to that utilized in the preceding season.

(3) In any event, where an applicant's share of the available frequency hours would be more than requested, the surplus shall be divided among the remaining applicants in the manner herein prescribed.

§ 3.703 Latitude and longitude of areas used for field intensity calculations.

Area No.	Latitude degrees	Longitude degrees	Area No.	Latitude degrees	Longitude degrees
1	65 N.	150 W.	34	55 N.	140 E.
2	60 N.	125 W.	35	55 N.	160 E.
3	60 N.	100 W.	36	40 N.	25 W.
4	60 N.	80 W.	37	30 N.	0°
5	70 N.	40 W.	38	30 N.	20 E.
6	40 N.	120 W.	39	30 N.	40 E.
7	40 N.	100 W.	40	30 N.	60 E.
8	40 N.	80 W.	41	20 N.	80 E.
9	50 N.	60 W.	42	40 N.	85 E.
10	20 N.	100 W.	43	35 N.	100 E.
11	10 N.	80 W.	44	30 N.	120 E.
12	10 S.	70 W.	45	35 N.	140 E.
13	10 S.	50 W.	46	10 N.	5 W.
14	30 S.	60 W.	47	10 N.	20 E.
15	25 S.	50 W.	48	10 N.	40 E.
16	45 S.	70 W.	49	15 N.	100 E.
17	65 N.	20 W.	50	10 N.	120 E.
18	65 N.	15 E.	51	0°	140 E.
19	65 N.	40 E.	52	10 S.	20 E.
20	70 N.	60 E.	53	10 S.	40 E.
21	70 N.	80 E.	54	5 S.	105 E.
22	70 N.	100 E.	55	15 S.	140 E.
23	70 N.	120 E.	56	20 S.	165 E.
24	65 N.	140 E.	57	30 S.	25 E.
25	65 N.	160 E.	58	25 S.	120 E.
26	65 N.	180 E.	59	35 S.	150 E.
27	50 N.	0°	60	40 S.	170 E.
28	50 N.	20 E.	61	20 N.	160 W.
29	50 N.	40 E.	62	20 S.	170 W.
30	50 N.	60 E.	63	20 S.	150 W.
31	50 N.	80 E.	64	15 N.	145 E.
32	50 N.	100 E.	65	10 N.	170 E.
33	50 N.	120 E.			

§ 3.704 **Daily frequency hour availability table.**

Band	Season	Sunspot Numbers								
		0–20	20–35	35–50	50–65	65–80	80–95	95–110	110–125	125–140
Mc.										
6	June	0	0	0	0	0	0	0	0	0
	March–September	29	21	14	7	0	0	0	0	0
	December	45	47	48	49	50	.....	.....	.....	32
9	June	34	30	27	24	21	16	11	5	2
	March–September	52	42	36	31	27	23	19	12	10
	December	54	50	47	44	42	39	36	33	32
11	June	53	50	48	46	45	39	31	23	14
	March–September	47	50	52	54	55	49	40	31	24
	December	31	34	36	38	39	34	30	26	22
15	June	84	88	91	94	96	87	79	69	58
	March–September	49	54	58	61	64	47	33	21	7
	December	35	35	35	35	35	33	31	29	27
17	June	23	32	40	47	53	59	66	75	84
	March–September	23	22	22	21	20	24	29	34	39
	December	14	18	21	23	25	23	20	17	16
21	June	2	9	14	18	22	39	52	68	80
	March–September	0	9	16	22	27	36	45	56	65
	December	6	11	15	18	21	29	36	47	53
26	.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Totals	June	196	209	220	229	237	240	239	239	238
	March–September	200	198	198	196	193	179	166	154	145
	December	185	195	202	207	212	158	153	152	181

(1) No limit.

Administrative Procedure

§ 3.710 **Cross reference.** See § 1.300 to 1.364, Subpart D of Part 1 of this chapter, for general requirements as to applications, filing of applications and description of application forms, other forms and information to be filed with the Commission, the manner in which applications are processed, and provisions applying to action on applications.

§ 3.711 **Application for international broadcast stations.** (a) If the application is for a construction permit or for modification of an existing authorization, FCC Form 309 shall be filed; if for a license, FCC Form 310 shall be filed; if for a renewal of license, FCC Form 311 shall be filed.

NOTE: Until these forms are revised, information required by these Rules and not required by the forms shall be submitted as a supplement to the application and will be considered a part thereof.

(b) Authorizations issued to international broadcast stations by the Commission will not specify the frequencies or hours of use, but will be authorizations to permit the construction or use of a particular transmitting equipment combination and related antenna systems for international broadcasting.

NOTE: Requests for the use of frequencies and frequency hours for transmissions to specific target areas should be submitted separately as provided in § 3.702.

(c) In the case of applications for authorizations to permit contract operations, as defined in § 3.701(n), the contracting agency and contract number should be indicated for each operation.

§ 3.712 **Notification of filing of applications.** In order to minimize harmful interference at the National Radio Astronomy Observatory site located at Green Bank, Pocahontas County, West Virginia, and at the Naval Radio Research Observatory at Sugar Grove, Pendleton County, West Virginia, an applicant for authority to construct a new international broadcast station or for authority to make changes in the frequency, power, antenna height, or antenna directivity of an existing station within the

area bounded by 39° 15′ N on the north, 78° 30′ W on the east, 37° 30′ N on the south and 80° 30′ W on the west shall, at the time of filing such application with the Commission, simultaneously notify the Director, National Radio Astronomy Observatory, P.O. Box #2, Green Bank, West Virginia, in writing, of the technical particulars of the proposed station. Such notification shall include the geographical coordinates of the antenna, antenna height, antenna directivity if any, proposed frequency, type of emission, and power. In addition, the applicant shall indicate in his application to the Commission the date notification was made to the Observatory. After receipt of such applications, the Commission will allow a period of twenty (20) days for comments or objections in response to the notifications indicated. If an objection to the proposed operation is received during the twenty-day period from the National Radio Astronomy Observatory for itself or on behalf of the Naval Radio Research Observatory, the Commission will consider all aspects of the problem and take whatever action is deemed appropriate.

§ 3.716 **Equipmeut tests.** (a) During the process of construction of an international broadcast station, the permittee after notifying the Commission and Engineer in Charge of the radio district in which the station is located may, without further authority of the Commission, conduct equipment tests for the purpose of such adjustments and measurements as may be necessary to assure compliance with the terms of the construction permit, the technical provisions of the application therefor, and the rules and regulations. No programming shall be conducted during equipment tests.

(b) The Commission may notify the permittee to conduct no tests or may cancel, suspend, or change the date for the beginning of equipment tests as and when such action may appear to be in the public interest, convenience, and necessity.

(c) Equipment tests may be continued so long as the construction permit shall remain valid.

(d) Inspection of a station will ordinarily be required during the equipmeut test period. After construction and after adjustments and measurements have been completed to show compliance with the terms of the construction permit, the technical provisions of the application therefor, and the rules and regulations, the permittee should notify the Engineer in Charge of the radio district in which the station is located that it is ready for inspection.

(e) The authorization for tests embodied in this section shall not be construed as constituting a license to operate but as a necessary part of construction.

§ 3.717 [Reserved.]

§ 3.718 **Normal license period.** All international broadcast station licenses will be issued so as to expire at the hour of 3 a.m. eastern standard time and will be issued for a normal license period of 1 year expiring November 1.

Licensing Policies

§ 3.731 **Licensing requirements; necessary showing.** A license for an international broadcast station will be issued only after a satisfactory showing has been made in regard to the following, among others:

(a) That there is a need for the international broadcast service proposed to be rendered.

(b) That the necessary program sources are available to the applicant to render an effective international service.

(c) That directive antennas and other technical facilities will be employed to deliver maximum signals to the target area or areas for which the service is designed.

(d) That the production of the program service and the technical operation of the proposed station will be conducted by qualified persons.

(e) That the applicant is technically and financially qualified and possesses adequate technical facilities to carry forward the service proposed.

(f) That the public interest, convenience and necessity will be served through the operation of the proposed station.

Equipment

§ 3.751 **Power requirement.** No international broadcast station will be authorized to install equipment or licensed for operation with a power less than 50 kilowatts.

§ 3.752 **Frequency control.** The transmitter of each international broadcast station shall be equipped with automatic frequency control apparatus so designed and constructed that it is capable of maintaining the operating frequency within 0.003% of the assigned frequency.

§ 3.753 **Antenna.** The antenna shall be so designed and operated that the signal (field intensity) toward the specific foreign country or countries served shall be at least 3.16 times the average effective signal from the station (power gain of 10).

§ 3.754 **Frequency monitors.** (a) The licensee of each international broadcast station shall operate at the transmitter a frequency monitor independent of the frequency control of the transmitter.

(b) The frequency monitor shall be designed and constructed in accordance with good engineering practice and shall have an accuracy sufficient to determine that the operating frequency is within one-half of the allowed tolerance.

§ 3.755 **Modulation monitors.** The licensee of each international broadcast station shall have in operation at the transmitter a modulation monitor.

§ 3.756 **Required transmitter performance.** (a) The construction, installation, operation, and performance of the international broadcast transmitter system shall be in accordance with good engineering practice.

NOTE: The establishment of specific levels of attenuation for spurious emissions will be the subject of further Rule Making in Docket 10962 pending the completion of additional studies of this matter.

(b) In addition to the requirements of paragraph (a) of this section in the event spurious emissions cause harmful interference, such additional steps as may be necessary to eliminate the interference must be taken immediately by the licensee.

§ 3.757 **Auxiliary transmitters.** Upon showing that a need exists for the use of auxiliary transmitters in addition to the regular transmitters of an international broadcast station, a license therefor may be issued provided that:

(a) Auxiliary transmitters may be installed either at the same location as the main transmitters or at another location.

(b) A licensed operator shall be in control whenever auxiliary transmitters are placed in operation.

(c) The auxiliary transmitters shall be maintained so that they may be put into immediate operation at any time for the following purposes:

(1) The transmission of the regular programs upon the failure of the main transmitters.

(2) The transmission of regular programs during maintenance or modification work on the main transmitter, necessitating discontinuance of its operation for a period not to exceed 5 days. (This includes the equipment changes which may be made without authority as set forth elsewhere in the Rules and Regulations or as authorized by the Commission by letter or by construction permit. Where such operation is required for periods in excess of 5 days, request therefor shall be in accordance with § 1.324 of this chapter.)

(3) Upon request by a duly authorized representative of the Commission.

(d) The auxiliary transmitters shall be tested at least once each week to determine that they are in proper operating condition and that they are adjusted to the proper frequency except that in the case of operation in accordance with paragraph (c) of this section during any week, the test in that week may be omitted provided the operation under paragraph (c) of this section is satisfactory. A record shall be kept of the time and result of each test. Such records shall be retained for a period of two years.

(e) The auxiliary transmitters shall be equipped with satisfactory control equipment which will enable the maintenance of the frequency emitted by the station within the limits prescribed by the regulations in this part.

(f) The operating power of an auxiliary transmitter may be less than the authorized power of the main transmitters, but in no event shall it be greater than such power.

§ 3.758 **Alternate main transmitters.** The licensee of an international broadcast station may be licensed for alternate main transmitters provided that a technical need for such alternate transmitters is shown and that the following conditions are met:

(a) Both transmitters are located at the same place.

(b) Both transmitters shall have the same power rating.

(c) Both transmitters shall meet the construction, installation, operation, and performance requirements of good engineering practice.

§ 3.759 **Changes in equipment and antenna system.** Licensees of international broadcast stations shall observe the following provisions with regard to changes in equipment and antenna system:

(a) No changes in equipment shall be made:

(1) That would result in the emission of signals outside of the authorized channel.

(b) Specific authority, upon filing formal application (FCC Form 309) therefor, is required for any of the following changes:

(1) Changes involving an increase or decrease in the power rating of the transmitters.

(2) A replacement of the transmitters as a whole.

(3) Change in the location of the transmitting antenna.

(4) Change in location of main studio, if it is proposed to move the main studio to a different city from that specified in the license.

(5) Change in the power delivered to the antenna.

(6) Change in frequency control and/or modulation system.

(c) Other changes, except as above provided for in this section, may be made at any time without the authority of the Commission, provided that the Commission shall be promptly notified thereof and such changes shall be shown in the next application for renewal of license.

Technical Operation

§ 3.761 **Time of operation.** (a) All international broadcast stations will be licensed for unlimited time operations except as may be directed by the Commission from time to time. In an emergency however, when, due to causes beyond the control of the licensee, it becomes impossible to continue operation, the station may cease operation for a period not to exceed 10 days, provided that the Commission and the Engineer in Charge of the radio district in which the station is located shall be notified in writing immediately after the emergency develops.

(b) Persons desiring to enter into a voluntary sharing arrangement of an international channel may file application therefor with the Commission. Copies of the time-sharing agreement should be filed with the application.

§ 3.762 **Station inspection.** The licensee of any international broadcast station shall make the station available for inspection by representatives of the Commission at any reasonable hour.

§ 3.763 **Station license, posting of.** The original of each station license shall be posted in the transmitter room.

§ 3.764 **Operator requirements.** One or more licensed radiotelephone first class operators shall be on duty at the place where the transmitting apparatus of each station is located and in actual charge thereof whenever it is being operated. The original license (or FCC Form 759) of each station operator shall be posted at the place where he is on duty. The licensed operator on duty and in charge of an international broadcast transmitter may, at the discretion of the licensee, be employed for other duties or for the operation of another station or stations in accordance with the class of operator's license which he holds and by the rules and regulations governing such stations. However, such duties shall in nowise interfere with the operation of the broadcast transmitter.

§ 3.765 **Operating power; how determined.** The operating power, and its maintenance, of each international broadcast station shall be in conformity with good engineering practice.

§ 3.766 **Modulation.** The percentage of modulation of the transmissions shall be maintained as high as possible consistent with good quality of transmission and good broadcast practice and in no case less than 50 percent nor more than 100 percent on peaks of frequent recurrence during any selection which normally is transmitted at the highest level of the program under consideration.

§ 3.767 **Frequency tolerance.** The operating frequencies of international broadcast station transmitters shall, at all times, be maintained within the frequency tolerances specified in § 3.752.

§ 3.768 **Antenna structure, marking and lighting.** Where an antenna structure(s) is required to be painted or lighted see § 17.37, *Inspection of tower lights and associated control equipment;* § 17.39, *Cleaning and repainting;* § 17.40, *Time when lights shall be exhibited;* § 17.41, *Spare lamps;* and § 17.42, *Lighting equipment;* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 3.769 **Discontinuance of operation.** The licensee of each station, except stations operating in Alaska, shall notify the Engineer in Charge of the radio district in which the station is located of any of the following changes in the status of such station at least two days before such change:

(a) Temporary discontinuance of operation for a period of ten days or more;

(b) The date of resumption of operation after temporary discontinuance of operation for a period of ten days or more;

(c) Permanent discontinuance of operation.

In all cases of permanent discontinuance of operation the licensee shall, in addition to notifying the Engineer in Charge of the radio district in which the station is located of intention to discontinue operation, immediately forward the station license to the Washington, D.C., office of the Commission for cancellation.

Other Operation

§ 3.781 **Logs.** The licensee or permittee of each international broadcast station shall maintain program and operating logs in the following manner:

(a) In the program log:

(1) An entry of the time each station identification announcement (call letters and location) is made.

(2) An entry briefly describing each program broadcast, such as "music," "drama," "speech," etc., together with the name or title thereof, language, and the sponsor's name, with the time of the beginning and ending of the complete program.

(3) An entry showing, for each program of network origin, the name of the network originating the program.

(b) In the operating log:

(1) An entry of the time the station begins to supply power to the antenna, and the time it stops.

(2) An entry of the time the program begins and ends.

(3) An entry of each interruption to the carrier wave, its cause, and duration.

(4) An entry of the following each 30 minutes:

(i) Operating constants of last radio stage of the transmitter (total plate current and plate voltage).

(ii) Frequency monitor reading.

(5) A log must be kept of all experimental operation. If the entries required above are not applicable thereto, then the entries shall be made so as to fully describe the operation.

(c) Where an antenna structure(s) is required to be illuminated, see § 17.38, *Recording of tower light inspections in the station record,* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 3.782 **Logs; retention of.** Logs of international broadcast stations shall be retained by the licensee or permittee for a period of two 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 per-

mittee 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.

§ 3.783 **Logs; by whom kept.** Each log shall be kept by the person or persons competent to do so, having actual knowledge of the facts required, who shall sign the log when starting duty and again when going off duty. The logs shall be made available upon request by an authorized representative of the Commission.

§ 3.784 **Log form.** The log shall be kept in an orderly manner, in suitable form, and in such detail that the data required for the particular class of station concerned are readily available. Key letters or abbreviations may be used if proper meaning or explanation is contained elsewhere in the log.

§ 3.785 **Correction of logs.** No log or portion thereof shall be erased, obliterated, or willfully destroyed within the period of retention provided by the rules. Any necessary correction may be made only by the person originating the entry who shall strike out the erroneous portion, initial the correction made, and indicate the date of correction.

§ 3.786 **Rough logs.** Rough logs may be transcribed into condensed form, but in such case, the original log or memoranda and all portions thereof shall be preserved and made a part of the complete log.

§ 3.787 **Station identification.** (a) A licensee of an international broadcast station shall make station identification announcement (call letters and location), at the beginning and ending of each time of operation and during the operation on the hour.

(b) Station identification, program announcements, and oral continuity shall be made with international significance (language particularly) which is designed for the foreign country or countries for which the service is primarily intended.

(c) Identification announcements during operation need not be made when to make such announcement would interrupt a single consecutive speech, play, religious service, symphony concert, or any type of production. In such cases the identification announcement shall be made at the first interruption of the entertainment continuity and at the conclusion thereof.

§ 3.788 **Service; commercial or sponsored programs.** (a) A licensee of an international broadcast station shall render only an international broadcast service which will reflect the culture of this country and which will promote international goodwill, understanding, and cooperation. Any program solely intended for, and directed to an audience in the continental United States does not meet the requirements for this service.

(b) Such international broadcast service may include commercial or sponsored programs: *Provided,* That:

(1) Commercial program continuities give no more than the name of the sponsor of the program and the name and general character of the commodity, utility or service, or attraction advertised.

(2) In case of advertising a commodity, the commodity is regularly sold or is being promoted for sale on the open market in the foreign country or countries to which the program is directed in accordance with paragraph (c) of this section.

(3) In case of advertising an American utility or service to prospective tourists or visitors to the United States, the advertisement continuity is particularly directed to such persons in the foreign country or countries where they reside and to which the program is directed in accordance with paragraph (c) of this section.

(4) In case of advertising an international attraction (such as a world fair, resort, spa, etc.) to prospective tourists or visitors to the United States, the oral continuity concerning such attraction is consistent with the purpose and intent of this section.

(5) In case of any other type of advertising, such advertising is directed to the foreign country or countries to which the program is directed and is consistent with the purpose and intent of this section.

(c) The geographic areas to be served by international broadcast stations are the

foreign standard target areas shown in Figure 1 of § 3.792, or foreign nonstandard target areas as provided in § 3.702(d), and directive antennas shall be employed to direct the transmission to these specific target areas.

(d) An international broadcast station may transmit the program of a standard broadcast station or network system: *Provided*, The conditions in paragragh (b) of this section in regard to any commercial continuities are observed and when station identifications are made, only the call letter designation of the international station is given on its assigned frequency: *And provided further*, That in the case of chain broadcasting the program is not carried simultaneously by another international station (except another station owned by the same licensee operated on a frequency in a different group to obtain continuity of signal service), the signals from which are directed to the same area. (See section 3(p) of the Communications Act of 1934 for the definition of "chain broadcasting.")

§ 3.789 **Sponsored programs; announcement of.** (a) In the case of each program for the broadcasting of which money, services, or other valuable consideration is either directly or indirectly paid or promised to, or charged or received by, any radio broadcast station, the station broadcasting such program shall make, or cause to be made, an appropriate announcement that the program is sponsored, paid for, or furnished, either in whole or in part.

(b) In the case of any political program or any program involving the discussion of public controversial issues for which any films, records, transcriptions, talent, scripts, or other material or services of any kind are furnished, either directly or indirectly, to a station as an inducement to the broadcasting of such program, an announcement shall be made both at the beginning and conclusion of such program on which such material or services are used that such films, records, transcriptions, talent, scripts, or other material or services have been furnished to such station in connection with the broadcasting of such program: *Provided, however*, That only one such announcement need be made in the case of any such program of 5 minutes' duration or less, which announcement may be made either at the beginning or conclusion of the program.

(c) The announcement required by this section shall fully and fairly disclose the true identity of the person or persons by whom or in whose behalf such payment is made or promised, or from whom or in whose behalf such services or other valuable consideration is received, or by whom the material or services referred to in paragraph (b) of this section are furnished. Where an agent or other person contracts or otherwise makes arrangements with a station on behalf of another, and such fact is known to the station, the announcement shall disclose the identity of the person or persons in whose behalf such agent is acting instead of the name of such agent.

(d) In the case of any program, other than a program advertising commercial products or services, which is sponsored, paid for or furnished, either in whole or in part, or for which material or services referred to in paragraph (b) of this section are furnished, by a corporation, committee, association or other unincorporated group, the announcement required by this section, shall disclose the name of such corporation, committee, association, or other unincorporated group. In each such case the station shall require that a list of the chief executive officers or members of the executive committee or of the board of directors of the corporation, committee, association, or other unincorporated group shall be made available for public inspection at one of the international broadcast stations carrying the program.

(e) In the case of programs advertising commercial products or services, an announcement stating the sponsor's corporate or trade name or the name of the sponsor's product, shall be deemed sufficient for the purposes of this section and only one such announcement need be made at any time during the course of the program.

§ 3.790 **Rebroadcast.** (a) The licensee of an international broadcast station may, without further authority of the Commission, rebroadcast the program of a United States standard, FM noncommercial educational, or FM broadcast station, provided the Commission is notified of the call letters of each station rebroadcast and the licensee certifies that express authority has been received from the licensee of the station originating the program. The notice and certification of consent must be

given within 3 days of any single rebroadcast, but in case of the regular practice of rebroadcasting certain programs of another broadcast station several times during a license period, notice and certification of consent must be given for the ensuing license period with the application for renewal of license, or at the beginning of such rebroadcast practice if begun during a license period.

NOTE: The broadcasting of a program relayed by a remote pickup broadcast station is not considered a rebroadcast.

(b) No licensee of an international broadcast station shall rebroadcast the programs of any other class of United States radio station without written authority having first been obtained from the Commission.

(c) A licensee of an international broadcast station may authorize the rebroadcast of its programs by any station outside the limits of the North American continent without permission from the Commission: *Provided,* That the station rebroadcasting the programs cannot be received consistently in the United States.

§ 3.791 Supplemental report with renewal application. A supplemental report shall be filed with and made a part of each application for renewal of license and shall include statements of the following:

(a) The number of hours operated on each frequency, listing contract operations and private operations separately.

(b) Outline of reports of reception and interference and conclusions with regard to propagation characteristics of assigned frequencies. (If such information is not available to the applicant in the case of contract operations, a statement to this effect will be considered adequate.)

§ 3.752 Engineering chart. [See Figure 1.]

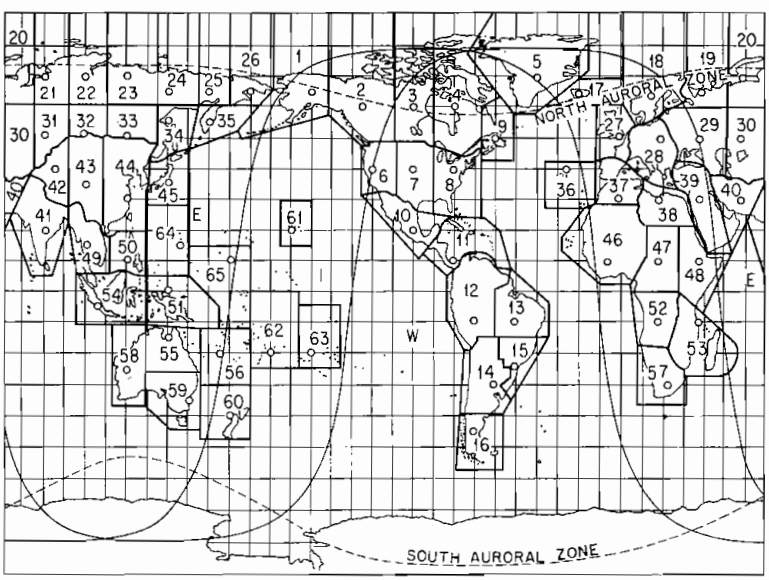


FIGURE 1. World map showing zones covered by predicted charts and auroral zones.

SUBPART G—CONELRAD FOR STANDARD, FM, AND TELEVISION BROADCAST STATIONS

Scope and Objective

§ 3.901 **Scope of subpart.** This subpart applies to all standard, FM and TV broadcast stations and is for the purpose of providing for operation of certain stations located within the Continental United States during periods of enemy air attack or imminent threat thereof.

§ 3.902 **Object of plan.** The aim of this plan is to minimize the navigational aid that may be obtained from the continued operation of broadcast stations while at the same time providing for transmission of civil defense information to the public. During CONELRAD radio alert periods, when not broadcasting civil defense programs or alert or all-clear notification messages, these stations may, on their own responsibility, broadcast such other programs as they may desire.

Definitions

§ 3.910 **CONELRAD.** The word CONELRAD is a contraction of the words Control of Electromagnetic Radiation and is the general name given to required procedures under authority of Executive Order 10312 dated December 10, 1951 (3 CFR, 1951 Supp.)

§ 3.911 **Air Defense Control Center (ADCC).** An air operations center from which an air division (defense) commander supervises and coordinates air defense activities within an air defense sector, including dissemination of warnings, identification and security control of air traffic and utilization of available combat forces in support of the national air defense effort.

§ 3.912 **Basic key station.** A station that receives the radio alert by telephone directly from the ADCC. Basic key stations relay radio alerts to other stations by radio and by telephone.

§ 3.913 **Relay key station.** A station that receives the radio alert by telephone or radio broadcast from a basic key station or other relay key station. Relay key stations pass the radio alert on to other stations by radio broadcast or telephone.

§ 3.914 **Skywave key station.** A station designated to disseminate a radio alert by broadcast primarily during the experimental period as an alternate for local key stations which may not be in operation. It will normally be capable of disseminating the alert over a wide area by means of skywave transmission.

§ 3.915 **Radio alert.** The radio alert is the Department of Defense order to operate stations in accordance with CONELRAD requirements for a period of time, as determined by the Air Division Commander or higher military authority.

§ 3.916 **Radio all clear.** The radio all clear is the Department of Defense order to discontinue CONELRAD requirements, as imposed by an outstanding radio alert, with authorization to return to normal operation. It is initiated by the Air Division Commander or higher military authority.

§ 3.917 **Cluster.** A cluster is a group of broadcast stations serving a single area, all operating on the same CONELRAD system frequency. All stations in a cluster will be inter-connected by wire lines and will carry a common program.

§ 3.918 **Sequential control lines.** Sequential control lines are the wire lines inter-connecting the several stations in a cluster. By means of a mechanical, manual or electronic device at a central control point, the stations in a cluster are turned on and off in sequence over the circuits provided by the sequential control lines. In some cases these lines may also carry the cluster program.

§ 3.919 **CONELRAD manual.** The CONELRAD manual is the document containing the detailed description of how broadcast stations will be alerted and operated in the CONELRAD system. The manual will be subject to modification from time to time as experience indicates a need for such changes.

Supervision

§ 3.920 **Zones.** CONELRAD activities under the authority of FCC are under the immediate supervision of three FCC Zone Supervisors whose respective zones are coextensive with the three Air Defense Force Areas. (Each broadcast station will be furnished the name and address of the Zone Supervisor of its Zone.)

§ 3.921 **Divisions.** Each zone is divided into several divisions corresponding to the USAF Air Divisions. An FCC Coordinating Engineer is assigned to each Air Division and has responsibility under the Zone Supervisor for all CONELRAD activities under the authority of FCC in his division.

Radio Alerts

§ 3.930 **Notification of a radio alert.** (a) All notifications of radio alerts and all clears shall be issued by the Air Defense Control Center(s) (ADCC) under the authority of the Air Division Commander or his duly authorized representative, to all basic key stations. All relay key stations will, in turn, be notified by the basic key stations or other relay key stations. The remaining stations will then be notified by basic key stations or relay key stations. These notifications will be accomplished either by telephone messages or by radio broadcast.

(b) During the experimental period many of the regular key stations may be off the air. All standard, FM and TV stations will be supplied with the list of skywave key stations at least one of which must be monitored during any period of operation when the regularly used key station is not on the air.

§ 3.931 **Reception of a radio alert.** All standard, FM and TV broadcast stations, including basic key and relay key stations, must install the necessary equipment to receive notifications of radio alerts and radio all clears by means of reception of radio broadcast messages, and must maintain this equipment in a state of readiness for reception, including arrangements for human listening watch or automatic alarm devices or both. Such equipment should have its termination at the transmitter control location.

§ 3.932 **Operation during a radio alert.** (a) Immediately upon receipt of a radio alert, either by radio broadcast or telephone, all standard, FM and TV broadcast stations, including such stations operating under equipment or program test authority, will follow the prescribed procedure and transmit an approved sign-off message as set forth in the CONELRAD Manual For Broadcast Stations, then remove the transmitter from the air.

(b) Those stations which are authorized to participate in the operating system will immediately take necessary steps and begin operations on assigned frequencies in accordance with the terms of their CONELRAD authorizations and current operating instructions. All other broadcast stations will observe radio silence until the radio all clear.

(c) No identification may be broadcast between the time the radio alert is received and the time the radio all clear is announced, unless expressly authorized by the FCC. The transmission of any information which would serve to identify the geographical location of the station is prohibited.

(d) A station operating in the CONELRAD system may transmit in accordance with its CONELRAD authorization during a radio alert beyond its normal hours and nothing in its regular license or other instrument of authorization shall prevent such operation in the CONELRAD system.

(e) Prior to commencing routine operation or originating any emissions under program test, equipment test, experimental or other authorization or for any other purpose, licensees or permittees shall first ascertain whether a state of radio alert exists and if so shall refrain from operation or operate in the CONELRAD system whichever is appropriate.

§ 3.933 **Emergency weather warnings.** Upon receipt of notification of an Emergency Weather Warning of a condition of immediate danger to life and property from the United States Weather Bureau, all standard, FM, and television broadcast

stations may, at their option, during authorized hours of operation only, broadcast the CONELRAD Attention Signals in connection therewith, as provided in §§ 3.90, 3.296, and 3.632, respectively, and as outlined in CONELRAD Manual BC-3 (Revised), Appendix A. Nothin herein shall be construed as permitting a standard broadcast station licensed to operate daytime only or limited time, to operate during unauthorized hours.

Radio All Clear

§ 3.940 **Notification of a radio all clear.** The radio all clear notification will be transmitted through the same channels as the radio alert. Stations operating in the CONELRAD system will transmit the radio all clear message on the CONELRAD system frequency. Key stations will, as soon as possible thereafter, follow the prescribed procedure and broadcast the radio all clear message on their regular operating frequency. All stations, including FM and TV stations, upon resuming regular operation will follow the prescribed procedure and immediately broadcast the radio all clear message.

System Operation

§ 3.950 **Procedure.** Each broadcast station permitted to operate during a radio alert must observe operating procedures for the mode of operation to which it is assigned, as set forth in detail in the CONELRAD Manual For Broadcast Stations.

§ 3.951 **Participation.** (a) Any standard broadcast station desiring to participate in a CONELRAD operating system should contact the Zone Supervisor, indicate the station's willingness to make such technical modification of the station equipment as might be necessary to permit operation on a system frequency and with such power limitations as might be necessary. The Commission will then issue a CONELRAD authorization to the station specifying the frequency to be used by the station. Stations which have indicated a willingness to participate in CONELRAD on a voluntary basis prior to the effective date of this rule need not take any further steps.

(b) At such time as technical consideration may warrant the inclusion of FM and TV broadcast stations within the operating CONELRAD system, appropriate announcement will be made by the Commission and application for participation made as above set forth.

(c) Any station participating in CONELRAD system operations may withdraw from the system by giving thirty days' notice to the FCC Zone Supervisor in writing and by submitting its CONELRAD authorization for cancellation.

(d) Broadcast stations are specifically exempt from complying with § 3.57 while operating under their CONELRAD authorization.

Tests

§ 3.960 **Alerting system.** Tests of the alerting system will be conducted periodically.

§ 3.961 **Sequential control lines.** Sequential control and program lines must be tested at frequent intervals and results reported in the prescribed manner to the FCC Zone Supervisor.

§ 3.962 **Entire system.** Tests of the entire system will be conducted from time to time. During such tests, all stations which are authorized to operate in the CONELRAD system will operate in accordance with terms of the CONELRAD authorization. Other stations will not be required to go off the air during such tests but will be subject to any interference which might result from the CONELRAD operation. Such tests will be scheduled to take place during the experimental period. Industry representatives will be consulted prior to conducting CONELRAD system tests to obtain views relative to the action and to coordinate the activity.

§ 3.963 **Equipment.** The licensee of each station authorized to participate in CONELRAD system operation shall make such tests of his equipment as may be necessary to assure it is ready for instant use.

§ 3.964 **Log entries.** Appropriate entries of all tests shall be made in the station log.

Drills

§ 3.970 **Notification of a drill.** At some time it may be necessary to conduct an Air Defense Drill under conditions of simulated attack. Industry representatives will be consulted prior to conducting CONELRAD drills to obtain views relative to the action and to coordinate the activity. Such drills will only be called when the Department of Defense, the Office of Defense Mobilization, and the Federal Communications Commission concurrently agree that the drill is necessary. All stations will be notified well in advance of such a drill.

§ 3.971 **Operation during a drill.** During a drill, all standard, FM and TV broadcast stations will take the same steps as such stations would be required to take in the event of an actual radio alert under this part of the rules and current operating instructions as set forth in the CONELRAD Manual For Broadcast Stations, except for special drill messages.

SUBPART H—CONELRAD FOR NONCOMMERCIAL EDUCATIONAL FM AND INTERNATIONAL BROADCAST STATIONS

§ 3.1001 **Scope and objective.** (a) This subpart applies to all radio stations in the noncommercial educational FM and the international broadcast services located in the Continental U. S., and is for the purpose of providing for the alerting and operation of radio stations in these services during periods of air attack or imminent threat thereof.

(b) The objective of the CONELRAD regulations in this subpart is to minimize the navigational aid that an enemy might obtain from the electromagnetic radiations from radio stations in the noncommercial educational FM and international broadcast services, while simultaneously providing for a continued radio service under controlled conditions when such operation is essential to the public welfare.

§ 3.1002 **Alerting.** (a) All radio stations in the noncommercial educational FM and the international broadcast services licensed by the Federal Communications Commission are responsible for making provisions to receive the CONELRAD Radio Alert Message and the CONELRAD Radio All Clear. (As used in this subpart the term "licensed by" includes every form of authority issued by FCC pursuant to which a radio station may be operated, including construction permits, station licenses, temporary authorizations, etc.)

(b) The CONELRAD Radio Alert will be initiated by the Commanding Officer of the Air Division (Defense) or higher military authority.

(c) The provision of an adequate receiver, to monitor any standard, FM or TV broadcast station either by aural or by automatic means, during all hours of operation of noncommercial educational FM or international broadcast stations, will be considered as compliance with the requirements of paragraph (a) of this section. Other means of receiving the CONELRAD Radio Alert may be authorized by the Federal Communications Commission in special cases.

NOTE: Every standard, FM and TV broadcast station will be notified of the Radio Alert by telephone calls or by radio broadcasts. Immediately upon receipt of the Radio Alert, each standard, FM and TV broadcast station will proceed as follows on its normally assigned frequency:

(1) Discontinue the normal program in progress.

(2) Cut the transmitter carrier for approximately 5 seconds. (Sound carrier only for television stations.)

(3) Return the carrier to the air for approximately 5 seconds.

(4) Cut transmitter carrier for approximately 5 seconds.

(5) Return carrier to the air.

(6) Broadcast 1,000 cycle (approximately) steady state tone for fifteen seconds.

(7) Broadcast the CONELRAD Radio Alert Message as follows: "We interrupt our normal program to cooperate in security and Civil Defense measures as requested by the United States Government. This is a CONELRAD Radio Alert. Normal broadcasting

will now be discontinued for an indefinite period. Civil Defense information will be broadcast in most areas at 640 and 1240 on your regular radio receiver."

(8) The CONELRAD Radio Alert Message will then be repeated.

The CONELRAD Radio Alert Message, as set forth in (7) of this note is worded in a manner suitable for reception by the public; however, the message is also the CONELRAD Radio Alert. When this CONELRAD Radio Alert Message is received, all licensees must immediately comply with the CONELRAD operating procedure. The precise CONELRAD Radio Alert Message, above, will be broadcast only in the event of the actual Alert. In the event of a CONELRAD test or drill, broadcast stations will make an announcement that a test or drill is taking place.

§ 3.1003 **Operating during a CONELRAD Radio Alert.** (a) Noncommercial educational FM broadcast stations, upon receipt of a CONELRAD Radio Alert, will interrupt the program in progress, and broadcast the CONELRAD Radio Alert Message as in subdivisions (7) and (8) of the note to § 3.1002. The station will then discontinue its carrier and maintain radio silence for the duration of the CONELRAD Radio Alert.

(b) International broadcast stations, upon receipt of a CONELRAD Radio Alert, will interrupt the program in progress, may make a brief sign-off announcement not longer than one minute, and, except for those stations specifically authorized by the Federal Communications Commission to continue transmitting, stations in this service will leave the air and maintain radio silence. Stations in the international broadcast service permitted to continue transmitting will be individually authorized to transmit by the Federal Communications Commission with concurrence of the Secretary of Defense, and the Director, Office of Defense Mobilization, and will transmit only urgent government broadcasts or messages. The stations' carrier must be removed from the air during periods of no broadcast or message transmissions.

§ 3.1004 **Identification.** After receipt of a CONELRAD Radio Alert, noncommercial educational FM broadcast and international broadcast stations shall make no station identification either by announcement of regularly assigned call signals or by announcement of geographical location.

§ 3.1005 **Radio All Clear.** The Radio All Clear will be initiated only by the Air Division (Defense) Commander or higher military authority and will be disseminated over the same channels as the CONELRAD Radio Alert. Radio stations in the noncommercial educational FM and the international broadcast services may resume normal operating schedules when the CONELRAD Radio All Clear is received, unless otherwise restricted by order of the Commission.

§ 3.1006 Tests. Tests of the CONELRAD alerting and operating systems of the noncommercial educational FM and the international broadcast services may be conducted at appropriate intervals. Reports of the results of such tests may be required in a form to be prescribed by the Commission.

§ 3.1007 **Log entries.** Appropriate entries of all CONELRAD tests, drills or operations shall be made in the station log.

Part 4

FEDERAL COMMUNICATIONS COMMISSION
PART 4 — EXPERIMENTAL, AUXILIARY, AND SPECIAL BROADCAST SERVICES

TITLE 47—TELECOMMUNICATION

Chapter I—Federal Communications Commission

Part 4—Experimental, Auxiliary, and Special Broadcast Services

General

§ 4.1 **Broadcast services covered by this part.** The following broadcast services are covered by this part:

(a) Experimental and developmental broadcast:
  (1) Experimental television broadcast (Subpart A).
  (2) Experimental facsimile broadcast (Subpart B).
  (3) Developmental broadcast (Subpart C).

(b) Auxiliary broadcast:
  (1) Remote pickup broadcast (Subpart D).
  (2) Standard and FM broadcast STL and FM intercity relay (Subpart E).
  (3) Television pickup (Subpart F).
  (4) Television STL (Subpart F).
  (5) Television intercity relay (Subpart F).

(c) Special broadcast:
  (1) Television broadcast translator (Subpart G).

Administrative Procedure

§ 4.11 **Cross reference.** See § 1.300 to 1.337, Subpart D of Part 1 of this chapter, for general requirements as to applications, filing of applications and description of application forms.

§ 4.12 **Notification of filing of applications.** In order to minimize harmful interference at the National Radio Astronomy Observatory site located at Greenbank, Pocahontas County, West Virginia and at the Naval Radio Research Observatory at Sugar Grove, Pendleton County, West Virginia, an applicant for authority to construct any class of station covered in § 4.1 except Remote Pickup Broadcast Mobile and TV Pickup Stations, or for authority to make changes in the frequency, power, antenna height, or antenna directivity of an existing station within an area bounded by 39° 15′ N on the north, 78° 30′ W on the east, 37° 30′ N on the south and 80° 30′ W on the west shall, at the time of filing such application with the Commission simultaneously notify the Director, National Radio Astronomy Observatory, P.O. Box 2, Green Bank, West Virginia, in writing, of the technical particulars of the proposed station. Such notification shall include the geographic coordinates of the antenna, antenna height, antenna directivity if any, proposed frequency, type of emission, and power. In addition, the applicant shall indicate in his application to the Commission the date notification was made to the Observatory. After receipt of such applications, the Commission will allow a period of twenty (20) days for comments or objections in response to the notifications indicated. If an objection to the proposed operation is received during the twenty (20) day period from the National Radio Astronomy Observatory for itself or on behalf of the Naval Radio Research Observatory, the Commission will consider all aspects of the problem and take whatever action is deemed appropriate.

§ 4.13 **Equipment tests.** (a) During the process of construction of any class of radio station listed in this part, the permittee, after notifying the Commission and Engineer in Charge of the district in which the station is located, may without further authority of the Commission, conduct equipment tests for the purpose of such adjustments and measurements as may be necessary to assure compliance with the terms of the construction permit, the technical provisions of the application therefor, the rules and regulations, and the applicable engineering standards.

(b) The Commission may notify the permittee to conduct no tests or may cancel, suspend, or change the date for the beginning of equipment tests as and when such action may appear to be in the public interest, convenience, and necessity.

(c) Equipment tests may be continued so long as the construction permit shall remain valid.

(d) The authorization for tests embodied in this section shall not be construed as constituting a license to operate but as a necessary part of construction.

§ 4.14 **Service or program tests.** (a) Upon completion of construction of a radio station in accordance with the terms of the construction permit, the technical provisions of the application therefor, and the rules and regulations and applicable engineering standards, and when an application for station license has been filed showing the station to be in satisfactory operating condition, the permittee of any class of station listed in this part may, without further authority of the Commission, conduct service or program tests: *Provided,* That the Engineer in Charge of the district in which the station is located and the Commission are notified at least two (2) days (not including Sundays and Saturdays and legal holidays when the offices of the Commission are not open) in advance of the beginning of such operation.

(b) The Commission may notify the permittee to conduct no tests or may cancel, suspend, or change the date for the beginning of such tests as and when such action may appear to be in the public interest, convenience, and necessity.

(c) Unless sooner suspended or revoked program test authority will continue valid during Commission consideration of the application for license and during this period further extension of the construction permit is not required. Program test authority shall be automatically terminated by final determination upon the application for station license.

(d) The authorization for tests embodied in this section shall not be construed as approval by the Commission of the application for station license.

§ 4.15 **License period.** (a) Licenses for the following classes of broadcast stations normally will be issued for a period of one year expiring as follows:

Class of Station and Date of Expiration

Experimental television broadcast station: Apr. 1.
Experimental facsimile broadcast station: Mar. 1.
Developmental broadcast station: May 1.
Television broadcast translator station: June 1.

(b) Licenses for stations in the Auxiliary Broadcast Services will be issued for a period running concurrently with the licenses of the broadcast station with which such auxiliary stations are used. A remote pickup broadcast station licensed for use with more than one broadcast station will be licensed for a period running concurrently with the license of the broadcast station having the longer license record.

§ 4.16 **Temporary extension of station licenses.** Where there is pending before the Commission any application, investigation or proceeding which, after hearing, might lead to or make necessary the modification of, revocation of, or the refusal to renew an existing auxiliary or experimental broadcast station license or a television broadcast translator station license, the Commission may, in its discretion, grant a temporary extension of such license: *Provided, however,* That no such temporary extension shall be construed as a finding by the Commission that the operation of any radio station thereunder will serve public interest, convenience, and necessity beyond the express terms of such temporary extension of license: *And provided further,* That such temporary extension of license will in no wise affect or limit the action of the Commission with respect to any pending application or proceeding.

CONELRAD

§ 4.51 **Scope and objective.** (a) Sections 4.51 to 4.57 apply to all radio stations in the Experimental, Auxiliary and Special Broadcast Services located within the Continental United States and are for the purpose of providing for the alerting and operation of radio stations in these services during periods of enemy air attack or imminent threat thereof.

(b) The objective of these CONELRAD rules is to minimize the navigational aid that an enemy might obtain from the electromagnetic radiations from radio stations in the Experimental, Auxiliary and Special Broadcast Services, while simultaneously providing for a continued radio service under controlled conditions when such operation is essential to the public welfare.

§ 4.52 **Alerting.** (a) Licensees of all radio stations in the Experimental, Auxiliary, and Special Broadcast Services are responsible for making provisions to receive the CONELRAD Radio Alert and the CONELRAD Radio All Clear, which will be initiated only by the Commanding Officer of the Air Division (Defense) or higher military authority.

(b) The CONELRAD Radio Alert for the Experimental, Auxiliary, and Special Broadcast Services shall be received by one or more of the following methods:

(1) By monitoring any standard, FM or TV broadcast station to receive the CONELRAD Radio Alert message.

(2) By reception of the CONELRAD Radio Alert from a point that received the Radio Alert directly from a standard, FM or TV broadcast station.

(3) Radio stations in the services affected by this plan may be specifically authorized by the FCC to receive the CONELRAD Radio Alert by other means.

(c) When the radio station is not in operation it is not necessary to make provisions to receive the CONELRAD Radio Alert, however, before starting a radio transmission, caution must be used to insure that a CONELRAD Radio Alert is not in progress.

§ 4.53 **Operation during a CONELRAD Radio Alert.** Stations in the Experimental, Auxiliary and Special Broadcast Services on receipt of a CONELRAD Radio Alert, will interrupt any communications in progress, may make a brief announcement, must then leave the air and maintain radio silence for the duration of the CONELRAD Radio Alert.

§ 4.54 **Special conditions.** Certain stations in the Experimental, Auxiliary and Special Broadcast Services may be specifically authorized by the Federal Communications Commission to operate in a manner not provided in §§ 4.51 to 4.57, if such operation is essential to the public welfare.

§ 4.55 **Radio All Clear.** The Radio All Clear will be initiated only by the Air Division (Defense) Commander or higher military authority and will be disseminated over the same channels as the CONELRAD Radio Alert. Radio stations and systems licensed in the Experimental, Auxiliary and Special Broadcast Services may resume normal operation when the CONELRAD Radio All Clear message is received, unless otherwise restricted by order of the Federal Communications Commission.

§ 4.56 **Tests.** Tests of the CONELRAD alerting and operating systems for the Experimental, Auxiliary and Special Broadcast Services may be conducted at appropriate intervals. Reports of the results of such tests may be required in a form to be prescribed by the Commission.

§ 4.57 **Station records.** Appropriate entries of all CONELRAD tests, drills, and operations shall be made in the station records.

SUBPART A—EXPERIMENTAL TELEVISION BROADCAST STATIONS

Definitions and Allocation of Frequencies

§ 4.101 **Experimental television broadcast station.** The term "experimental television broadcast station" means a station licensed for experimental transmission of transient visual images of moving or fixed objects for simultaneous reception and reproduction by the general public.

NOTE: The transmission of synchronized sound (aural broadcast) is considered an essential phase of television broadcast and one license will authorize both visual and aural broadcast.

§ 4.102 **Purpose.** A license for an experimental television broadcast station will be issued for the purpose of carrying on research and experimentation for the advancement of television broadcasting which may include tests of equipment, training of personnel, and experimental programs as are necessary for the experimentation.

§ 4.103 **Frequency assignment.** (a) Frequencies allocated to television broadcasting and the various categories of television auxiliary stations, in the Commission's

Table of Frequency Allocations (Part 2 of this chapter), may be assigned respectively to experimental television broadcast and experimental television auxiliary stations.

(b) More than one frequency may be assigned upon a satisfactory showing of the need therefor.

(c) Frequencies best suited to the purpose of the experimentation and on which there appears to be the least likelihood of interference to established stations, shall be selected.

(d) In a case of important experimentation which cannot be feasibly conducted on frequencies allocated to television broadcasting or the various categories of television auxiliary stations, the Commission may authorize an experimental television station of any class to operate on other frequencies upon a satisfactory showing of the need therefor and a showing that the proposed operation can be conducted without causing harmful interference to established services: *Provided, however,* That experimental operation which looks toward the development of radio transmitting apparatus or the rendition of any type of regular service using such frequencies, will not be authorized prior to a determination by the Commission that the development of such apparatus or the rendition of such service would serve the public interest.

Administrative Procedure

§ 4.111 Cross reference. See §§ 4.11 to 4.16 inclusive.

§ 4.112 Supplementary statements to be filed with application for construction permit. A supplementary statement shall be filed with and made a part of each application for construction permit for any experimental television broadcast station confirming the applicant's understanding:

(a) That all operation upon the frequency requested is for experimental purposes only.

(b) That the frequency requested may not be the best suited to the particular experimental work to be carried on, and

(c) That the frequency requested need not be allocated for any service that may be developed as a result of the experimental operation,

(d) That any frequency which may be assigned is subject to change without advance notice or hearing,

(e) That any authorization issued pursuant to the application may be cancelled at any time without notice or hearing.

§ 4.113 Supplementary reports to be filed with application for renewal of license. (a) A report shall be filed with each application for renewal of experimental television broadcast station license which shall include a statement of each of the following:

(1) Number of hours operated.

(2) Full data on research and experimentation conducted including the type of transmitting and studio equipment used and their mode of operation.

(3) Data on expense of research and operation during the period covered.

(4) Power employed, field intensity measurements and visual and aural observations and the types of instruments and receivers utilized to determine the station service area and the efficiency of the respective types of transmissions.

(5) Estimated degree of public participation in reception and the results of observations as to the effectiveness of types of transmission.

(6) Conclusions, tentative and final.

(7) Program for further developments in television broadcasting.

(8) All developments and major changes in equipment.

(9) Any other pertinent developments.

(b) Special or progress reports shall be submitted from time to time as the Commission shall direct.

Licensing Policies

§ 4.131 Licensing requirements, necessary showing. (a) An applicant for a new experimental television broadcast station, change in facilities of any existing station,

or modification of license is required to make a satisfactory showing of compliance with the general requirements of the Communications Act of 1934, as amended, as well as the following:

(1) That the applicant has a definite program of research and experimentation in the technical phases of television broadcasting, which indicates reasonable promise of substantial contribution to the developments of the television art.

(2) That upon the authorization of the proposed station the applicant can and will proceed immediately with its program of research and experimentation.

(3) That the transmission of signals by radio is essential to the proposed program of research and experimentation.

(4) That the program of research and experimentation will be conducted by qualified personnel.

(b) A license for an experimental television broadcast station will not authorize exclusive use of any frequency. In case interference would be caused by simultaneous operation of stations licensed experimentally, such licensees shall endeavor to arrange satisfactory time division. If such agreement cannot be reached, the Commission will determine and specify the time division.

(c) A license for an experimental television broadcast station will be issued only on the condition that no objectionable interference will result from the transmissions of the station to the regular program transmissions of television broadcast stations. It shall at all times be the duty of the licensee of an experimental television broadcast station to ascertain that no interference will result from the transmissions of its station. With regard to interference with the transmissions of an experimental television broadcast station or the experimental or test transmissions of a television broadcast station, the licensees shall make arrangements for operations to avoid interference.

§ 4.132 **Power limitations.** Experimental television broadcast stations will be licensed with a power output not in excess of that necessary to render satisfactory service. The license for these stations will specify the maximum authorized power. The operating power shall not be greater than necessary to carry on the service and in no event more than 5 percent above the maximum power specified. Engineering standards have not been established for these stations. The efficiency factor for the last radio stage of transmitters employed will be subject to individual determination but shall be in general agreement with values normally employed for similar equipment operated within the frequency range authorized.

§ 4.133 **Emission authorized.** In case emission of a different type than that specified in the license is necessary or desirable in carrying on any phases of experimentation, application setting out fully the needs shall be made by informal application.

§ 4.134 **Multiple ownership.** No persons (including all persons under common control) shall control directly or indirectly, two or more experimental television broadcast stations (other than television relay broadcast stations) unless a showing is made that the character of the programs of research require a licensing of two or more separate stations.

Equipment

§ 4.151 **Equipment changes.** The licensee of an experimental television broadcast station may make any changes in the equipment that are deemed desirable or necessary provided:

(a) That the operating frequency is not permitted to deviate more than the allowed tolerance;

(b) That the emissions are not permitted outside the authorized band;

(c) That the power output complies with the license and the regulations governing the same; and

(d) That the transmitter as a whole or output power rating of the transmitter is not changed.

Technical Operation

§ 4.161 **Frequency tolerance.** The licensee of an experimental television broadcast station operating below 450 megacycles shall maintain the operating frequency of its station within plus or minus 0.01 percent of the assigned frequency. The licensee of an experimental television broadcast station operating above 450 megacycles shall maintain the operating frequency of its station within plus or minus 0.05 percent of the assigned frequency. However, where a lesser tolerance is necessary in order to prevent interference, the Commission will specify the tolerance.

§ 4.162 **Frequency monitors and measurements.** The licensee of an experimental television broadcast station shall provide the necessary means for determining that the frequency of the station is within the allowed tolerance. The date and time of each frequency check, the frequency as measured, and a description or identification of the method employed shall be entered in the station log. Sufficient observations shall be made to insure that the assigned carrier frequency is maintained within the prescribed tolerance.

§ 4.163 **Time of operation.** (a) A licensee of an experimental television broadcast station is not required to adhere to a regular schedule of operation but shall actively conduct a program of research and experimentation.

(b) The program of research and experimentation as offered by an applicant in compliance with the requirements for obtaining a license for an experimental television broadcast station shall be adhered to in the main, unless the licensee is authorized to do otherwise by the Commission.

(c) The Commission may from time to time require that a station licensed experimentally conduct such experiments as are deemed desirable and reasonable for the development of the service.

§ 4.164 **Station inspection.** The licensee of each experimental television broadcast station shall make the station available for inspection by representatives of the Commission at any reasonable hour.

§ 4.165 **Station and operator licenses; posting of.** (a) The station license and any other instrument of authorization or individual order concerning the construction of the equipment or manner of operation of the station shall be posted so that all terms thereof are visible in a conspicuous place in the room in which the transmitter is located. However, if the station is licensed for portable-mobile operation, the station license or a photo copy thereof shall be affixed to the equipment or kept in the possession of the operator on duty at the transmitter. If a photo copy is used the original license shall be available for inspection by an authorized Government representative.

NOTE: The term portable-mobile as here used is intended to include any type of portable or mobile operation.

(b) The original license of each station operator shall be posted at the place where he is on duty: *Provided, however,* If the original license of a station operator is posted at another radio transmitting station in accordance with the rules governing that class of station and is there available for inspection by an authorized Commission representative, or if the station operated is licensed for portable-mobile operation, a verification card (Form 758-F) is acceptable in lieu of the posting of such license.

§ 4.166 **Operator requirements.** One or more radio operators holding radiotelephone first-class or radiotelephone second-class operator licenses shall be on duty at the place where the transmitting apparatus of any experimental television broadcast station is located and in actual charge of its operation. The licensed operator on duty and in charge of a broadcast transmitter may at the discretion of the licensee, be employed for other duties or for the operation of another station or stations in accordance with the class of operator's license which he holds and the rules and regulations governing such stations. However, such duties shall in no wise interfere with the operation of the broadcast transmitter.

§ 4.167 **Antenna structure, marking and lighting.** Where an antenna structure(s)

is required to be painted or lighted see § 17.37, *Inspection of tower lights and associated control equipment;* § 17.39, *Cleaning and repainting;* § 17.40, *Time when lights shall be exhibited;* § 17.41, *Spare lamps;* and § 17.42, *Lighting equipment;* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 4.168 Additional orders. In case the rules contained in this part do not cover all phases of operation or experimentation with respect to external effects, the Commission may make supplemental or additional orders in each case as may be deemed necessary.

Other Operating Requirements

§ 4.181 Station records. (a) The licensee of each experimental television broadcast station shall maintain adequate records of the operation, including:

(1) Hours of operation.

(2) Program transmitted.

(3) Frequency check.

(4) Pertinent remarks concerning transmission.

(5) In case of relay or pickup station, an entry giving points of program origination and receiver location shall be included.

(6) Research and experimentation conducted.

(b) Where an antenna structure(s) is required to be illuminated see § 17.38, *Recording of tower light inspections in the station record,* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

(c) Station records shall be retained for a period of two years.

§ 4.182 Charges. No charges, either direct or indirect, shall be made by the licensee of an experimental television broadcast station for the production or transmission of either aural or visual programs transmitted by such station except that this section shall not apply to the transmission of commercial programs by an experimental television relay or pickup broadcast station for retransmission by a television broadcast station.

§ 4.183 Station identification. Each experimental television broadcast station shall make aural and visual announcements of its call letters and location at the beginning and end of each period of operation, and during operation, at least once every hour.

§ 4.184 Rebroadcasts. (a) The term "rebroadcast" means reception by radio of the program of a radio station, and the simultaneous or subsequent retransmission of such program by a broadcast station.

NOTE 1: As used in this section the word "program" includes any complete program or part thereof.

NOTE 2: In case a program is transmitted from its point of origin to a broadcast station primarily by telephone facilities in which a section of such transmission is by radio, the broadcasting of this program is not considered a rebroadcast. The broadcasting of a program relayed by a remote pickup broadcast station is not considered a rebroadcast.

(b) No licensee of any experimental television broadcast station shall rebroadcast the program of any radio station without written authority having first been obtained from the Commission upon application. Informal application may be employed.

(c) An application for authority to rebroadcast the program of any radio station shall be accompanied by written consent or certification of consent of the licensee of the station originating the program.

SUBPART B—EXPERIMENTAL FACSIMILE BROADCAST STATIONS

Definitions and Allocation of Frequencies

§ 4.201 Facsimile broadcast station. The term "facsimile broadcast station" means a station licensed to transmit images of still objects for record reception by the general public.

§ 4.202 **Frequency assignment.** (a) Frequencies allocated to broadcasting and the various categories of broadcast auxiliary stations, in the Commission's Table of Frequency Allocations (Part 2 of this chapter), may be assigned respectively to experimental facsimile broadcast or experimental facsimile broadcast auxiliary stations.

(b) More than one frequency may be assigned upon a satisfactory showing of the need therefor.

(c) Frequencies best suited to the purpose of the experimentation and on which there appears to be the least likelihood of interference to established stations, shall be selected.

(d) In a case of important experimentation which cannot be feasibly conducted on frequencies allocated to broadcasting or the various categories of broadcast auxiliary stations, the Commission may authorize an experimental facsimile broadcast station of any class to operate on other frequencies upon a satisfactory showing of the need therefor and a showing that the proposed operation can be conducted without causing harmful interference to established services: *Provided, however,* That experimental operation which looks toward the development of radio transmitting apparatus or the rendition of any type of regular service using such frequencies, will not be authorized prior to a determination by the Commission that the development of such apparatus or the rendition of such service would serve the public interest.

Administrative Procedure

§ 4.211 **Administrative procedure.** See §§ 4.11 to 4.16, inclusive.

§ 4.212 **Supplementary statements to be filed with application for construction permit.** A supplementary statement shall be filed with and made a part of each application for construction permit for any experimental facsimile broadcast station confirming the applicant's understanding:

(a) That all operation upon the frequency requested is for experimental purposes only,

(b) That the frequency requested may not be the best suited to the particular experimental work to be carried on,

(c) That the frequency requested need not be allocated for any service that may be developed as a result of the experimental operation,

(d) That any frquency which may be assigned is subject to change without advance notice or hearing,

(e) That any authorization issued pursuant to the application may be cancelled at any time without notice or hearing.

§ 4.213 **Supplemental report with renewal application.** A supplemental report shall be filed with and made a part of each application for renewal of license and shall include statements of the following:

(a) Number of hours operated for transmission of facsimile programs.

(b) Comprehensive report of research and experimentation conducted.

(c) Conclusions and program for further developments of the facsimile broadcast service.

(d) All developments and major changes in equipment.

(e) Any other pertinent developments.

Licensing Policies

§ 4.231 **Licensing requirements, necessary showing.** (a) An applicant for a construction permit for a new experimental facsimile broadcast station, change in facilities of any existing station, or modification of license is required to make a satisfactory showing of compliance with the general requirements of the Communications Act of 1934, as amended, as well as with regard to the following:

(1) That the applicant has a program of research and experimentation which indicates reasonable promise of substantial contribution to the development of the facsimile broadcast service.

(2) That sufficient facsimile recorders will be distributed to accomplish the experimental program proposed.

(3) That the program of research and experimentation will be conducted by qualified personnel.

(b) A license for an experimental facsimile broadcast station will not authorize exclusive use of any frequency. In case interference would be caused by simultaneous operation of stations licensed experimentally, such licensees shall endeavor to arrange satisfactory time division. If such agreement cannot be reached, the Commission will determine and specify the time division.

§ 4.232 **Power limitations.** Experimental facsimile broadcast stations will be licensed with a power output not in excess of that necessary to render satisfactory service. The license for these stations will specify the maximum authorized power. The operating power shall not be greater than necessary to carry on the service and in no event more than 5 percent above the maximum power specified. Engineering standards have not been established for these stations. The efficiency factor for the last radio stage of transmitters employed will be subject to individual determination but shall be in general agreement with values normally employed for similar equipment operated within the frequency range authorized.

§ 4.233 **Emission authorized.** In case emission of a different type than that specified in the license is necessary or desirable in carrying on any phases of experimentation, application setting out fully the needs shall be made by informal application.

§ 4.234 **Multiple ownership.** No persons (including all persons under common control) shall control, directly or indirectly, two or more experimental facsimile broadcast stations unless a showing is made that the character of the programs of research require a licensing of two or more separate stations.

Equipment

§ 4.251 **Equipment changes.** The licensee of an experimental facsimile broadcast station may make any changes in the equipment that are deemed desirable or necessary provided:

(a) That the operating frequency is not permitted to deviate more than the allowed tolerance;

(b) That the emissions are not permitted outside the authorized band;

(c) That the power output complies with the license and the regulations governing the same; and

(d) That the transmitter as a whole or output power rating of the transmitter is not changed.

Technical Operation

§ 4.261 **Frequency tolerance.** The licensee of an experimental facsimile broadcast station shall maintain the operating frequency of its station within plus or minus 0.01 percent of the assigned frequency. However, where a lesser tolerance is necessary in order to prevent interference, the Commission will specify the tolerance.

§ 4.262 **Frequency monitors and measurements.** The licensee of an experimental facsimile broadcast station shall provide the necessary means for determining that the frequency of the station is within the allowed tolerance. The date and time of each frequency check, the frequency as measured, and a description or identification of the method employed shall be entered in the station log. Sufficient observations shall be made to insure that the assigned carrier frequency is maintained within the prescribed tolerance.

§ 4.263 **Time of operation.** (a) A licensee of an experimental facsimile broadcast station is not required to adhere to a regular schedule of operation but shall actively conduct a program of research and experimentation.

(b) The program of research and experimentation as offered by an applicant in compliance with the requirements for obtaining a license for an experimental facsimile

broadcast station shall be adhered to in the main, unless the licensee is authorized to do otherwise by the Commission.

(c) The Commission may from time to time require that a station licensed experimentally conduct such experiments as are deemed desirable and reasonable for the development of the service.

§ 4.264 Station inspection. The licensee of each experimental facsimile broadcast station shall make the station available for inspection by representatives of the Commission at any reasonable hour.

§ 4.265 Station and operator licenses; posting of. (a) The station license and any other instrument of authorization or individual order concerning the construction of the equipment or manner of operation of the station shall be posted so that all terms thereof are visible in a conspicuous place in the room in which the transmitter is located.

(b) The original license of each station operator shall be posted at the place where he is on duty: *Provided, however,* If the original license of a station operator is posted at another radio transmitting station in accordance with the rules governing that class of station and is there available for inspection by an authorized Commission representative, a verification card (Form 758-F) is acceptable in lieu of the posting of such license.

§ 4.266 Operator requirements. One or more radio operators holding radiotelephone first-class or radiotelephone second-class operator licenses shall be on duty at the place where the transmitting apparatus of any experimental facsimile broadcast station is located and in actual charge of its operation. The licensed operator on duty and in charge of a broadcast transmitter may at the discretion of the licensee, be employed for other duties or for the operation of another station or stations in accordance with the class of operator's license which he holds and the rules and regulations governiug such stations. However, such duties shall in no wise interfere with the operation of the broadcast transmitter.

§ 4.267 Antenna structure, marking and lighting. Where an antenna structure(s) is required to be painted or lighted see § 17.37, *Inspection of tower lights and associated control equipment;* § 17.39, *Cleaning and repainting;* § 17.40, *Time when lights shall be exhibited;* § 17.41, *Spare lamps;* and § 17.42, *Lighting equipment;* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 4.268 Additional orders. In case the rules contained in this part do not cover all phases of operation or experimentation with respect to external effects, the Commission may make supplemental or additional orders in each case as may be deemed necessary.

Other Operating Requirements

§ 4.281 Station records. (a) The licensee of each experimental facsimile broadcast station shall maintain adequate records of the operation, including:

(1) Hours of operation.
(2) Program transmitted.
(3) Frequency check.
(4) Pertinent remarks concerning transmission.
(5) Research and experimentation conducted.

(b) Where an antenna structure(s) is required to be illuminated see § 17.38, *Recording of tower light inspections in the station record,* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

(c) Station records shall be retained for a period of two years.

§ 4.282 Charges. (a) A licensee of an experimental facsimile broadcast station shall not make any charge, directly or indirectly, for the transmission of programs.

(b) No licensee of any standard or FM broadcast station shall make any additional charge, directly or indirectly, for the transmission of some phase of its programs by an associated experimental facsimile broadcast station.

§ 4.283 Station identification. Each experimental facsimile broadcast station shall transmit visual information which will permit it to be identified at the beginning and end of each period of operation, and during operation, at least once every hour.

§ 4.284 **Rebroadcasts.** (a) The term "rebroadcast" means reception by radio of the program of a radio station, and the simultaneous or subsequent retransmission of such program by a broadcast station.

NOTE 1: As used in this section the word "program" includes any complete program or part thereof.

NOTE 2: In case a program is transmitted from its point of origin to a broadcast station primarily by telephone facilities in which a section of such transmission is by radio, the broadcasting of this program is not considered a rebroadcast. The broadcasting of a program relayed by a remote pickup broadcast station is not considered a rebroadcast.

(b) No licensee of any experimental facsimile broadcast station shall rebroadcast the program of any radio station without written authority having first been obtained from the Commission upon application. Informal application may be employed.

(c) An application for authority to rebroadcast the program of any radio station shall be accompanied by written consent or certification of consent of the licensee of the station originating the program.

SUBPART C—DEVELOPMENTAL BROADCAST STATIONS

Definitions and Allocation of Frequencies

§ 4.301 **Developmental broadcast station.** The term "developmental broadcast station" means a station licensed experimentally to carry on development and research primarily in radiotelephony for the advancement of the broadcast services.

§ 4.302 **Frequency assignment.** (a) Frequencies allocated to the various classes of aural broadcasting stations and broadcast auxiliary stations, in the Commission's Table of Frequency Allocations (Part 2 of this chapter), may be assigned to developmental broadcast stations.

(b) More than one frequency may be assigned upon a satisfactory showing of the need therefor.

(c) Frequencies best suited to the purpose of the experimentation and on which there appears to be the least likelihood of interference to established stations, shall be selected.

(d) In a case of important experimentation which cannot be feasibly conducted on frequencies allocated to the various classes of aural broadcasting stations and broadcast auxiliary stations, the Commission may authorize a developmental broadcast station to operate on other frequencies upon a satisfactory showing of the need therefor and a showing that the proposed operation can be conducted without causing harmful interference to established services: *Provided, however,* That experimental operation which looks toward the development of radio transmitting apparatus or the rendition of any type of regular service using such frequencies, will not be authorized prior to a determination by the Commission that the development of such apparatus or the rendition of such service would serve the public interest.

Administrative Procedure

§ 4.311 **Cross reference.** See §§ 4.11 to 4.16, inclusive.

§ 4.312 **Supplementary statements to be filed with application for construction permit.** A supplementary statement shall be filed with and made a part of each application for construction permit for any developmental broadcast station confirming the applicant's understanding:

(1) That all operation upon the frequency requested is for experimental purposes only,

(2) That the frequency requested may not be the best suited to the particular experimental work to be carried on, and

(3) That the frequency requested need not be allocated for any service that may be developed as a result of the experimental operation,

(4) That any frequency which may be assigned is subject to change without advance notice or hearing,

(5) That any authorization issued pursuant to the application may be cancelled at any time without notice or hearing.

§ 4.313 Supplemental report with renewal application. A supplemental report shall be filed with and made a part of each application for renewal of license and shall include statements of the following, among others:

(a) The number of hours operated.

(b) Comprehensive report on research and experiments conducted.

(c) Conclusions and program for further development of the broadcast service.

(d) All developments and major changes in equipment.

(e) Any other pertinent developments.

Licensing Policies

§ 4.331 Licensing requirements; necessary showing. (a) An applicant for a construction permit for a new developmental broadcast station, change of facilities or modification of an existing license is required to make a satisfactory showing of compliance with the general requirements of the Communications Act of 1934, as amended, as well as with regard to the following:

(1) That the applicant has a program of research and experimentation which can best be carried on under the license requested.

(2) That the program of research has reasonable promise of substantial contribution to the development of broadcasting.

(3) That the program of research and experimentation will be conducted by qualified personnel.

(b) A license for a developmental broadcast station will not authorize exclusive use of any frequency. In case interference would be caused by simultaneous operation of stations licensed experimentally, such licensees shall endeavor to arrange satisfactory time division. If such agreement cannot be reached, the Commission will determine and specify the time division.

§ 4.332 Power limitations. Developmental broadcast stations will be licensed with a power output not in excess of that necessary to render satisfactory service. The license for these stations will specify the maximum authorized power. The operating power shall not be greater than necessary to carry on the service and in no event more than 5 percent above the maximum power specified. Engineering standards have not been established for these stations. The efficiency factor for the last radio stage of transmitters employed will be subject to individual determination but shall be in general agreement with values normally employed for similar equipment operated within the frequency range authorized.

§ 4.333 Emission authorized. In case emission of a different type than that specified in the license is necessary or desirable in carrying on any phases of experimentation, application setting out fully the needs shall be made by informal application.

Equipment

§ 4.351 Equipment changes. The licensee of a developmental broadcast station may make any changes in the equipment that are deemed desirable or necessary: *Provided,*

(a) That the operating frequency is not permitted to deviate more than the allowed tolerance;

(b) That the emissions are not permitted outside the authorized band;

(c) That the power output complies with the license and the regulations governing the same; and

(d) That the transmitter as a whole or output power rating of the transmitter is not changed. This limitation shall not apply to developmental broadcast stations licensed to operate in connection with the development and testing of commercial broadcast equipment.

Technical Operation

§ 4.361 **Frequency tolerance.** The licensee of a developmental broadcast station operating below 450 megacycles shall maintain the operating frequency of its station within plus or minus 0.01 percent of the assigned frequency. The licensee of a developmental broadcast station operating above 450 megacycles shall maintain the operating frequency of its station within plus or minus 0.05 percent of the assigned frequency. However, where a lesser tolerance is necessary in order to prevent interference, the Commission will specify the tolerance.

§ 4.362 **Frequency monitors and measurements.** The licensee of a developmental broadcast station shall provide the necessary means for determining that the frequency of the station is within the allowed tolerance. The date and time of each frequency check, the frequency as measured, and a description or identification of the method employed shall be entered in the station log. Sufficient observations shall be made to insure that the assigned carrier frequency is maintained within the prescribed tolerance.

§ 4.363 **Time of operation.** (a) A licensee of a developmental broadcast station is not required to adhere to a regular schedule of operation but shall actively conduct a program of research and experimentation. However, licensees of developmental broadcast stations which are licensed to conduct special intermittent experiments, such as the development and testing of commercial broadcast equipment, are authorized to operate only when there is a need therefor.

(b) The program of research and experimentation as offered by an applicant in compliance with the requirements for obtaining a license for a developmental broadcast station shall be adhered to in the main, unless the licensee is authorized to do otherwise by the Commission.

(c) The Commission may from time to time require that a station licensed experimentally conduct such experiments as are deemed desirable and reasonable for the development of the service.

§ 4.364 **Station inspection.** The licensee of each developmental broadcast station shall make the station available for inspection by representatives of the Commission at any reasonable hour.

§ 4.365 **Station and operator licenses; posting of.** (a) The station license and any other instrument of authorization or individual order concerning the construction of the equipment or manner of operation of the station shall be posted so that all terms thereof are visible in a conspicuous place in the room in which the transmitter is located. However, if the station is licensed for portable-mobile operation, the station license or a photo copy thereof shall be affixed to the equipment or kept in the possession of the operator on duty at the transmitter. If a photo copy is used the original license shall be available for inspection by an authorized Government representative.

NOTE: The term portable-mobile as here used is intended to include any type of portable or mobile operation.

(b) The original license of each station operator shall be posted at the place where he is on duty: *Provided, however,* If the original license of a station operator is posted at another radio transmitting station in accordance with the rules governing that class of station and is there available for inspection by an authorized Commission representative, or if the station operated is licensed for portable-mobile operation, a verification card (Form 758-F) is acceptable in lieu of the posting of such license.

§ 4.366 **Operator requirements.** One or more radio operators holding radiotelephone first-class or radiotelephone second-class operator licenses shall be on duty at the place where the transmitting apparatus of any developmental broadcast station is located and in actual charge of its operation. The licensed operator on duty and in charge of a broadcast transmitter may at the discretion of the licensee, be employed for other duties or for the operation of another station or stations in accordance with the class of operator's license which he holds and the rules and regulations governing

such stations. However, such duties shall in no wise interfere with the operation of the broadcast transmitter.

§ 4.367 Antenna structure, marking and lighting. Where an antenna structure(s) is required to be painted or lighted see § 17.37, *Inspection of tower lights and associated control equipment;* § 17.39, *Cleaning and repainting;* § 17.40, *Time when lights shall be exhibited;* § 17.41, *Spare lamps;* and § 17.42, *Lighting equipment;* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 4.368 Additional orders. In case the rules contained in this part do not cover all phases of operation or experimentation with respect to external effects, the Commission may make supplemental or additional orders in each case as may be deemed necessary.

Other Operating Requirements

§ 4.381 Station records. (a) The licensee of each developmental broadcast station shall maintain adequate records of the operation, including:

(1) Hours of operation.

(2) Program transmitted.

(3) Frequency check.

(4) Pertinent remarks concerning transmission.

(5) In case of relay or remote pickup station, an entry giving points of program origination and receiver location shall be included.

(6) Research and experimentation conducted.

(b) Where an antenna structure(s) is required to be illuminated see § 17.38, *Recording of tower light inspections in the station record,* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

(c) Station records shall be retained for a period of two years.

§ 4.382 Program service; charges prohibited; announcements. (a) A licensee of a developmental broadcast station shall broadcast programs only when they are necessary to the experiments being conducted. No regular program service shall be broadcast unless specifically authorized. If the license authorizes the carrying of programs, the developmental broadcast station may transmit the programs of a standard, or FM broadcast station or networks, provided, that during the broadcast a statement is made identifying the station or network originating the program (by giving the call letters of the station or name of the network) and announcing that the program is being broadcast in connection with the experimental operation of a developmental broadcast station.

(b) No licensee of any standard, or FM broadcast station shall make any additional charge, directly or indirectly, for the transmission of programs by a developmental broadcast station.

(c) The provisions of paragraphs (a) and (b) of this section shall be applicable to rebroadcasts of the programs of a standard or FM broadcast station or network by a developmental broadcast station.

§ 4.383 Station identification. Each developmental broadcast station shall announce its call letters at the beginning and end of each period of operation, and during operation, at least once every hour.

§ 4.384 Rebroadcasts. (a) The term "rebroadcast" means reception by radio of the program of a radio station, and the simultaneous or subsequent retransmission of such program by a broadcast station.

NOTE 1: As used in this section the word "program" includes any complete program or part thereof.

NOTE 2: In case a program is transmitted from its point of origin to a broadcast station primarily by telephone facilities in which a section of such transmission is by radio, the broadcasting of this program is not considered a rebroadcast. The broadcasting of a program relayed by a remote pickup broadcast station is not considered a rebroadcast.

(b) No licensee of any developmental broadcast station shall rebroadcast the program of any radio station without written authority having first been obtained from the Commission upon application. Informal application may be employed.

(c) An application for authority to rebroadcast the program of any radio station shall be accompanied by written consent or certification of consent of the licensee of the station originating the program.

SUBPART D—REMOTE PICKUP BROADCAST STATIONS

Definitions and Allocation of Frequencies

§ 4.401 Classes of stations. (a) *Remote pickup broadcast mobile station.* A land mobile station, licensed for the transmission of program material from remote points of origination to a broadcasting station for simultaneous or delayed broadcasting and for the transmission of orders pertaining to such programs.

(b) *Remote pickup broadcast base station.* A base station licensed for the transmission of program material from remote points of origination to a broadcasting station for simultaneous or delayed broadcasting and for the transmission of orders pertaining to such programs.

(c) *Remote pickup broadcast station.* The term "remote pickup broadcast station" as used in this subpart includes the definitions in paragraphs (a) and (b) of this section.

§ 4.402 Frequency assignment. (a) The following frequencies are allocated for assignment to remote pickup broadcast base and mobile stations:

(1)

Group A (*kc*)
[1] 1606
1622
1646

(2)

Group D (*Mc*)	*Group E* (*Mc*)	*Group F* (*Mc*)	*Group G* (*Mc*)	*Group H* (*Mc*)
[2] 25.87	[2] 25.91	[2] 25.95	[2] 25.99	[2] 26.03
26.15	26.17	26.19	26.21	26.23
26.25	26.27	26.29	26.31	26.33
26.35	26.37	26.39	26.41	26.43

(3)

Group I (*Mc*)	*Group J* (*Mc*)
[2] 26.07	[2] 26.09
26.11	26.13
26.45	26.47

(4)

Group K [3] (*Mc*)		
152.87	153.05	153.23
152.93	153.11	153.29
152.99	153.17	153.35

(5)

Group L (*Mc*)	*Group M* (*Mc*)
[4] 166.25	[4] 170.15

[1] Subject to the condition that no harmful interference is caused to the reception of standard broadcast stations.

[2] Subject to the condition that no harmful interference is caused to the reception of broadcasting stations.

[3] Subject to the condition that no harmful interference is caused to the Industrial Radio Services.

[4] Operation on the frequencies 166.25 Mc and 170.15 Mc is not authorized (i) within the area bounded on the west by the Mississippi River, on the north by the parallel of latitude 37° 30′ N., and on the east and south by that arc of the circle with center at Springfield, Ill., and radius equal to the airline distance between Springfield, Ill., and Montgomery,

(6)

Group N (Mc)			
450.05	450.55	455.05	455.55
450.15	450.65	455.15	455.65
450.25	450.75	455.25	455.75
450.35	450.85	455.35	455.85
450.45	450.95	455.45	455.95

Alabama, subtended between the foregoing west and north boundaries; (ii) within 150 miles of New York City; and (iii) outside the continental United States; and is subject to the condition that no harmful interference is caused to government radio stations in the band 162–174 Mc.

(b) The following frequencies are allocated for assignment to remote pickup base and mobile stations in the Island of Puerto Rico only:

Mc	*Mc*	*Mc*
159.51	159.69	159.87
159.57	159.75	159.93
159.63	159.81	159.99

NOTE: Use of these frequencies by remote pickup stations is subject to the condition that no harmful interference is caused to stations in the Land Transportation Radio Services.

(c) A licensee is not limited with respect to the number of remote pickup broadcast stations which may be licensed for operation in a single area and each such station may be assigned one or more frequencies: *Provided, however,* That such frequency assignments shall be limited to those within a single frequency Group in any subparagraph of paragraph (a) of this section. This limitation does not preclude the assignment of frequencies listed in different subparagraphs to the same licensee. Applicants shall request the assignment of only those frequencies on which operation is contemplated and the transmitter shall be suitably equipped to operate on all assigned frequencies.

(d) Remote pickup broadcast stations will not be granted exclusive frequency assignments, and the same frequency or frequencies may be assigned to other licensees in the same area.

§ 4.403 Frequency selection to avoid interference. (a) Where two or more remote pickup broadcast stations are licensed for the same frequency or group of frequencies in the same area and when simultaneous operation is contemplated, the licensees shall endeavor to select frequencies or schedule operation in such manner as to avoid mutual interference. If a mutual agreement to this effect cannot be reached the Commission shall be notified and it will specify the freqeuncy or frequencies on which each station is to be operated.

(b) The following order of priority of transmissions shall be observed on all frequencies except those listed in § 4.402(a)(3): (1) The transmission of program material for broadcast, (2) the transmission of orders immediately necessary thereto, and (3) other transmissions permitted under § 4.431(a). On frequencies listed in § 4.402(a)(3), transmissions permitted under § 4.431 shall have priority over transmissions permitted under § 4.432(e).

Administrative Procedure

§ 4.411 Administrative procedure. See §§ 4.11 to 4.16, inclusive.

Licensing Policies

§ 4.431 Purpose of remote pickup broadcast stations. (a) The license of a remote pickup broadcast station authorizes the transmission of program material, orders concerning such program material, and related communications necessary to the accomplishment of such transmissions, to an associated broadcast station (a broadcast

station with which the remote pickup station is licensed as an auxiliary facility), to such other stations as are also broadcasting the same program material, or to the network with which the broadcast station is regularly affiliated. A license issued within the provisions of § 4.432(e) authorizes the additional communications therein provided. Remote pickup broadcast stations may be operated in conjunction with other broadcast stations not aforementioned: *Provided*, That the transmissions by the remote pickup broadcast station shall be under the control of the remote pickup broadcast station licensee, and that such operation shall not exceed a total of 10 days in any 30-day period.

(b) In the event of damage or impairment of the regular circuits of a broadcast station due to storms or other emergencies, remote pickup broadcast stations may be used to provide temporary emergency circuits for program transmission and cue purposes pending completion of repairs. However, remote pickup broadcast stations may not be used for such circuits on a regular basis.

(c) The license of a remote pickup broadcast station authorizes operation on only one of the assigned frequencies at any one time. A licensee may operate two or more remote pickup broadcast stations simultaneously. Remote pickup broadcast stations may be used to transmit orders and related communications from the program control point to the remote pickup point.

(d) Remote pickup broadcast stations licensed in Alaska, Hawaii, Puerto Rico, and the Virgin Islands of the United States may be used for any auxiliary broadcast purpose including inter-city relay circuits which may be operated by the licensee for the purpose of maintaining studios at locations other than that of the main studio: *Provided, however*, That such stations shall not be used for transmissions intended to be received by the public directly.

§ 4.432 Licensing requirements. (a) A license for a remote pickup broadcast station will be issued only to the licensee of a broadcast station. Remote pickup broadcast stations will be licensed to television broadcast stations upon an interim basis pending development of equipment capable of transmitting the aural and the visual portions of television programs within the bands of frequencies allocated for television pickup stations. A separate license is required for each remote pickup broadcast station. Each application for construction permit for a new remote pickup broadcast station or for a change in the facilities of an existing station shall be specific with regard to the frequency or frequencies requested.

(b) In case a licensee has two or more broadcast stations of different services (standard, FM, television, etc.) located in the same city, it shall, in applying for a new remote pickup broadcast station or for renewal of license of an existing station, designate each of the stations with which the remote pickup broadcast station is to be operated.

(c) In case a licensee has two or more broadcast stations located in different cities, it shall, in applying for a new remote pickup station or for renewal of license of an existing station, designate the broadcast station, or stations under the provisions of paragraph (b) of this section, in conjunction with which the remote pickup station is to be operated.

(d) A remote pickup broadcast station may be licensed for portable or mobile operation in accordance with § 4.401(a), or for operation at a fixed location in accordance with § 4.401(b). An application for a new remote pickup broadcast station or for modification of license of an existing station requesting portable or mobile operation shall specify the area in which the proposed station is intended to be employed.

(e) Remote pickup broadcast base stations will be licensed for the purpose of providing communication between the studio and the transmitter of broadcast stations which utilize a broadcast STL station for program transmission, provided that such operation shall not be conducted on frequencies other than those listed in § 4.402(a)(3). The term "broadcast STL station" as used in this section includes "FM broadcast STL," "standard broadcast STL," and "television STL" stations.

§ 4.433 Temporary authorizations. (a) Special temporary authority may be granted for operation, as a remote pickup broadcast station, of equipment already

licensed to another class of station or equipment in use by a class of station which under the Communications Act of 1934 does not require a construction permit.

(b) An application for special temporary authority for the operation of a remote pickup broadcast station shall be filed with the Commission at least 10 days previous to the date of operation. Any application received within less than 10 days may be accepted upon due showing of sufficient reasons for the delay in submitting such request. The application shall set forth full particulars of the purpose for which the request is made and shall show the licensee, call letters, and type of equipment of the station proposed to be used and specify the frequency or frequencies, time and date, location, transmitter power, and type emission proposed and the purpose of the operation requested.

(c) An application for special temporary authority to operate another class of station as a remote pickup broadcast station [6] shall specify a frequency or frequencies allocated in § 4.402: *Provided, however,* In case of events of national interest and importance which cannot be transmitted successfully on these frequencies, other frequencies under the jurisdiction of the Commission may be requested, if it is shown that the operation thereon will not cause interference to established stations: *And provided further,* That no remote pickup operation will be authorized on frequencies employed in the emergency service or otherwise employed for the safety of life and property.

(d) An application for special temporary authority to operate equipment as a remote pickup broadcast station [6] filed by a person other than the licensee of such equipment shall contain a statement to show that temporary control of the transmissions therefrom has been secured for the duration of the special operation proposed. An application for special temporary authority to operate another class of station as a remote pickup broadcast station filed by a person other than the licensee of a standard or FM broadcast station shall contain a statement to show which broadcast station or stations contemplate broadcast of the program proposed to be transmitted.

NOTE: Informal application may be employed.

§ 4.434 Remote control operation. Remote control operation of remote pickup stations will be permitted subject to the following conditions.

(a) A percentage modulation indicator or calibrated program level meter shall be provided at the operating position.

(b) The operator shall have off-and-on control of the power to the last radio stage.

(c) The transmitter shall be so installed and protected that it is not accessible to other than duly authorized persons.

§ 4.435 Power limitations. Remote pickup broadcast stations will be licensed with a power output not in excess of that necessary to render satisfactory service. The license for these stations will specify the maximum authorized power. The operating power shall not be greater than necessary to carry on the service and in no event more than 5 percent above the maximum power specified. Engineering standards have not been established for these stations. The efficiency factor for the last radio stage of transmitters employed will be subject to individual determination but shall be in general agreement with values normally employed for similar equipment operated within the frequency range authorized.

§ 4.436 Emission authorized. (a) The license for a remote pickup broadcast station operating on frequencies below 25 Mc. will normally authorize A3 emission and may in addition authorize A1 and A2 emission where a need therefor is shown. A license for a remote pickup broadcast station operating on frequencies above 25 Mc. will authorize A3 or F3 emission, depending upon the equipment employed. Stations licensed to employ F3 emission shall limit the frequency swing so that the bandwidth of emission will conform to the requirements of the channel widths authorized as follows:

(1) For stations operating on the frequencies 26.11 to 26.47 Mc, 20 kilocycles.

(2) For stations operating on the frequencies 152.87 to 153.35, 159.51 to 159.99, 166.25, and 170.15 Mc, 60 kilocycles.

(3) For stations operating on the frequencies 450.05 to 451.95 Mc, 100 kilocycles.

NOTE: The term "frequency swing" means the instantaneous departure of the frequency of the emitted wave from the center frequency resulting from modulation.

(b) Any emissions outside the authorized channel shall be limited to such an extent as not to constitute a source of potential interference to other stations and in no event shall such emissions be in excess of minus 40 decibels as compared to the emissions within the authorized channel.

§ 4.437 Special rules relating to low power broadcast auxiliary stations. (a) The devices which will be licensed under this section are those which are normally intended to be operated over distances not in excess of a few hundred feet and will fall into two general categories: studio cueing transmitters and wireless microphones. Paragraphs (b) to (j) of this section will govern the licensing of such devices.

(b) A license for a low power broadcast auxiliary station will be issued only to the licensee of a standard, FM, or television broadcast station and for use with a specific station or combination of such broadcast stations within the same city. Such stations may be operated at other locations from time-to-time in accordance with the provisions of paragraph (f) of this section.

(c) The license of a low power broadcast auxiliary station authorizes the transmission of cues and orders to production personnel and participants in broadcast programs and in the preparation thereof, and the transmission of program material by means of a wireless microphone worn by a performer or other participant in a broadcast program during rehearsal and the actual performance. Such transmissions shall be intended for reception at a receiving point within the same studio, building, stadium, or similarly limited indoor or outdoor area.

(d) An application for a new low power broadcast auxiliary station or for a change in an existing authorization shall specify the broadcast station or combination of stations in the same city, as set forth in paragraph (b) of this section, with which it is to be used principally. A single application, filed on FCC Form 313, in duplicate, may be used in applying for authority to construct and operate one or more low power broadcast auxiliary transmitting units provided that such transmitting units are designed for operation in a common frequency band and will be normally operated with the same broadcast station or combination of stations in a single city.

(e) The operation of low power broadcast auxiliary stations will be authorized only in the bands 26.10–26.48 Mc and 450–451 Mc. Transmitting units may be operated on any frequency within the band of frequencies for which the station is licensed, provided that the emissions are confined to the authorized band. Transmitting units are not required to maintain a constancy of frequency beyond that necessary to insure compliance with the above requirement.

(f) A low power broadcast auxiliary station may be used in conjunction with broadcast stations of other licensees located in the same area as the broadcast station or stations with which it is licensed without further authority of the Commission, provided that such operation is conducted by the licensee of the low power broadcast auxiliary station. Low power broadcast auxiliary stations may also be operated in conjunction with broadcast stations of its licensee or other licensees in other locations provided that such operation is conducted by the licensee of the low power broadcast auxiliary station and provided further that if such operation is to be conducted over a consecutive period of more than one day, the Engineer in Charge of the radio district in which the low power broadcast auxiliary station is licensed and the Engineer in Charge of the radio district in which the operation is to be conducted shall be notified in writing at least two days in advance of such operation and of the expected duration of the proposed operation.

(g) Low power broadcast auxiliary stations will not be licensed for a power input to the plate of the final radio frequency amplifier in excess of 1 watt and all operation thereof is subject to the condition that no harmful interference is caused to remote pickup broadcast base and mobile stations. Unusual transmitting antennas or antenna elevations shall not be used to extend the range of these low power devices beyond the limited areas defined in paragraph (c) of this section.

(h) No operator's license is required of the person actually using a low power broadcast auxiliary transmitting unit, provided that an operator holding any commer-

cial radio operator license or permit, except an aircraft radiotelephone operator authorization or a temporary radiotelegraph second-class operator license, is on duty at the place where the transmitting unit is being operated to take immediate steps to correct any condition of improper operation observed. Any adjustments or repairs that could affect the proper operation of transmitting units shall be made by or under the immediate supervision of an operator holding a valid first- or second-class radiotelephone license.

(i) Call signs will not be assigned to low power broadcast auxiliary stations. In lieu thereof, an announcement shall be made at the beginning and end of each period of operation at a single location, over the transmitting unit being operated, identifying the type of transmitting unit, its location, and the call sign of the broadcast station with which it is being used. Transmitting units will normally fall into one of two types: a cueing transmitter or a wireless microphone. A period of operation may consist of a continuous transmission or intermittent transmissions in connection with a single program.

(j) The licensee of each low power broadcast auxiliary station shall maintain adequate records at the main studio or transmitter of the broadcast station with which the auxiliary is principally used, which will accurately show the current location of all transmitting units, the periods of operation at such locations and any other pertinent remarks concerning transmissions.

Equipment

§ 4.451 Equipment changes. The licensee of a remote pickup broadcast station may make any changes in the equipment that are deemed desirable or necessary: *Provided,*

(a) That the operating frequency is not permitted to deviate more than the allowed tolerance;

(b) That the emissions are not permitted outside the authorized band;

(c) That the power output complies with the license and the regulations governing the same; and

(d) That the transmitter as a whole or output power rating of the transmitter is not changed.

Rules Relating to Technical Operation

§ 4.461 Frequency tolerance. The licensee of a remote pickup broadcast station shall maintain the operating frequency of its station in accordance with the following:

Frequency range	Tolerance (percent)	
	Base station	Mobile station
1606 to 2830 kc:		
200 watts or less	0.01	0.02
Over 200 watts [1]	.005	.02
26.11 to 26.47 Mc:		
5 watts or less	.005	.02
Over 5 watts	.005	.005
152.87 to 153.35, 159.51 to 159.99, 166.25, and 170.15 Mc:		
5 watts or less	.005	.01
Over 5 watts	.005	.005
450.05 to 451.95 Mc: All powers	.01	.01

[1] The listing of tolerance for power over 200 watts is in accordance with treaty values and shall not be construed as a finding that such power will be authorized.

§ 4.462 Frequency monitors and measurements. (a) The licensee of a remote pickup broadcast station shall provide the necessary means for determining that the frequency of the station is within the allowed tolerance. The date and time of each frequency check, the frequency as measured, and a description or identification of the method employed shall be entered in the station log. Sufficient observations shall be made to insure that the assigned carrier frequency is maintained within the prescribed tolerance.

(b) Each frequency for which the remote pickup broadcast station is licensed shall be measured at least once during each calendar year.

§ 4.463 Station inspection. The licensee of each remote pickup broadcast station shall make the station available for inspection by representatives of the Commission at any reasonable hour.

§ 4.464 Station and operator licenses; posting of. (a) The station license and any other instrument of authorization or individual order concerning the construction of the equipment or manner of operation of the station shall be posted so that all terms thereof are visible in a conspicuous place in the room in which the transmitter is located: *Provided:*

(1) If the transmitter operator is located at a distance from the transmitter pursuant to § 4.434, the station license shall be posted in the above-described manner at the operating position.

(2) If the station is licensed for portable-mobile operation, the station license or a photo copy thereof shall be affixed to the equipment or kept in the possession of the operator on duty at the transmitter. If a photo copy is used the original license shall be available for inspection by an authorized Government representative.

(b) The original license of each station operator shall be posted at the place where he is on duty: *Provided, however,* If the original license of a station operator is posted at another radio transmitting station in accordance with the rules governing that class of station and is there available for inspection by an authorized Commission representative, or if the station operated is licensed for portable-mobile operation, a verification card (Form 758-F) is acceptable in lieu of the posting of such license: *Provided further, however,* That if the operator on duty holds a restricted radiotelephone operator permit of the card form (as distinguished from the diploma form) he shall not post that permit but shall keep it in his personal possession.

NOTE: The term portable-mobile as here used is intended to include any type of portable or mobile operation.

§ 4.465 Operator requirements. One or more radio operators holding any class of commercial radio operator license or permit shall be on duty at the place where the transmitting apparatus of any remote pickup broadcast station is located, except as provided in § 4.434, and in actual charge of its operation. Further provisions and restrictions concerning the operator's authority are contained in Part 13 of this chapter. The licensed operator on duty and in charge of a broadcast transmitter may, at the discretion of the licensee, be employed for other duties or for the operation of another station or stations in accordance with the class of operator's license which he holds and the rules and regulations governing such stations. However, such duties shall in no wise interfere with the operation of the broadcast transmitter.

§ 4.466 Antenna structure, marking and lighting. Where an antenna structure(s) is required to be painted or lighted see § 17.37, *Inspection of tower lights and associated control equipment;* § 17.39, *Cleaning and repainting;* § 17.40, *Time when lights shall be exhibited;* § 17.41, *Spare lamps;* and § 17.42, *Lighting equipment;* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 4.467 Additional orders. In case the rules contained in this part do not cover all phases of operation or experimentation with respect to external effects, the Commission may make supplemental or additional orders, in each case as may be deemed necessary.

Other Operating Requirements

§ 4.481 **Station records.** (a) The licensee of each remote pickup broadcast station shall maintain adequate records of the operation, including:

(1) Hours of operation.
(2) Program transmitted.
(3) Frequency check.
(4) Pertinent remarks concerning transmission.
(5) An entry giving points of program origination and receiver location.

(b) Where an antenna structure(s) is required to be illuminated see § 17.38, *Recording of tower light inspections in the station record,* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

(c) Station records shall be retained for a period of two years.

§ 4.482 **Station identification.** Each remote pickup broadcast station shall announce its call letters at the beginning and end of each period of operation, and during operation, at least once every hour it shall either announce its call letters or make an announcement which will permit it to be identified. (Such as announcement during program operation of the call letters of the broadcast station with which the remote pickup broadcast station is regularly affiliated.)

SUBPART E—STANDARD AND FM BROADCAST STL AND FM INTERCITY RELAY STATIONS

Definitions and Allocation of Frequencies

§ 4.501 **Classes of stations.** (a) FM Broadcast STL Station: A fixed station utilizing telephony to transmit from a studio of an FM broadcasting station to the transmitter of that broadcasting station, programs to be broadcast by that station.

(b) Standard broadcast STL station: A fixed station utilizing telephony to transmit from a studio of a standard broadcasting station to the transmitter of that broadcasting station, programs to be broadcast by that station.

(c) FM intercity relay station: A fixed station used for the transmission of FM broadcasting programs from one FM broadcasting station to other FM broadcasting stations to provide simultaneous network FM broadcasting and operated only by FM broadcast licensees.

NOTE 1: The term "FM broadcasting station" as used in this part of the rules includes non-commercial educational FM broadcasting stations.

NOTE 2: The abbreviation "STL" is derived from "studio-transmitter link."

§ 4.502 **Frequency assignment.** (a) An FM broadcast STL station may be licensed on one of the following frequencies:

942.5 Mc	946.0 Mc	949.5 Mc
943.0 Mc	946.5 Mc	950.0 Mc
943.5 Mc	947.0 Mc	950.5 Mc
944.0 Mc	947.5 Mc	951.0 Mc
944.5 Mc	948.0 Mc	951.5 Mc
945.0 Mc	948.5 Mc	
945.5 Mc	949.0 Mc	

(b) Any standard broadcast STL station or FM broadcast STL station for which there was outstanding a valid construction permit or license on April 16, 1958, specifying operation on any frequency between 890 Mc and 942 Mc, may continue to be operated on such frequencies for the remainder of the term specified in such authorization and may upon appropriate application therefor be granted a renewal of such license, subject to the condition that no harmful interference shall be caused to the radiopositioning service operating in the band 890–942 Mc and subject to the further condition that the licensee must accept any interference which may be caused by the

operation of radiopositioning stations in the band 890–942 Mc and industrial, scientific, and medical (ISM) equipment in the band 890–940 Mc.

(c) FM inter-city relay stations may be licensed to operate on any of the frequencies listed in paragraph (a) of this section, subject to the condition that no harmful interference is caused to stations operating in the band 942–952 Mc in accordance with the Table of Frequency Allocations contained in § 2.104(a) of this chapter.

§ 4.503 Frequency selection. (a) Each application for a new station or change in an existing station shall be specific with regard to frequency. In general, the lowest suitable frequency will be assigned which, on an engineering basis, will not cause harmful interference to other stations operating in accordance with existing frequency allocations.

(b) Any standard broadcast STL station or FM broadcast STL station for which there was outstanding a valid construction permit or license on April 16, 1958, specifying operation on any frequency between 890 Mc and 942 Mc, may continue to be operated on such frequencies for the remainder of the term specified in such authorization and may upon appropriate application therefor be granted a renewal of such license, subject to the condition that no harmful interference shall be caused to the radiopositioning service operating in the band 890–942 Mc and subject to the further condition that the licensee must accept any interference which may be caused by the operation of radiopositioning stations in the band 890–942 Mc and industrial, scientific, and medical (ISM) equipment in the band 890–940 Mc.

Administrative Procedure

§ 4.511 Cross reference. See §§ 4.11 to 4.16, inclusive.

Licensing Policies

§ 4.531 Licensing requirements. (a) An FM broadcast STL station will be licensed only to the licensee of an FM broadcasting station as an auxiliary to a particular FM broadcasting station of that licensee.

(b) A standard broadcast STL station will be licensed only to the licensee of a standard broadcast station as an auxiliary to a particular standard broadcast station of that licensee.

(c) An FM intercity relay station will be licensed only to the licensee of an FM broadcast station and only upon a satisfactory showing that suitable common carrier facilities are not available. An application for construction permit for a new FM intercity relay station or for renewal of license of an existing station shall be accompanied by a verified statement containing the following:

(1) A full statement as to why the applicant requires the requested facilities including reasons why common carrier facilities cannot be utilized; and,

(2) A showing that the applicant has, at the earliest time reasonably practicable, requested the appropriate common carrier or common carriers serving the general area involved to furnish the intercity FM transmission service required by the applicant, including in such showing a copy of the request or requests and of the reply or replies received from such common carriers.

(d) More than one broadcast STL station or FM intercity relay stations will be licensed for use with single broadcast station only upon a showing that, (1) more than one transmitter is required for the effective operation of a single STL or intercity relay circuit due to distance of transmission, terrain anomalies, or similar circumstances; or, (2) more than one STL circuit is needed to connect additional studios or more than one FM intercity relay circuit is needed to connect additional FM broadcast stations in the network; and it is shown that the nature and extent of use of such additional circuits is such as to justify their authorization.

(e) Each station shall be licensed at a fixed location and the direction of radiation of the antenna shall be fixed.

§ 4.532 Service. (a) The license of an FM broadcast STL station or a standard

broadcast STL station authorizes the relaying of programs from a studio to the transmitter of the broadcast station with which it is licensed, for simultaneous or delayed broadcast: *Provided, however,* That where the licensee of an FM broadcast STL station or a standard broadcast STL station is the licensee of an FM broadcast station and a standard broadcast station in the same city or metropolitan district, the license of each such STL station authorizes the relaying to be made to either or both such broadcast stations.

(b) The license of an FM intercity relay station authorizes the relaying of FM broadcast programs and communications relating thereto between FM broadcasting stations located in different cities in order to provide network FM broadcasting. The operation of FM intercity relay stations is subject to the condition that no harmful interference is caused to other radio stations, present or future, operating in accordance with the Table of Frequency Allocations set forth in § 2.104(a) of this chapter.

(c) Each FM broadcast STL station, standard broadcast STL station, or FM intercity relay station will be licensed for unlimited time operation.

(d) During periods in which it is not a part of the broadcast circuit, the transmitting equipment may be used for the transmisson of communications which pertain to the broadcast operations. If the transmitter and receiver are equipped with a multiplex circuit, communications during broadcast periods may be authorized upon application therefor. Such a circuit, if used, shall be designed and operated in a manner which will not cause spurious emissions or derogation of the program transmission. Studio to transmitter and transmitter to studio communication may also be provided by equipment operated under the remote pickup broadcast station rules. Superfluous transmissions are not permitted.

§ 4.533 Remote control and unattended operation. (a) Broadcast STL or FM intercity relay stations may be operated by remote control: *Provided,* That such operation is conducted in accordance with the conditions listed in this section: *And provided further,* That the Commission is notified at least 10 days prior to such operation and that such notification is accompanied by a detailed description of the proposed remote control installation showing the manner of compliance with the following couditions:

(1) The operating position shall be under the control and supervision of the licensee and shall be the place at which a licensed operator meeting the requirements of § 4.565 and responsible for the operation of the transmitter is stationed;

(2) A carrier operated device shall be provided at the operating position which shall give a continuous visual indication when the transmitter is radiating; or, in lieu thereof, a device shall be provided which will give a continuous visual indication when any transmitter control circuits have been placed in a coudition to produce radiatiou;

(3) Facilities shall be provided at the operating position which will permit the operator to turn the transmitter carrier on and off at will; and

(4) The transmitter and all of its operating controls shall be so installed and protected that they are not accessible to other than authorized personnel.

(b) FM intercity relay stations, and broadcast STL stations where the circuit requires the use of more than one STL transmitter, may be operated unattended: *Provided,* That such operation is conducted in accordance with the conditions listed below: *And provided further,* That the Commission is notified at least 10 days prior to the beginning of such operation and that such notification is accompanied by a detailed description of the proposed installation showing the manner of compliance with the following conditions:

(1) The transmitter is capable of retransmitting by self-actuating means a radio signal received from another radio station or stations;

(2) The transmitter shall be provided with adequate safeguards to prevent improper operation of the equipment;

(3) The tranmsitter shall be so installed and protected that it is not accessible to other than duly authorized persons;

(4) Appropriate observations shall be made, at intervals not exceeding one hour during the period of its operations, at the receiving end of the circuit by a person

holding a valid first or second class radiotelephone operator license who shall immediately institute measures sufficient to assure prompt correction of any condition of improper operation that is observed; and

(5) The station licensee shall remain responsible for the proper operation of the station, and all adjustments or tests during or coincident with the installation, servicing, or maintenance of the station which may affect its proper operation, shall be performed by or under the immediate supervision and responsibility of a person holding a valid first or second class radiotelephone operator license.

(c) The Commission may notify the licensee not to commence remote control or unattended operation, or to cancel, suspend, or change the date of the beginning of such operation as and when such action may appear to be in the public interest, convenience and necessity.

§ 4.534 Power limitations. Broadcast STL and FM intercity relay stations will be licensed with a power output not in excess of that necessary to render satisfactory service. The license for these stations will specify the maximum authorized power. The operating power shall not be greater than necessary to carry on the service and in no event more than 5 percent above the maximum power specified. Engineering standards have not been established for these stations. The efficiency factor for the last radio stage of transmitters employed will be subject to individual determination but shall be in general agreement with values normally employed for similar equipment operated within the frequency range authorized.

§ 4.535 Emission authorized. (a) Broadcast STL and FM intercity relay stations normally will be authorized to employ frequency modulation only.

(b) The maximum frequency swing employed shall not be in excess of 200 kilocycles.

NOTE: The term "frequency swing" means the instantaneous departure of the frequency of the emitted wave from the center frequency resulting from modulation.

§ 4.536 Directional antenna required. Each broadcast STL or FM intercity relay station is required to employ a directional antenna. Considering one kilowatt of radiated power as a standard for comparative purposes, such antenna shall provide a free space field intensity at one mile of not less than 435 mv/m in the main lobe of radiation toward the receiver and not more than 20 percent of the maximum value in any azimuth 30 degrees or more off the line to the receiver. Where more than one antenna is authorized for use with a single station, the radiation pattern of each shall be in accordance with the foregoing requirement.

Equipment

§ 4.551 Equipmeut changes. The licensee of a broadcast STL or FM intercity relay station may make any changes in the equipment that are deemed desirable or necessary provided:

(a) That the operating frequency is not permitted to deviate more than the allowed tolerance;

(b) That the emissions are not permitted outside the authorized band;

(c) That the power output complies with the license and the regulations governing the same; and

(d) That the transmitter as a whole or output power rating of the transmitter is not changed.

Technical Operation

§ 4.561 Frequency tolerance. The licensee of each broadcast STL or FM intercity relay station shall maintain the operating frequency of the station within plus or minus 0.005 percent of the assigned frequency.

§ 4.562 Frequency monitors and measurements. The licensee of a broadcast STL or FM intercity relay station shall provide the necessary means for determining that the frequency of the station is within the allowed tolerance. The date and time of

each frequency check, the frequency as measured, and a description or identification of the method employed shall be entered in the station log. Sufficient observations shall be made to insure that the assigned carrier frequency is maintained within the prescribed tolerance.

§ 4.563 Station inspection. The licensee of each broadcast STL or FM intercity relay station shall make the station available for inspection by representatives of the Commission at any reasonable hour.

§ 4.564 Station and operator license; posting of. (a) The station license and any other instrument of authorization or individual order concerning the construction of the equipment or manner of operation of the station shall be posted so that all terms thereof are visible, in a conspicuous place in the room in which the transmitter is located: *Provided,* That if the transmitter operator is located at a distance from the transmitter pursuant to § 4.533 the station license shall be posted in the above-described manner at the operating position.

(b) The original license of each station operator shall be posted at the place where he is on duty: *Provided, however,* If the original license of a station operator is posted at another radio transmitting station in accordance with the rules governing that class of station and is there available for inspection by an authorized Commission representative, a verification card (Form 758-F) is acceptable in lieu of the posting of such license: *Provided further, however,* That if the operator on duty holds a restricted radiotelephone operator permit of the card form (as distinguished from the diploma form) he shall not post that permit but shall keep it in his personal possession.

§ 4.565 Operator requirements. One or more radio operators holding any class of commercial radio operator license or permit shall be on duty at the place where the transmitting apparatus is located, except as provided in § 4.533, and in actual charge of its operation. Further provisions and restrictions concerning the operator's authority are contained in Part 13 of this chapter. The licensed operator on duty and in charge of a broadcast transmitter may, at the discretion of the licensee, be employed for other duties or for the operation of another station or stations in accordance with the class of operator's license which he holds and the rules and regulations governing such stations. However, such duties shall in no wise interfere with the operation of the broadcast transmitter.

§ 4.566 Antenna structure, marking and lighting. Where an antenna structure(s) is required to be painted or lighted see § 17.37, *Inspection of tower lights and associated control equipment;* § 17.39, *Cleaning and repainting;* § 17.40, *Time when lights shall be exhibited;* § 17.41, *Spare lamps;* and § 17.42, *Lighting equipment;* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 4.567 Additional orders. In case the rules contained in this part do not cover all phases of operation or experimentation with respect to external effects, the Commission may make supplemental or additional orders in each case as may be deemed necessary.

Other Operating Requirements

§ 4.581 Station records. (a) The licensee of each broadcast STL or FM intercity relay station shall maintain adequate records of the operation, including:

(1) Hours of operation.

(2) Program transmitted.

(3) Frequency check.

(4) Pertinent remarks concerning transmission.

(b) Where an antenna structure(s) is required to be illuminated see § 17.38 of this chapter.

(c) Station records shall be retained for a period of two years.

§ 4.582 Station identification. Each broadcast STL or FM intercity relay station shall announce its call letters at the beginning and end of each period of operation, and during operation, at least once every hour, it shall either announce its call letters or make an announcement which will permit it to be identified. (Such as announcement during program operation of the call letters of the broadcast station with which the broadcast STL station is operated.)

SUBPART F—TELEVISION AUXILIARY BROADCAST STATIONS

Definitions and Allocation of Frequencies

§ 4.601 Classes of stations. (a) 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.

(b) 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.

(c) Television inter-city relay station: A fixed station used for inter-city transmission of television program material and related communications for use by television broadcast stations.

NOTE: Wherever used in this subpart the term "television broadcast station licensee" includes a television broadcast station permittee.

§ 4.602 Frequency assignment. (a) The following frequencies are allocated for assignment to television pickup, television STL, and television inter-city relay stations:

Band A (Mc)	Band B (Mc)	Band C (Mc)	Band D (Mc)	
1990–2008	6875–6900	10550–10575	12700–12725	12975–13000
2008–2025	6900–6925	10575–10600	12725–12750	13000–13025
2025–2042	6925–6950	10600–10625	12750–12775	13025–13050
2042–2059	6950–6975	10625–10650	12775–12800	13050–13075
2059–2076	6975–7000	10650–10675	12800–12825	13075–13100
2076–2093	7000–7025	10675–10700	12825–12850	13100–13125
2093–2110	7025–7050	.....	12850–12875	13125–13150
2450–2467	[1] 7050–7075	.....	12875–12900	13150–13175
2467–2484	[1] 7075–7100	.....	12900–12925	13175–13200
2484–2500	[1] 7100–7125	.....	12925–12950	13200–13225
.....	.....	.....	12950–12975	.....

[1] Pending further order by the Commission, frequencies between 7050 Mc and 7125 Mc will be reserved for use by communications common carriers to provide television pickup and television STL service to television broadcast stations.

Frequencies in the bands 16000–18000 Mc and 26000–30000 Mc are available for assignment on a case-by-case basis for television pickup, STL and intercity relay purposes. Channel widths and frequency tolerance will be specified in individual authorizations. Frequencies shown above between 2450 and 2500 Mc in Band A and between 17850 and 18000 Mc are allocated to accommodate the incidental radiations of industrial, scientific, and medical (ISM) equipment, and stations operating therein must accept any interference that may be caused by the operation of such equipment. ISM frequencies are also shared with other communication services and exclusive channel assignments will not be made, nor is the channeling shown above necessarily that which will be employed by such other services.

(b) Except as provided above each television broadcast station licensee in an area may request the assignment of one channel in Band A or Band B and one channel in Band D on an exclusive basis. In making such exclusive assignments, priority will be based on the filing date of an appropriate application (FCC Form 313) completed in accordance with the instructions thereon. Frequency assignments will normally be made as requested if the requested frequency is not assigned to another licensee on an exclusive basis. However, the Commission reserves the right to assign frequencies other than those requested if, in its opinion, such action is warranted.

(c) Where the relative locations of the studio and transmitter are such as to permit co-channel operation of television STL stations by two or more licensees in the same

area such licensees may, by mutual agreement, request the assignment of a common channel for STL use on an exclusive basis. In the event that such a shared assignment is made each participating licensee may request the assignment of an individual exclusive channel in Band A, Band B, or Band D in addition to the shared STL channel.

(d) A television broadcast station licensee will normally be limited to the assignment of not more than three channels in Bands A and B combined, only one of which will be assigned on an exclusive basis: *Provided, however,* That additional channels in Bands A and B may be assigned on a non-exclusive basis upon a satisfactory showing that additional channels are necessary and that such additional channels, if assigned, will not be needed to provide an exclusive channel to some other licensee in the same area within the foreseeable future. The number of channels in Bands C and D that may be assigned to a licensee in a single area is not restricted.

(e) Non-exclusive channel assignments are subject to withdrawal without advance notice to provide an exclusive channel assignment to a licensee pursuant to the provisions of paragraph (b) of this section. The Commission reserves the right to select the non-exclusive channel assignment to be withdrawn; however, withdrawals will normally be made in the following order:

(1) The most recent channel assignment to the licensee having the greatest number of assignments in Band A, B, or D. Determination as to whether the withdrawal shall be made in Band A, Band B, or Band D, will be based on the design of the equipment proposed to be used by the applicant for whom the exclusive channel is required.

(2) Where two or more licensees are assigned individually an equal number of non-exclusive channels in the same band and a greater number of channels in that band than any one of the other licensees, the assignment of most recent date.

(3) In all other cases the assignment of most recent date of a non-exclusive channel.

(f) The use of frequencies in the bands 1990–2110 Mc, 6875–7125Mc, and 12,700–13,200 Mc, by television inter-city relay stations shall be on a secondary basis and is subject to the condition that no harmful interference is caused to stations operating in accordance with the table of frequency allocations in § 2.104(a) of this subchapter.

(g) In the event that a television broadcast station licensee engages a communications common carrier to provide television pickup or television STL service, the frequencies available to that licensee may be assigned to the communications common carrier for the purpose of providing such service to that licensee. For the purpose of applying the provisions with respect to exclusive channel assignments and the withdrawal of channels, channels assigned to communications common carriers to provide television pickup or television STL service to an individual television broadcast station licensee will be considered to be assigned to that television broadcast licensee.

§ 4.603 Sound channels. (a) The frequencies listed in § 4.602(a) may be used for the simultaneous transmission of the picture and sound portions of television broadcast programs and for cue and order circuits, either by means of multiplexing or by the use of a separate transmitter within the same channel. When multiplexing of a television STL station is contemplated consideration should be given to the requirements of § 3.687 of this subchapter regarding the overall system performance requirements. Applications for new television pickup, television STL, and television intercity relay stations shall clearly indicate the nature of any multiplexing proposed. Multiplexing equipment may be installed on licensed equipment without further authority of the Commission: *Provided,* That the Commission in Washington, D.C., and the Commission's engineer-in-charge of the radio district in which the station is located shall be promptly notified of the installation of such apparatus: *And provided further,* That the installation of such apparatus on a television STL station shall not result in degradation of the overall system performance of the television broadcast station below that permitted by § 3.687 of this subchapter.

(b) The following additional frequencies are allocated for assignment to television STL stations and television intercity stations for the transmission of the sound portion only of television program material or communications relating thereto: [1]

[1] Shared with other services. See § 2.104(a) of this chapter.

890.5 Mc	895.0 Mc	899.0 Mc	903.0 Mc	907.0 Mc
891.0	895.5	899.5	903.5	907.5
891.5	896.0	900.0	904.0	908.0
892.0	896.5	900.5	904.5	908.5
892.5	897.0	901.0	905.0	909.0
893.0	897.5	901.5	905.5	909.5
893.5	898.0	902.0	906.0	910.0
894.0	898.5	902.5	906.5	910.5
894.5				

Stations operating on these frequencies must accept any interference that may be experienced from the operation of industrial, scientific, and medical equipment in the 890–940 Mc band.

(c) Remote pickup broadcast stations may be used in conjunction with television pickup stations for the transmission of the aural portion of television programs or events that occur outside a television studio and for the transmission of cues, orders, and other related communications necessary thereto. The rules governing remote pickup broadcast stations are contained in Subpart D of this part.

§ 4.604 Frequency selection to avoid interference. (a) Applicants for new television pickup, television STL, and television inter-city relay station shall endeavor to select frequency assignments which will be least likely to result in mutual interference with other licensees in the same area. Consideration should be given to the relative locations of receiving points, normal transmission path, and nature of the contemplated operation.

(b) Because of the more or less continuous nature of the operation of television STL stations, frequency assignments to such stations will normally be designated as the exclusive channel of the licensee pursuant to § 4.602(b).

(c) Where two or more licensees are assigned a common channel for television pickup, television STL, or television inter-city relay purposes in the same area and simultaneous operation is contemplated, they shall take such steps as may be necessary to avoid mutual interference. If a mutual agreement to this effect cannot be reached, the Commission shall be notified and it will take such action as may be necessary, including time-sharing arrangements, to assure an equitable distribution of available facilities.

Administrative Procedure

§ 4.621 Cross reference. See §§ 4.11 through 4.16.

§ 4.631 Purpose of television auxiliary stations. (a) The license of a television pickup station authorizes the transmission of program material, orders concerning such program material, and related communications necessary to the accomplishment of such transmissions, from the scenes of events occurring in places other than a television studio, to its associated television broadcast station, to such other stations as are broadcasting the same program material, or to the network or networks with which the television broadcast station is affiliated. Television pickup stations may be operated in conjunction with other television broadcast stations not aforementioned: *Provided,* That the transmissions by the television pickup station are under the control of the licensee of the television pickup station and that such operation shall not exceed a total of 10 days in any 30-day period. Television pickup stations may be used to provide temporary studio-transmitter links or intercity relay circuits consistent with § 4.632, without further authority of the Commission: *Provided, however,* That prior Commission authority shall be obtained if the transmitting antenna to be installed will increase the height of any natural formation or man-made structure by more than 20 feet and will be in existence for a period of more than 2 consecutive days.

NOTE: As used in this subpart, "associated television broadcast station" means a television broadcast station licensed to the licensee of the television auxiliary broadcast station and with which the television auxiliary station is licensed as an auxiliary facility.

(b) The license of a television STL station authorizes the transmission of program material, orders concerning such program material, and related communications necessary to the accomplishment of such transmissions, from the studio or studios of the associated television broadcast station to the transmitter of that station. A television STL station may be authorized to operate in the direction from the transmitter to the studio upon a showing that such operation is necessary and that it may be effected without the assignment of frequencies in addition to those available for assignment to the applicant under these rules.

(c) The license of a television intercity relay station authorizes the transmission of program material, orders concerning such program material and related communications necessary to the accomplishment of such transmissions between television broadcast stations for the purpose of simultaneous programming or network broadcasting.

§ 4.632 Licensing requirements. (a) A license for a television pickup, television STL, or television intercity relay station will be issued only to the licensee of a television broadcast station. A separate application is required for each transmitter and the application shall be specific with regard to the frequency requested. Except as provided in § 4.604(b), the first channel assigned in Band A or Band B to a licensee will be considered to be the exclusive assignment provided in § 4.602(b). Exclusive channel assignments in Band D will be designated only upon request. A licensee may request a change in its exclusive channel assignment only where there are unassigned channels available. In making such changes, the priority set forth in § 4.602(b) will be observed.

(b) A license for a television intercity relay station may be issued in any case where the circuit will operate between television broadcast stations either by means of "off-the-air" pickup and relay or location of the initial relay station at the studio or transmitter of a television broadcast station.

(c) An application for construction permit for a new television pickup station or for renewal of license of an existing station shall designate the television broadcast station with which it is to be operated and specify the area in which the proposed operation is intended.

(d) In case a licensee has two or more television broadcast stations located in different cities, it shall, in applying for a new television pickup station or for renewal of license of an existing station, designate the television broadcasting station in conjunction with which it is to be operated principally, and it shall not thereafter operate the television pickup station in conjunction with another of its television broadcast stations located in a different city for a total of more than 10 days in any 30-day period.

§ 4.633 Temporary authorizations. (a) Special temporary authority may be granted for the operation, as a television auxiliary broadcast station, of equipment licensed to another television broadcast station, or other class of station, or equipment of suitable design not heretofore licensed. Such authority will normally be granted only for special operation of a temporary nature.

(b) A request for special temporary authority for the operation of a television auxiliary broadcast station may be made by informal application, which shall be filed with the Commission at least 10 days prior to the date of the proposed operation: *Provided*, That an application filed within less than 10 days of the proposed operation may be accepted upon a satisfactory showing of the reasons for the delay in submitting the request.

(c) An application for special temporary authority shall set forth full particulars of the purpose for which the request is made, and shall show the type of equipment, power output, emission, and frequency or frequencies proposed to be used, as well as the time, date and location of the proposed operation. In the event that the proposed antenna installation will increase the height of any natural formation, or existing man-made structure, by more than 20 feet, a vertical plan sketch showing the height of the structure proposed to be erected, the height above ground of any existing structure, the elevation of the site above mean sea level, and the geographic coordinates of the proposed site, shall be submitted with the application.

(d) A request for special temporary authority shall specify a channel or channels consistent with the provisions of § 4.602: *Provided,* That in the case of events of widespread interest and importance which cannot be transmitted successfully on these frequencies, frequencies assigned to other services may be requested upon a showing that operation thereon will not cause interference to established stations: *And provided further,* That in no case will a television auxiliary broadcast operation be authorized on frequencies employed for the safety of life and property.

§ 4.634 Remote control operation. (a) A television auxiliary station may be operated by remote control provided that such operation is conducted in accordance with the conditions listed below, and provided further that the Commission is notified at least 10 days prior to such operation and that such notification is accompanied by a detailed description of the proposed remote control installation showing the manner of compliance with the following conditions:

(1) The operating position shall be under the control and supervision of the licensee and shall be the place at which a licensed operator, meeting the requirements of § 4.665 and responsible for the operation of the transmitter, is stationed.

(2) A carrier operated device shall be provided at the operating position which shall give a continuous visual indication when the transmitter is radiating; or, in lieu thereof, a device shall be provided which will give a continuous visual indication when any transmitter control circuits have been placed in a condition to produce radiation;

(3) Facilities shall be provided at the operating position which will permit the operator to turn the transmitter carrier on and off at will; and

(4) The transmitter and all of its operating controls shall be so installed and protected that they are not accessible to other than duly authorized personnel.

(b) The Commission may notify the licensee not to commence remote control operation, or to cancel, suspend, or change the date of beginning for such operation as and when such action may appear to be in the public interest, convenience, and necessity.

§ 4.635 Unattended operation. (a) Television inter-city relay stations and television STL stations, where the circuit requires the use of more than one STL transmitter, may be operated unattended: *Provided,* That such operation is conducted in accordance with the conditions listed below: *And provided further,* That the Commission is notified at least 10 days prior to the beginning of such operation and that such notification is accompanied by a detailed description of the proposed installation showing the manner of compliance with the following conditions:

(1) The transmitter is capable of retransmitting by self-actuating means a radio signal received from another radio station or stations;

(2) The transmitter shall be provided with adequate safeguards to prevent improper operation of the equipment;

(3) The transmitter shall be so installed and protected that it is not accessible to other than duly authorized persons;

(4) Appropriate observations shall be made, at intervals not exceeding one hour during the period of its operation, at the receiving end of the circuit by a person holding a valid first or second class radiotelephone operator license who shall immediately institute measures sufficient to assure prompt correction of any condition of improper operation that is observed; and

(5) The station licensee shall remain responsible for the proper operation of the station, and all adjustments or tests during or coincident with the installation, servicing, or maintenance of the station which may affect its proper operation, shall be performed by or under the immediate supervision and responsibility of a licensed operator as provided in § 4.665.

(b) The Commission may notify the licensee not to commence unattended operation, or to cancel, suspend, or change the date of the beginning of such operation as and when such action may appear to be in the public interest, convenience, and necessity.

§ 4.636 Power limitations. Television auxiliary broadcast stations will be licensed with a power output not in excess of that necessary to render satisfactory service.

The license for these stations will specify the maximum authorized power. The operating power shall not be greater than necessary to carry on the service and in no event more than 10 percent above the maximum power specified. Engineering standards have not been established for these stations. The efficiency factor for the last radio stage of transmitters employed will be subject to individual determination but shall be in general agreement with values normally employed for similar equipment operated within the frequency range authorized.

§ 4.637 **Emission and bandwidth.** (a) Television auxiliary broadcast stations operating on frequencies above 1500 Mc may be authorized to employ any type of emission suitable for the transmission of the visual and accompanying aural signals. The emission of such stations shall be confined to the assigned channel.

(b) Television auxiliary broadcast stations operating on frequencies below 1500 Mc may be authorized to employ either frequency modulation or amplitude modulation, or both, depending upon the equipment employed. The emissions of such stations shall be confined to the assigned channel.

Equipment

§ 4.651 **Equipment changes.** (a) Commission authority upon appropriate formal application (FCC Form 313) therefor is required for any of the following equipment changes:

(1) A change of the transmitter as a whole (except replacement with an identical transmitter), or a change in the power output.

(2) A change of frequency assignment.

(3) A change in the location of a television STL or television intercity relay station (except relocation of the equipment within the same building) or a change in the area of operation of a television pickup station.

(4) Any change in the antenna system of a television STL or television intercity relay station which will result in a change of more than 20 feet in the height above ground of the antenna and supporting structure, or that will result in a change of the direction of the main radiation lobe.

(b) Other equipment changes not specifically referred to above may be made at the discretion of the licensee provided that the engineer-in-charge of the radio district in which the station is located, and the Commission at its Washington office, are notified in writing upon the completion of such changes, and provided that the changes are appropriately reflected in the next application for renewal of license of the television auxiliary broadcast station filed by the licensee.

Technical Operation

§ 4.661 **Frequency tolerance.** (a) The licensee of a television auxiliary broadcast station shall maintain the operating frequency of its station so that the normal sideband energy shall fall within the assigned channel. If transmission is by asymmetrical sideband operation, suitable filters or other devices shall be employed to insure a minimum of radiated energy outside the assigned channel.

(b) Television STL stations operating on frequencies shown in § 4.603(b) shall maintain their operating frequency within 0.005 percent of the assigned frequency.

§ 4.662 **Frequency monitors and measurements.** The licensee of a television auxiliary broadcast station shall provide means for measuring the operating frequency in order to insure that the emissions are confined to the authorized channel. The date and time of each frequency check, the frequency as measured and a description or identification of the method employed shall be entered in the station log.

§ 4.663 **Station inspection.** The licensee of each television auxiliary broadcast station shall make the station available for inspection by representatives of the Commission at any reasonable hour.

§ 4.664 **Station and operator licenses; posting of.** (a) The station license and any other instrument of authorization or individual order concerning the construction of the equipment or manner of operation of the station shall be posted so that all

terms thereof are visible in a conspicuous place in the room in which the transmitter is located: *Provided:*

(1) If the transmitter operator is located at a distance from the transmitter pursuant to § 4.634 the station license shall be posted in the above-described manner at the operating position.

(2) If the station is licensed for mobile operation, the station license or a photo copy thereof shall be affixed to the equipment or kept in the possession of the operators on duty at the transmitter. If a photo copy is used the original license shall be available for inspection by an authorized government representative.

(b) The original license of each station operator shall be posted at the place where he is on duty: *Provided, however,* That if the original license of a station operator is posted at another radio transmitting station in accordance with the rules governing that class of station and is there available for inspection by an authorized Commission representative, a duly issued verified statement (Form 759) may be posted at the television auxiliary broadcast station in lieu of such original license: *And provided further,* That if the television auxiliary broadcast station is licensed for mobile operation, a duly issued verification card (Form 758-F) attesting to the existence of such original license may be carried on the person of the operator in lieu of the posting of such license or verified statement.

NOTE: The term mobile as here used is intended to include any type of mobile operation.

§ 4.665 Operator requirements. (a) One or more radio operators holding valid radiotelephone first-class or radiotelephone second-class operator licenses shall be on duty at the place where the transmitting apparatus of any television auxiliary broadcast station is located and in actual charge of its operation: *Provided, however,* That if a station is operated by remote control as provided in § 4.634, such operator or operators must be on duty at the control point in lieu of the transmitting location: *And provided further,* That, in case a station is operated unattended as provided in § 4.635 such an operator shall be on duty at the receiving end of the circuit and shall be responsible for the required observations and the proper operation of the station within the terms of its license.

(b) The licensed operator on duty and in charge of a television auxiliary broadcast station may, at the discretion of the licensee, be employed for other duties or for the operation of another station or stations in accordance with the class of operators license which he holds and the regulations governing such stations; however, such duties shall in nowise interfere with the operation of the television auxiliary broadcast station.

§ 4.666 Antenna structure, marking and lighting. Where an antenna structure(s) is required to be painted or lighted see § 17.37, *Inspection of tower lights and associated control equipment;* § 17.39, *Cleaning and repainting;* § 17.40, *Time when lights shall be exhibited;* § 17.41, *Spare lamps;* and § 17.42, *Lighting equipment;* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

§ 4.667 Additional orders. In case the rules contained in this part do not cover all phases of operation or experimentation with respect to external effects, the Commission may make supplemental or additional orders in each case as may be deemed necessary.

§ 4.681 Station logs. (a) The licensee of each television auxiliary broadcast station shall maintain adequate records of the operation including:

(1) Hours of operation.

(2) Call letters of broadcast station to which program transmitted.

(3) Frequency check.

(4) Pertinent remarks concerning transmission.

(b) Where an antenna structure(s) is required to be illuminated see § 17.38, *Recording of tower light inspections in the station record,* of Part 17 of this chapter (Construction, Marking and Lighting of Antenna Structures).

(c) Station records shall be retained for a period of two years.

§ 4.682 Station identification. (a) Each television auxiliary broadcast station shall identify itself by transmitting its call sign at the beginning and end of each

period of operation; and during operation, shall identify itself on the hour by transmitting its own call sign or the call sign of the television broadcast station with which it is associated.

(b) Identification transmissions during operation need not be made when to make such transmission would interrupt a single consecutive speech, play, religious service, symphony concert, or any type of production. In such cases, the identification transmission shall be made at the first interruption of the entertainment continuity and at the conclusion thereof.

(c) Where more than one television auxiliary broadcast station is employed in an integrated relay system, the station at the point of origination may originate the transmission of the call signs of all the stations in the relay system.

(d) The transmission of the call sign shall normally employ the type of emission for which the station is authorized, i.e., a visual transmitter shall employ visual identification and an aural transmitter shall employ aural identification: *Provided, however,* When the transmitter is used for visual transmission only, the identifying call sign may be transmitted in international Morse code by keying the radio frequency carrier or a modulating signal impressed on the carrier. The Commission may, at its discretion, specify other methods of identification.

SUBPART G—TELEVISION BROADCAST TRANSLATOR STATIONS

Definitions and Allocation of Frequencies

§ 4.701 Television broadcast translator station and primary station. (a) A television broadcast translator station is a station in the broadcasting service operated solely for the purpose of retransmitting the signals of a television broadcast station or another television broadcast translator station, by means of direct frequency conversion and amplification of the incoming signals and 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.

(b) A primary station is the television broadcasting station radiating the signals which are retransmitted by a television broadcast translator station.

§ 4.702 Frequency assignment. (a) An application for a television broadcast translator station shall be specific with regard to the channel requested. One of the following channels may be assigned:

Channel No.	Frequency band	Visual carrier frequency	Aural carrier frequency
	Mc.	*Mc.*	*Mc.*
70	806–812	807.25	811.75
71	812–818	813.25	817.75
72	818–824	819.25	823.75
73	824–830	825.25	829.75
74	830–836	831.25	835.75
75	836–842	837.25	841.75
76	842–848	843.25	847.75
77	848–854	849.25	853.75
78	854–860	855.25	859.75
79	860–866	861.25	865.75
80	866–872	867.25	871.75
81	872–878	873.25	877.75
82	878–884	879.25	883.75
83	884–890	885.25	889.75

(b) An applicant for a television broadcast translator station shall endeavor to select a channel on which its operation will not cause interference to other television broadcast translator stations.

(c) A channel listed in paragraph (a) of this section will not be assigned to a television broadcast translator station located:

(1) Within 20 miles of a television broadcast channel assignment on the second, third, fourth, fifth, or eighth channel below or above the requested channel;

(2) Within 55 miles of a television broadcast channel assignment on an adjacent channel;

(3) Within 60 miles of a television broadcast channel assignment on the seventh channel above or below or the fourteenth channel below the requested assignment;

(4) Within 75 miles of a television broadcast channel assignment on the fifteenth channel below the requested assignment;

(5) Within 155 miles of a television broadcast channel assignment on the same channel as that requested for the television broadcast translator station.

The distances specified above in this paragraph are to be determined with respect to channels having the above relationship, between the proposed site of the television broadcast translator station and the Post Office location in any city listed in § 3.606 of this chapter unless the channel shown therein has been assigned to a television broadcast station, in which case the distance shall be determined between the proposed site of the translator and the transmitter site of the television broadcast station. Changes in the Table of Assignments of § 3.606(b) of this chapter may be made without regard to existing or proposed television broadcast translator stations and where such changes result in minimum separations less than those specified above, the licensee of an affected television broadcast translator station shall file an application for a change in channel assignment to comply with the required separations.

(d) No minimum distance separation is specified between television broadcast translator stations operating on the same channel. However, the separation shall in all cases be adequate to prevent mutual interference. Adjacent channel assignments will not be made to television broadcast translator stations intended to serve all or a part of the same area.

§ 4.703 Interference. (a) An application for a new television broadcast translator station or for changes in the facilities of an existing station will not be granted where it is apparent that mutual interference will result within the area or areas intended to be served by such stations. In general, the licensee of a new television broadcast translator station shall protect existing television broadcast translator stations from interference resulting from its operation.

(b) It shall be the responsibility of the licensee of a television broadcast translator station to correct any condition of interference which results from the radiation of radio frequency energy by its equipment on any frequency outside the assigned channel. Upon notice by the Commission to the station licensee or operator that such interference is being caused, the operation of the television broadcast translator station shall be suspended immediately and shall not be resumed until the interference has been eliminated, or it can be demonstrated that the interference is not due to spurious emissions by the television broadcast translator station: *Provided, however,* That short test transmissions may be made during the period of suspended operation to check the efficacy of remedial measures.

(c) In each instance where suspension of operation is required, the licensee shall submit a full report to the Commission after operation is resumed, containing details of the nature of the interference, the source of the interfering signals, and the remedial steps taken to eliminate the interference.

Administrative Procedure

§ 4.711 Administrative procedure. See §§ 4.11 to 4.16, inclusive.

Licensing Policies

§ 4.731 Purpose and permissible service. (a) Television broadcast translator stations provide a means whereby the signals of television broadcast stations may be retransmitted to areas in which direct reception of such television broadcast stations is unsatisfactory due to distance or intervening terrain barriers.

(b) A television broadcast translator station may be used only for the purpose of retransmitting to the general public, on one of the channels provided herein, the sig-

nals of a television broadcast station, or of another television broadcast translator station operating on a channel other than the one on which the retransmission is made. The retransmitted signals shall not be significantly altered as to content or technical characteristics other than in frequency and amplitude.

(c) A television broadcast translator station may retransmit the signals of different television broadcast stations or different television broadcast translator stations during different periods of its operation in order to provide programs best suited to the needs of a particular community.

(d) Retransmission of the signals of any station shall be made only in accordance with the provisions of § 4.784.

§ 4.732 Eligibility and licensing requirements. (a) A license for a television broadcast translator station may be issued to any qualified individual, organized group of individuals, broadcast station licensee, or local civil governmental body upon an appropriate showing that plans for financing the installation and operation of the station are sufficiently sound to insure continuation of the operation for the period of the license.

(b) More than one television broadcast translator station may be licensed to the same applicant whether or not such stations serve substantially the same area, upon an appropriate showing of need for such additional stations.

(c) Only one channel will be assigned to each television broadcast translator station. Additional television broadcast translator stations may be authorized to provide additional reception. A separate application is required for each television broadcast translator station and each application shall be complete in all respects.

§ 4.733 [Reserved]

§ 4.734 Remote control operation. (a) A television broadcast translator station may be operated by remote control, provided that such operation is conducted in accordance with conditions set forth in subparagraphs (1) through (5) of this paragraph.

(1) The control point shall be located on premises under the control and supervision of the licensee or its agent. Facilities shall be provided at the control point to enable the operator to observe the transmissions of the television broadcast translator station at any time, and which will permit the operator to turn the transmitter on and off at will.

(2) An operator holding a commercial radio operator's license of any class issued by the Commission except a Temporary Limited Radiotelegraph Second-Class License or an Aircraft Radiotelephone Operator Authorization, shall be in charge of this control point and shall observe the transmissions of the television broadcast translator station at the control point within one hour after the start of any period of operation and during operation at intervals of no more than six hours. The operator in charge shall promptly correct any condition of improper operation observed and if unable or not qualified to do so under the provisions of § 4.750(d), shall immediately suspend operation until suitable repairs can be made.

(3) A carrier operated device shall be installed at the control point which shall give a continuous visual indication whenever the transmitter is radiating; or, in lieu thereof, a device shall be provided which will give a continuous visual indication when any transmitter control circuits have been placed in a condition to produce radiation.

(4) The control circuits shall be so designed and installed that failure of any part of the circuit which results in loss of control from the remote control point will place the transmitter in an inoperative condition.

(5) The transmitter and its associated controls shall be so installed and protected that they are not accessible to other than duly authorized persons.

(b) In the event that the control point is not continuously manned by a qualified operator, the transmitter shall be equipped with suitable automatic devices which will place it in an inoperative condition when no signal is available for retransmission. In addition to the automatic and manual controls, a television broadcast translator station may be turned on and off by a time switch.

(c) If remote control is proposed at a new television broadcast translator station, the application for construction permit shall be accompanied by a showing as to the

manner of compliance with the above conditions. Any proposal to change a television broadcast translator station from direct control to remote control shall be submitted in the form of an application for modification of existing authorization accompanied by the above showing of compliance.

§ 4.735 Power limitations. (a) A television broadcast translator station will not be authorized to operate with transmitter power output in excess of the rated power output of the transmitter and in no event shall the rated peak visual power output of the transmitter be in excess of 100 watts. No minimum power is specified for television broadcast translator stations.

(b) No limit is placed upon the effective radiated power which may be obtained by the use of horizontally or vertically directive transmitting antennas.

§ 4.736 Emissions and bandwidth. (a) The license of a television broadcast translator station authorizes the transmission of the visual signal by amplitude modulation (A5) and the accompanying aural signal by frequency modulation (F3).

(b) Standard width television channels will be assigned and the emissions of a television broadcast translator station shall be confined to the authorized channel in accordance with the Television Technical Standards contained in Part 3, Subpart E of this chapter.

(c) Spurious emissions, including radio frequency harmonics, more than 3 Mc above or below the upper and lower edges, respectively, of the assigned channel shall be attenuated no less than 60 decibels below the visual transmitter power. These requirements shall not be applicable to transmitters installed prior to January 1, 1960: *Provided, however,* That in the event that interference is caused to other radio stations, the licensee shall take such steps as may be necessary to eliminate the interference. Greater attenuation will be required if such spurious emissions cause interference to any radio service.

§ 4.737 Antenna location. (a) An applicant for a new television broadcast translator station or for a change in the facilities of an existing station shall endeavor to select a site which will provide a line-of-sight transmission path to the entire area intended to be served and at which there is available a suitable signal from the primary station or stations. The transmitting antenna should be placed above growing vegetation and trees lying in the direction of the area intended to be served to minimize the possibility of signal absorption by foliage.

(b) A site within 5 miles of the area intended to be served is to be preferred if the conditions in paragraph (a) of this section can be met.

(c) Consideration should be given to accessibility of the site at all seasons of the year and to the availability of facilities for the maintenance and operation of the television broadcast translator station.

(d) The transmitting antenna should be located as near as is practical to the transmitter to avoid the use of long transmission lines and the associated power losses.

(e) Consideration should be given to the existence of strong radio frequency fields from other transmitters at the translator site and the possibility that such fields may result in the retransmission of signals originating on frequencies other than that of the primary station.

Equipment

§ 4.750 Equipment and installation. (a) An application for construction permit for a new television broadcast translator station or for changes in the facilities of an existing station shall specify equipment which has been type approved by the Commission.

(b) Type approval will be granted only after tests have been made at the Commission's Laboratory, Laurel, Maryland. Manufacturers may submit a production model for type approval and such approval, if granted, will be considered to apply to all identical models manufactured under that type number. No change, either mechanical or electrical, may be made in any type approved apparatus without prior approval of the Commission upon appropriate application therefor. Type approval may be withdrawn at any time if the apparatus fails to meet the requirements under which type approval was granted.

(c) Type approval will be granted only if the apparatus meets the following requirements:

(1) The frequency converter and associated amplifiers shall be so designed that the electrical characteristics of the incoming signal will not be altered significantly upon retransmission except as to frequency and amplitude.

(2) The overall characteristics of the apparatus shall be such that emissions on any discrete frequency more than 3 Mc above or below the upper and lower limits respectively, of the assigned channel shall be attenuated no less than 60 decibels below the visual transmitted power, regardless of whether such emissions are generated within the translator or are produced as the result of an external signal introduced into the input circuits of the translator apparatus.

NOTE: These requirements shall not be applicable to transmitters installed prior to January 1, 1960: *Provided, however,* That in the event that interference is caused to other radio stations, the licensee shall take such steps as may be necessary to eliminate the interference. Type approvals granted prior to September 1, 1959, will be designated as Limited Type Approval. Such approval will be granted only if it is found that reasonable precautions have been taken in the design of equipment, to minimize interference resulting from spurious emissions.

(3) The local oscillator employed in the frequency converter shall be sufficiently stable that, subject to variations in ambient temperature between −15° and +55° Centigrade and power main voltage variations of 15 percent, its frequency will not vary more than 0.01 percent.

(4) The translator shall be so designed and adjusted that its overall characteristics will remain essentially linear under all conditions of operation. It shall be equipped with suitable automatic circuits to maintain a constant output under conditions where the intensity of the received signal varies 20 decibels. If a manual adjustment is provided to compensate for differing average signal intensities which may be encountered in various locations and installations, provision shall be made for determining the proper setting of the manual adjustment by means of a meter or meter jack to measure direct current or voltage of appropriate circuits in the translator. If improper adjustment of the manual control could result in improper operation of the translator, a label shall be affixed at the adjustment control bearing a suitable warning.

NOTE: These requirements shall not be applicable to transmitters installed prior to January 1, 1960: *Provided, however,* That in the event that interference is caused to other radio stations, the licensee shall take such steps as may be necessary to eliminate the interference. Type approvals granted prior to September 1, 1959, will be designated as Limited Type Approval. Such approval will be granted only if it is found that reasonable precautions have been taken in the design of equipment, to minimize interference resulting from spurious emissions.

(5) The tube or tubes employed in the final radio frequency amplifier shall be of the proper rating to supply the rated power output. The rated maximum peak visual power output of the translator shall not be greater than 100 watts. The translator shall be capable of delivering the rated power in continuous service when driven with an input signal modulated by a video wave form corresponding to a black picture and a sound signal power equal to 50% of the peak visual power. Translators rated at more than 10 watts maximum peak visual power output shall be equipped with a suitable device for indicating the peak visual power output. Where the composite aural and visual signal powers are measured together the output indicating device shall be calibrated in terms of the peak visual power component of the combined visual and aural signals when the input television signal is modulated by a wave form corresponding to a black picture and when the sound signal power is equal to 50% of the peak visual power.

(6) The apparatus shall be equipped with suitable automatic devices which will place it in an inoperative condition in the absence of a visual and aural signal from the primary station. Such automatic devices may be provided with reasonable time constants to prevent momentary failures of the incoming signal from interrupting the operation.

(7) In general, the transmitter shall be mounted on racks and panels or in totally enclosed frames protected as required by Article 810 of the National Electrical Code.

(8) (i) Any manufacturer desiring to submit a translator for type approval shall supply the Commission with full specification details (two sworn copies) as well as the test data specified in this section. If this information appears to meet the requirements of the rules, shipping instructions will be issued to the manufacturer. The shipping charges to and from the Laboratory at Laurel, Maryland, shall be paid for by the manufacturer. Approval of a translator will only be given on the basis of the data obtained from a sample translator submitted to the Commission for test.

(ii) In approving a translator upon the basis of the tests conducted by the Laboratory, the Commission merely recognizes that the type of translator has the inherent capability of functioning in compliance with the Rules, if properly constructed, maintained, and operated.

(iii) Additional rules with respect to withdrawal of type approval, modification of type approval equipment, and limitations on the findings upon which type approval is based are set forth in Part 2, Subpart F, of this chapter.

(d) The installation of a television broadcast translator station shall be made only by, or under the direct supervision of, a qualified electronics engineer, and any repairs or adjustments made during or subsequent to the installation, which could result in improper operation, shall be made by or under the direct supervision of an operator holding a valid first or second class radiotelephone operator's license issued by the Commission.

(e) The choice of transmitting and receiving antennas is left to the discretion of the applicant. In general, the transmitting antenna should be designed to provide maximum signal over the area intended to be served and to minimize radiation over other areas, particularly those in which interference could be caused to the reception of other stations. The Commission reserves the right to require the use of suitable directive transmitting antennas in order to permit the assignment of the same channel to two or more television broadcast translator stations located in the same general area. An application for construction permit for a new television broadcast translator station or for changes in the facilities of an existing station, shall supply complete details of the proposed receiving and retransmitting antenna systems, including an accurate plot of the field pattern of the transmitting antenna, if directive.

§ 4.751 Equipment changes. (a) No change, either mechanical or electrical, may be made in type approved apparatus except upon instructions of the manufacturer of the equipment, based upon Commission approval for the change granted to the manufacturer in accordance with § 4.750(b).

(b) Formal application (FCC Form 346) is required for any of the following changes:

(1) Replacement of the transmitter as a whole, except by one of an identical type.

(2) A change in the transmitting antenna system, including the direction of radiation, directive antenna pattern, or transmission line.

(3) An increase in the overall height of the antenna above ground of more than 20 feet or which will result in an overall height above ground of more than 170 feet.

(4) A change of the control point of a remotely controlled television broadcast translator station or any change in the control circuits.

(5) Any change in the location of the transmitter except a move within the same building or upon the same tower or pole, and any horizontal change in the location of the transmitting antenna in excess of 500 feet.

(6) A change of frequency assignment.

(7) A change of authorized operating power.

(8) A change of the primary TV station or stations being retransmitted.

(c) Other equipment changes not specifically referred to above may be made at the discretion of the licensee, provided that the Engineer in Charge of the radio district in which the television broadcast translator station is located and the Commission's Washington, D.C., office, are notified in writing upon completion of such changes, and provided, further, that the changes are appropriately reflected in the next application for renewal of license of the television broadcast translator station.

Technical Operation

§ 4.761 **Frequency tolerance.** The licensee of a television broadcast translator station shall maintain the visual carrier frequency and the aural center frequency at the outpnt of the translator within 0.01 percent of its assigned frequencies when the primary station is operating exactly on its assigned frequencies. This tolerance shall not be exceeded at times when the primary station is not on its assigned frequencies, by more than the amount of the departure by the primary station.

§ 4.762 **Frequency monitors and measurements.** (a) The licensee of a television broadcast translator station is not required to provide means for measuring the operating frequencies of the transmitter. However, only equipment having the required stability will be approved for use at a television broadcast translator station.

(b) In the event that a television broadcast translator station is found to be operating beyond the frequency tolerance prescribed in § 4.761, the licensee shall promptly suspend operation of the translator and shall not resume operation until the translator has been restored to its assigned frequencies. Adjustment of the frequency determining circuits of a television broadcast translator station shall be made only by a qualified person in accordance with § 4.750(d).

(c) The licensee of a television broadcast translator station may, at its discretion, provide means for comparing the frequency of the translator with an external frequency source of known accuracy as a preventive measure to avoid unnecessary interruptions to service.

§ 4.763 **Time of operation.** (a) A television broadcast translator station is not required to adhere to any regular schedule of operation. However, the licensee of a television translator station is expected to provide a dependable service to the extent that such is within its control and to avoid unwarranted interruptions to the service provided.

(b) If causes beyond the control of the licensee require that a television broadcast translator station remain inoperative for a period in excess of 10 days, the Engineer in Charge of the radio district in which the station is located shall be notified promptly in writing, describing the cause of failure and the steps taken to place the station in operation again, and shall be notified promptly when the operation is resumed.

(c) Failure of a television broadcast translator station to operate for a period of 30 days or more, except for causes beyond the control of the licensee, shall be deemed evidence of discontinuance of operation and the license of the station will be cancelled.

(d) A television broadcast translator station shall not be permitted to radiate during extended periods when signals of the primary station are not being retransmitted.

§ 4.764 **Station inspection.** The licensee of a television broadcast translator station shall make the station and the records required to be kept by the rules in this subpart, available for inspection by representatives of the Commission.

§ 4.765 **Posting of station and operators licenses.** (a) The station license and any other instrument of authorization or individual order concerning the construction of the equipment or manner of operation shall be posted in a conspicuous place in the room in which the transmitter is located so that all terms thereof are visible; *Provided:*

(1) If the transmitter is operated by remote control pursuant to § 4.734, the station license shall be posted in the above described manner at the control point.

(2) If the transmitter is installed so as to be exposed to the elements and posting of the license would result in its being so exposed, the license or a photo copy thereof may be kept in the possession of the operator in charge of the transmitter. If a photo copy is used, the original license shall be conveniently available for inspection by a representative of the Commission.

(b) The original of each station operator license shall be posted at the place where he is on duty: *Provided, however,* That if the original license of a station operator is posted at another radio transmitting station in accordance with the Rules governing that class of station and is there available for inspection by a representative of the Commission, a verification card (Form 758-F) is acceptable in lieu of the posting of

such license: *Provided, further, however,* That if the operator in charge holds a restricted radiotelephone operator permit of the card form (as distinguished from the diploma form), he shall not post that permit but shall keep it in his personal possession.

§ 4.766 Operator requirements. (a) The actual operation of the transmitting apparatus at a television broadcast translator station shall be carried on only by a person holding a valid commercial radio operator's license or permit of any class issued by the Commission except a Temporary Limited Radiotelegraph Second-Class License or an Aircraft Radiotelephone Operator Authorization who shall provide supervision to no less extent than that required by § 4.734 and who shall be responsible for the proper operation of the apparatus with respect to those functions under his control. This responsibility, however, shall in no way relieve the licensee of its responsibility for the proper operation of the station.

(b) Any repairs or adjustments to a television broadcast translator station which might result in improper operation of the equipment shall be made only by or under the direct supervision of a person holding a valid first or second class radiotelephone operator's license issued by the Commission.

(c) The licensed operator on duty and in charge of a television broadcast translator station may, at the discretion of the licensee, be employed for other duties or for the operation of another station or stations in accordance with the class of license which he holds and the rules and regulations governing such stations. However, such duties shall in nowise interfere with the operation of the television broadcast translator station.

§ 4.767 Marking and lighting of antenna structures. The marking and lighting of antenna structures employed at a television broadcast translator station, where required, will be specified in the authorization issued by the Commission. Part 17 of this chapter sets forth the conditions under which such marking and lighting will be required and the responsibility of the licensee with regard thereto.

§ 4.768 Additional orders. In case the rules contained in this part do not cover all phases of operation or experimentation with respect to external effects, the Commission may make supplemental or additional orders, in each case as may be deemed necessary.

§ 4.769 Copies of rules. The licensee of a television broadcast translator station shall have current copies of Part 3, Part 4, and Part 17 of this chapter available for use by the operator in charge, and is expected to be familiar with those rules relating to the operation of a television broadcast translator station. Copies of the Commission's rules may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at nominal cost.

Operation

§ 4.781 Station records. (a) The licensee of a television broadcast translator station shall maintain an operating log showing the following:

(1) Hours of operation.

(2) Call letters, channel, and location of primary station or stations.

(3) Time of periodic observation required by § 4.734(a)(2), and operating conditions signed by the operator making the observation.

(4) A record of all repairs, adjustments, maintenance, tests, and equipment changes, showing the date of such events, the name and qualifications of the person performing the operation, and a brief description of the matter logged.

(b) Where an antenna structure is required to be illuminated, see § 17.38 of this chapter.

(c) The operating log shall be made available upon request to any authorized representative of the Commission.

(d) Station records shall be retained for a period of two years.

§ 4.782 [Reserved]

§ 4.783 Station identification. (a) The call sign of a television broadcast translator station shall be transmitted in international Morse Code by means of an automatic keying device, at the beginning and end of each period of operation and during

operation, within 5 minutes of the hour and half hour. This transmission may be accomplished either by turning the visual and aural carriers of the translator on and off in the proper sequence or by superimposing an audio frequency tone containing the telegraphic identification, on the visual and aural carriers radiated by the translator. The modulation level of the identifying signal shall not be less than 30 percent of the aural signal.

(b) The Commission may, in its discretion, specify other methods of identification.

(c) Call signs for television broadcast translator stations will be made up of the initial letter K or W followed by the channel number assigned to the translator and two letters. The use of the initial letter will generally follow the pattern used in the broadcast service, i.e., stations west of the Mississippi River will be assigned an initial letter K and those east of the mississippi River the letter W. The two letter combinations following the channel number will be assigned in order and requests for the assignment of particular combinations of letters will not be considered.

§ 4.784 **Rebroadcasts.** (a) The term "rebroadcast" means the reception by radio of the programs or other signals of a radio or television station and the simultaneous or subsequent retransmission of such programs or signals for direct reception by the general public.

(b) The licensee of a television broadcast translator station shall not rebroadcast the programs of any television broadcast station or other television broadcast translator station without obtaining prior consent of the station whose signals or programs are proposed to be retransmitted. The Commission shall be notified of the call letters of each station rebroadcast and the licensee of the television broadcast translator station shall certify that express authority has been received from the licensee of the station whose programs are retransmitted.

(c) A television broadcast translator station is not authorized to rebroadcast the transmissions of any class of station other than a television broadcast station or another television broadcast translator station.

Part 5

FEDERAL COMMUNICATIONS COMMISSION
PART 13 — COMMERCIAL RADIO OPERATORS

TITLE 47—TELECOMMUNICATION

Chapter I—Federal Communications Commission

Part 13—Commercial Radio Operators

General

§ 13.1 **Licensed operators required.** Unless otherwise specified by the Commission, the actual operation of any radio station for which a station license is required shall be carried on only by a licensed radio operator of the required class (see § 13.61).

NOTE A: Whenever the term "license" is used generally to denote an authorization from the Commission, it includes "license," "permit," and "authorization."

NOTE B: Provision is made in Parts 5, 6, 7, 8, 9, 10, 11, 16, and 19 of the Commission's rules for operation of certain radio stations without licensed operators subject to limitations and conditions specified therein.

§ 13.2 Classes of operator licenses. The classes of commercial radio operator licenses issued by the Commission are classified basically as radiotelegraph and radiotelephone licenses, and are further classified in accordance with international usage as follows:

(a) General radio operator group:
(1) General radiotelegraph certificates:
(i) Radiotelegraph first-class operator license.
(ii) Radiotelegraph second-class operator license.
(2) General radiotelephone certificates (classification by international usage):
(i) Radiotelephone first-class operator license.
(ii) Radiotelephone second-class operator license.
(b) Restricted radio operator group:
(1) Special radiotelegraph certificate (classification by international usage):
(i) Radiotelegraph third-class operator permit.
(2) Restricted radiotelephone certificate (classification by international usage):
(i) Radiotelephone third-class operator permit.
(c) Limited radio operator group:
(1) Limited radiotelephone operator certificate:
(i) Restricted radiotelephone operator permit.

§ 13.3 Dual holding of licenses. A person may not hold more than one radiotelegraph operator license or permit at the same time.

§ 13.4 Term of licenses. Commercial operator licenses (except restricted radiotelephone operator permits) will normally be issued for a term of five years from date of issuance. Restricted radiotelephone operator permits will normally be issued for the lifetime of the operator. The term of all restricted radiotelephone operator permits issued prior to November 15, 1953, which are outstanding on that date is extended to encompass the lifetime of such operators.

§ 13.5 Eligibility for new license. (a) Under the provisions of section 303(1) of the Communications Act of 1934, as amended, United States citizens who are found qualified by the Commission are the only persons to whom radio operator licenses may be issued.

(b) Notwithstanding any other provisions of the Commission's rules, no person otherwise eligible shall be deemed to be eligible to be examined for or to receive a commercial radio operator license of any class, (1) whose commercial radio operator license is under suspension or is involved in a suspension proceeding, (2) who is involved in any pending litigation based on an alleged violation of the Communications Act of 1934, as amended, or (3) who is afflicted with complete deafness or complete muteness or complete inability for any other reason to transmit correctly and to receive correctly by telephone spoken messages in English.

(c) No applicant who is eligible to apply for any commercial radio operator license shall, by reason of any physical handicap, other than as set forth in paragraph (b) of this section, be denied the privilege of applying and being permitted to attempt to prove his qualifications (by examination if examination is required) for such commercial radio operator license in accordance with established procedure; nor, subject to the following conditions, shall such applicant be denied the issuance of any commercial radio operator license for which he is found qualified:

(1) If the applicant is afflicted with an uncorrected physical handicap which would clearly prevent the performance of all or any part of the duties of a radio operator, under the license for which application is made, at a station under emergency conditions involving the safety of life or property, he may be issued the license for which he is found qualified: *Provided,* that any license so received, if of the diploma form (as distinguished from such document of the card form), shall bear the following restrictive endorsement as follows:

This license is not valid for the performance of any operating duties, other than installation, service and maintenance duties, at any station licensed by the Federal Communications Commission which is required, directly or indirectly, by any treaty, statute or rule or regulation pursuant to statute to be provided for safety purposes.

Provided further, that in the case of a diploma-form license for which no examination in technical matters is required, the endorsement will be modified by deleting the reference therein to installation, service, and maintenance duties.

(2) In any case where an applicant, who normally would receive or has received a commercial radio operator license bearing the endorsement prescribed by subparagraph (1) of this paragraph, indicates his desire to operate a station falling within the prohibitive terms of the endorsement, he may request in writing that such endorsement not be placed upon, or be removed from, his license, and may submit in support of his request any written comment or statement of himself or any interested party.

(3) An applicant who shows that he has theretofore performed satisfactorily (by means of the service record appearing on the appropriate license document of the applicant or such other proof as may be appropriate under the circumstances of the particular case) the duties of a radio operator at a station required, directly or indirectly, by any treaty, statute, or rule or regulation pursuant to statute to be provided for safety purposes, during a period when he was afflicted by uncorrected physical handicaps of the same kind and to the same degree as the physical handicaps shown by his current application (this showing may be made by means of the applicant's written, sworn statement or such other documentary proof as may be appropriate under the circumstances of the particular case), shall not be deemed to be within the provisions of subparagraph (1) of this paragraph.

§ 13.6 **Operator license, posting of.** The original license of each station operator shall be posted at the place where he is on duty, except as otherwise provided in this part or in the rules governing the class of station concerned.

§ 13.7 **Operators, place of duty.** (a) Except as may be provided in the rules governing a particular class of station, one or more licensed radio operators of the grade specified by this part shall be on duty at the place where the transmitting apparatus of each licensed radio station is located and in actual charge thereof whenever it is being operated: *Provided, however,* That, (1) subject to the provisions of paragraph (b) of this section, where remote control of the transmitting apparatus has been authorized to be used, the Commission may modify the foregoing requirements upon proper application and showing being made so that such operator or operators may be on duty at the control point in lieu of the place where the transmitting apparatus is located; (2) in the case of two or more stations, except amateur and broadcast, licensed in the name of the same person to use frequencies above 30 megacycles only, a licensed radio operator holding a valid radiotelegraph or radiotelephone first- or second-class license who has the station within his effective control may be on duty at any point within the communication range of such stations in lieu of the transmitter location or control point during the actual operation of the transmitting apparatus and shall supervise the emissions of all such stations so as to insure the proper operation in accordance with the station license.

(b) An operator may be on duty at a remote control point in lieu of the location of the transmitting apparatus in accordance with the provisions of paragraph (a)(1) of this section: *Provided,* That all of the following conditions are met: (1) The transmitter shall be so installed and protected that it is not accessible to other than duly authorized persons; (2) the emissions of the transmitter shall be continuously monitored at the control point by a licensed operator of the grade specified for the class of station involved; (3) provision shall be made so that the transmitter can quickly and without delay be placed in an inoperative condition by the operator at the control point in the event there is a deviation from the terms of the station license; (4) the radiation of the transmitter shall be suspended immediately when there is a deviation from the terms of the station license.

§ 13.8 **Provisional radio operator certificate.** In circumstances requiring immediate authority to operate a radio station pending submission of proof of eligibility or of qualifications or pending a determination by the Commission as to these matters,

an applicant for a radio operator license may request a provisional radio operator certificate. Any such request may be in letter form and shall be in addition to the formal application. If the Commission finds that the public interest will be served it may issue such certificate for a period not to exceed six months with such additional limitation as may be indicated. In no case will the Commission issue a provisional radio operator certificate if the applicant has not fulfilled examination or service requirements, if any, for the license applied for.

Applications

§ 13.11 Procedure. (a) *General.* Applications shall be governed by applicable rules in force on the date when application is filed (see § 13.28). The application in the prescribed form and including all required subsidiary forms and documents, properly completed and signed, shall be submitted in person or by mail to the office at which the applicant desires his application to be considered and acted upon, which office will make the final arrangements for conducting any required examination. If the application is for renewal of license, it may be filed 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. During this one-year period of grace an expired license is not valid. A renewed license issued upon the basis of an application filed during the grace period will be dated currently and will not be back-dated to the date of expiration of the license being renewed. A renewal application shall be accompanied by the license sought to be renewed. If the prescribed service requirements for renewal without examination (see § 13.28) are fulfilled, the renewed license may be issued by mail. If the service record on the reverse side of the license does not fully describe or cover the service desired by the applicant to be considered in connection with license renewal (as might occur in the case of service rendered at U.S. government stations), the renewal application shall be supported by documentary evidence describing in detail the service performed and showing that the applicant actually performed such service in a satisfactory manner.

(b) *Restricted radiotelephone operator permit.* No oral or written examination is required for this permit. If the application is properly completed and signed, and if the applicant is found to be qualified, the permit may be issued forthwith by personal delivery to the applicant or by mail.

§ 13.12 Special provisions, radiotelegraph first class. An applicant for the radiotelegraph first-class operator license must be at least 21 years of age at the time the license is issued and shall have had an aggregate of 1 year of satisfactory service as a radiotelegraph operator manipulating the key of a manually operated radiotelegraph station on board a ship or in a manually operated coastal telegraph station.

§ 13.13 Age limit, restricted radiotelephone operator permit. An applicant for a restricted radiotelephone operator permit must be at least 14 years of age at the time the permit is issued.

Examinations

§ 13.21 Examination elements. Written examinations will comprise questions from one or more of the following examination elements:

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 oper-

ation 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.

§ 13.22 **Examination requirements.** Applicants for original licenses will be required to pass examinations 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 sixteen (16) code groups per minute.

(3) Written examination elements: 1, 2, 5, and 6.

(d) *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.

(e) *Radiotelephone third-class operator permit:*

(1) Ability to transmit and receive spoken messages in English.

(2) Written examination elements: 1 and 2.

(f) *Radiotelegraph third-class operator permit:*

(1) Ability to transmit and receive spoken messages in English.

(2) Transmitting and receiving code test of sixteen (16) code groups per minute.

(3) Written examination elements: 1, 2, and 5.

(g) *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.

§ 13.23 **Form of writing.** Written examination shall be in English and shall be written by the applicant in longhand in ink, except that diagrams may be in pencil.

§ 13.24 **Passing mark.** A passing mark of 75 percent of a possible 100 percent will be required on each element of a written examination.

§ 13.25 **New class, additional requirements.** The holder of a license who applies for another class of license will be required to pass only the added examination requirements for the new class of license: *Provided,* That the holder of a radiotelegraph third-class operator permit who takes an examination for a radiotelegraph second-class operator license more than one year after the issuance date of the third-class permit will also be required to pass the code test prescribed therefor: *Provided further,* That no person holding a new, duplicate, or replacement Restricted Radiotelephone Operator Permit issued upon the basis of a declaration, or a renewed restricted radiotelephone operator permit which renews a permit issued upon the basis of a declaration, shall, by reason of the declaration or the holding of such permit, be relieved in any respect of qualifying by examination when applying for any other class of license.

§ 13.26 **Canceling and issuing new licenses.** 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.

§ 13.27 Eligibility for reexamination. An applicant who fails an examination element will be ineligible for 2 months to take an examination for any class of license requiring that element. Examination elements will be graded in the order listed (see § 13.21), and an applicant may, without further application, be issued the class of license for which he qualifies.

NOTE: A month after date is the same day of the following month, or if there is no such day, the last day of such month. This principle applies for other periods. For example, in the case of the 2-month period to which this note refers, an applicant examined December 1 may be reexamined February 1, and an applicant examined December 29, 30, or 31 may be reexamined the last day of February while one examined February 28 may be reexamined April 28.

§ 13.28 Renewal service requirements, renewal examinations, and exceptions. A restricted radiotelephone operator permit normally is issued for the lifetime of the holder and need not be renewed. An aircraft radiotelephone operator authorization or 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 sought to be renewed, plus the code test (if any) required for such a 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 waved 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.

Code Tests

§ 13.41 Transmitting speed requirements. An applicant is required to transmit correctly in the International Morse code for 1 minute at the rate of speed prescribed in this part for the class of license desired.

§ 13.42 Transmitting test procedure. Transmitting tests shall be performed by the use of the conventional Morse key except that a semi-automatic key, if furnished by the applicant, may be used in transmitting code tests of 25 words per minute.

§ 13.43 Receiving speed requirements. An applicant is required to receive the International Morse code by ear, and legibly transcribe, consecutive words or code groups for a period of 1 minute without error at the rate of speed specified in the rules for the class of license for which the application is made.

§ 13.44 Receiving test procedure. Receiving code tests shall be written in longhand either in ink or pencil except that in the case of the 25 words per minute code test a typewriter may be used when furnished by the applicant.

§ 13.45 Computing words or code groups. Each five characters shall be counted as one word or code group. Punctuation marks or figures count as two characters.

Scope of Authority

§ 13.61 Operating authority. The various classes of commercial radio operator licenses issued by the Commission authorize the holders thereof to operate radio stations, except amateur, as follows (see also § 13.62(c) for additional operating authority with respect to standard and FM broadcast stations):

(a) *Radiotelegraph first-class operator license.* Any station except:

(1) Stations transmitting television, or

(2) Any of the various classes of broadcast stations other than remote pickup and ST broadcast stations, or

(3) On a cargo vessel (other than a vessel operated exclusively on the Great Lakes) required by treaty or statute to be equipped with a radiotelegraph installation, the holder of this class of license may not act as chief or sole operator until he has had at least 6 months' satisfactory service in the aggregate as a qualified radiotelegraph operator in a station on board a ship or ships of the United States.

(4) On an aircraft employing radiotelegraphy, the holder of this class of license may not operate the radiotelegraph station during the course of normal rendition of service unless he has satisfactorily completed a supplementary examination qualifying him for that duty, or unless he has served satisfactorily as chief or sole radio operator on an aircraft employing radiotelegraphy prior to February 15, 1950. The supplementary examination shall consist of:

(i) Written examination element: 7.

(5) At a ship radar station licensed in the Ship Service, the holder of this class of license may not supervise or be responsible for the performance of any adjustments or tests during or coincident with the installation, servicing or maintenance of the radar equipment while it is radiating energy unless he has satisfactorily completed a supplementary examination qualifying him for that duty and received a ship radar endorsement on his license certifying to that fact: *Provided,* That nothing in this subparagraph shall be construed to prevent persons holding licenses not so endorsed from making replacements of fuses or of receiving-type tubes. The supplementary examination shall consist of:

(i) Written examination element: 8.

(b) *Radiotelegraph second-class operator license.* Any station except:

(1) Stations transmitting television, or

(2) Any of the various classes of broadcast stations other than remote pickup and ST broadcast stations, or

(3) On a passenger vessel (a ship shall be considered a passenger ship if it carries or is licensed or certificated to carry more than 12 passengers; a cargo ship means any ship not a passenger ship) required by treaty or statute to maintain a continuous radio watch by operators or on a vessel having continuous hours of service for public correspondence, the holder of this class of license may not act as chief operator, or

(4) On a vessel (other than a vessel operated exclusively on the Great Lakes) required by treaty or statute to be equipped with a radiotelegraph installation, the holder of this class of license may not act as chief or sole operator until he has had at least 6 months' satisfactory service in the aggregate as a qualified radiotelegraph operator in a station on board a ship or ships of the United States.

(5) On an aircraft employing radiotelegraphy, the holder of this class of license may not operate the radiotelegraph station during the course of normal rendition of service unless he is at least eighteen (18) years of age and has satisfactorily completed a supplementary examination qualifying him for that duty, or unless he has served satisfactorily as chief or sole radio operator on an aircraft employing radiotelegraphy prior to February 15, 1950. The supplementary examination shall consist of:

(i) Transmitting and receiving code test at twenty-five (25) words per minute plain language and twenty (20) code groups per minute.

(ii) Written examination element: 7.

(6) At a ship radar station licensed in the Ship Service, the holder of this class of license may not supervise or be responsible for the performance of any adjustments

or tests during or coincident with the installation, servicing or maintenance of the radar equipment while it is radiating energy unless he has satisfactorily completed a supplementary examination qualifying him for that duty and received a ship radar endorsement on his license certifying to that fact: *Provided,* That nothing in this subparagraph shall be construed to prevent persons holding licenses not so endorsed from making replacements of fuses or of receiving-type tubes. The supplementary examination shall consist of:

(i) Written examination element: 8.

(c) [Deleted]

(d) *Radiotelegraph third-class operator permit.* Any station except:

(1) Stations transmitting television, or

(2) Any of the various classes of broadcast stations other than noncommercial educational FM broadcast stations using transmitters with power ratings of 10 watts or less, remote pickup broadcast stations and ST broadcast stations, or

(3) Coastal telephone stations (other than when transmitting manual radiotelegraphy for identification or for testing) at which the power in the antenna of the unmodulated carrier wave is authorized to exceed 250 watts, or

(4) Coastal harbor telephone stations (other than in Alaska and other than when transmitting manual radiotelegraphy for identification or for testing) at which the power in the antenna of the unmodulated carrier wave is authorized to exceed 250 watts, or

(5) Ship stations or aircraft stations other than those at which the installation is used solely for telephony and at which the power in the antenna of the unmodulated carrier wave is not authorized to exceed 250 watts, or

(6) Ship telegraph, coastal telegraph or marine-relay stations open to public correspondence, or

(7) Radiotelegraph stations on board a vessel required by treaty or statute to be equipped with a radio installation, or

(8) Aircraft stations while employing radiotelegraphy:

Provided, That (1) such operator is prohibited from making any adjustments that may result in improper transmitter operation, and (2) the equipment is so designed that the stability of the frequencies of the transmitter is maintained by the transmitter itself within the limits of tolerance specified by the station license, and none of the operations necessary to be performed during the course of normal rendition of the service of the station may cause off-frequency operation or result in any unauthorized radiation, and (3) any needed adjustments of the transmitter that may affect the proper operation of the station are regularly made by or under the immediate supervision and responsibility of a person holding a first- or second-class commercial radio operator license, either radiotelephone or radiotelegraph as may be appropriate for the class of station involved (as determined by the scope of the authority of the respective licenses as set forth in paragraphs (a), (b), (c), (e) and (f) of this section and § 13.62), who shall be responsible for the proper functioning of the station equipment, and (4) in the case of ship radiotelephone or aircraft radiotelephone stations when the power in the antenna of the unmodulated carrier wave is authorized to exceed 100 watts, any needed adjustments of the transmitter that may affect the proper operation of the station are made only by or under the immediate supervision and responsibility of an operator holding a first- or second-class radiotelegraph license, who shall be responsible for the proper functioning of the station equipment.

(e) *Radiotelephone first-class operator license.* Any station except:

(1) Stations transmitting telegraphy by any type of the Morse Code, or

(2) Ship stations licensed to use telephony and power in excess of 100 watts for communication with coastal telephone stations.

(3) At a ship radar station licensed in the Ship Service, the holder of this class of license may not supervise or be responsible for the performance of any adjustments or tests during or coincident with the installation, servicing or maintenance of the radar equipment while it is radiating energy unless he has satisfactorily completed a supplementary examination qualifying him for that duty and received a ship radar

endorsement on his license certifying to that fact: *Provided,* That nothing in this subparagraph shall be construed to prevent persons holding licenses not so endorsed from making replacements of fuses or of receiving-type tubes. The supplementary examination shall consist of:

(i) Written examination element: 8.

(f) *Radiotelephone second-class operator license.* Any station except:

(1) Stations transmitting telegraphy by any type of the Morse Code, or

(2) Standard broadcast stations, or

(3) International broadcast stations, or

(4) FM broadcast stations, or

(5) Non-commercial educational FM broadcast stations with transmitter power rating in excess of 1 kilowatt, or

(6) Television broadcast stations licensed for commercial operation, or

(7) Ship stations licensed to use telephony and power in excess of 100 watts for communication with coastal telephone stations.

(8) At a ship radar station licensed in the Ship Service, the holder of this class of license may not supervise or be responsible for the performance of any adjustments or tests during or coincident with the installation, servicing or maintenance of the radar equipment while it is radiating energy unless he has satisfactorily completed a supplementary examination qualifying him for that duty and received a ship radar endorsement on his license certifying to that fact: *Provided,* That nothing in this subparagraph shall be construed to prevent persons holding licenses not so endorsed from making replacements of fuses or of receiving-type tubes. The supplementary examination shall consist of:

(i) Written examination element: 8.

(g) *Radiotelephone third-class operator permit.* Any station except:

(1) Stations transmitting television, or

(2) Stations transmitting telegraphy by any type of the Morse code, or

(3) Any of the various classes of broadcast stations other than noncommercial educational FM broadcast stations using transmitters with power ratings of 10 watts or less, remote pickup broadcast stations and ST broadcast stations, or

(4) Coastal telephone stations at which the power in the antenna of the unmodulated carrier wave is authorized to exceed 250 watts, or

(5) Coastal harbor telephone stations, other than in Alaska, at which the power in the antenna of the unmodulated carrier wave is authorized to exceed 250 watts, or

(6) Ship stations or aircraft stations other than those at which the installation is used solely for telephony and at which the power in the antenna of the unmodulated carrier wave is not authorized to exceed 250 watts:

Provided, That (1) such operator is prohibited from making any adjustments that may result in improper transmitter operation, and (2) the equipment is so designed that the stability of the frequencies of the transmitter is maintained by the transmitter itself within the limits of tolerance specified by the station license, and none of the operations necessary to be performed during the course of normal rendition of the service of the station may cause off-frequency operation or result in any unauthorized radiation, and (3) any needed adjustments of the transmitter that may affect the proper operation of the station are regularly made by or under the immediate supervision and responsibility of a person holding a first- or second-class commercial radio operator license, either radiotelephone or radiotelegraph as may be appropriate for the class of station involved (as determined by the scope of the authority of the respective licenses as set forth in paragraphs (a), (b), (c), (e), and (f) of this section and § 13.62), who shall be responsible for the proper functioning of the station equipment, and (4) in the case of ship radiotelephone or aircraft radiotelephone stations when the power in the antenna of the unmodulated carrier wave is authorized to exceed 100 watts, any needed adjustments of the transmitter that may affect the proper operation of the station are made only by or under the immediate supervision and responsibility of an operator holding a first- or second-class radiotelegraph license, who shall be responsible for the proper functioning of the station equipment.

(h) *Restricted radiotelephone operator permit.* Any station except:

(1) Stations transmitting television, or

(2) Stations transmitting telegraphy by any type of the Morse Code, or

(3) Any of the various classes of broadcast stations other than remote pickup, broadcast STL, and FM intercity relay stations, or

(4) Ship stations licensed to use telephony for communication with Class I coast stations on frequencies between 4000 kc and 30 Mc, or

(5) Radio stations provided on board vessels for safety purposes pursuant to statute or treaty, or

(6) Coast stations other than in Alaska while employing a frequency below 30 Mc, or

(7) Coast stations at which the power in the antenna of the unmodulated carrier wave is authorized to exceed 250 watts;

(8) At a ship radar station the holder of this class of license may not supervise or be responsible for the performance of any adjustments or tests during or coincident with the installation, servicing or maintenance of the radar equipment while it is radiating energy: *Provided,* That nothing in this subparagraph shall be construed to prevent any person holding such a license from making replacements of fuses or of receiving type tubes:

Provided, That, with respect to any station which the holder of this class of license may operate, such operator is prohibited from making any adjustments that may result in improper transmitter operation, and the equipment is so designed that the stability of the frequencies of the transmitter is maintained by the transmitter itself within the limits of tolerance specified by the station license, and none of the operations necessary to be performed during the course of normal rendition of the service of the station may cause off-frequency operation or result in any unauthorized radiation, and any needed adjustments of the transmitter that may affect the proper operation of the station are regularly made by or under the immediate supervision and responsibility of a person holding a first- or second-class commercial radio operator license, either radiotelephone or radiotelegraph, who shall be responsible for the proper functioning of the station equipment.

§ 13.62 **Special privileges.** In addition to the operating authority granted under § 13.61, the following special privileges are granted the holders of commercial radio operator licenses:

(a) [Reserved.]

(b) The holder of any class of radiotelephone operator license, whose license authorizes him to operate a station while transmitting telephony, may operate the same station when transmitting on the same frequencies, any type of telegraphy under the following conditions:

(1) When transmitting telegraphy by automatic means for identification, for testing, or for actuating an automatic selective signaling device, or

(2) When properly serving as a relay station and for that purpose retransmitting by automatic means, solely on frequencies above 50 megacycles, the signals of a radiotelegraph station, or

(3) When transmitting telegraphy as an incidental part of a program intended to be received by the general public, either directly or through the intermediary of a relay station or stations.

(c) The holder of a commercial radio operator license of any class may operate broadcast stations under the following conditions:

(1) A standard broadcast station with authorized operating power of 10 kw or less and employing a nondirectional antenna, an FM broadcast station with authorized transmitter output power of 10 kw or less, or a noncommercial educational FM broadcast station with authorized transmitter output power of more than 1 kw but not in excess of 10 kw: *Provided,* That adjustments of transmitting equipment by such operators, except when under the immediate supervision of a radiotelephone first-class operator, and except as provided in paragraph (d) of this section, shall be limited to the following:

(i) Those necessary to commence or terminate transmitter emissions as a routine matter.

(ii) Those external adjustments that may be required as a result of variations of primary power supply.

(iii) Those external adjustments which may be necessary to insure modulation within the limits required.

(iv) Those adjustments necessary to effect any changes in operating power which may be required by the station's instrument of authorization.

(2) A noncommercial educational FM broadcast station with authorized transmitter power output of more than 10 watts but not in excess of 1 kw: *Provided,* That adjustments of transmitting equipment by such operators, except under the immediate supervision of a radiotelephone first- or second-class operator, shall be limited to those adjustments set forth in subparagraph (1)(i), (ii), and (iii) of this paragraph.

(3) A noncommercial educational FM broadcast station with authorized transmitter power output of 10 watts or less: *Provided,* That adjustments of transmitting equipment by such operators, except under the immediate supervision of a radiotelephone first- or second-class operator or a radiotelegraph first- or second-class operator, shall be limited to those adjustments set forth in subparagraph (1)(i), (ii), and (iii) of this paragraph.

(4) Should the broadcast transmitting apparatus be observed to be operating in a manner inconsistent with the station's instrument of authorization and none of the adjustments specifically described under subparagraph (1), (2) or (3) of this paragraph are effective in bringing it into proper operation, an operator holding a lesser grade license than that which authorizes unlimited adjustment, with respect to the class of broadcast station involved, and not acting under the supervision of a person holding the higher grade license permitting such unlimited adjustment, shall terminate the station's emissions.

(5) Except in the case of noncommercial educational FM broadcast stations with authorized transmitter output power of 10 watts or less, the special operating authority granted in this section with respect to broadcast stations is subject to the condition that there shall be in regular full-time employment at the station one or more operators of a class authorized to make or supervise all adjustments, whose primary duty shall be to effect and insure the proper functioning of the transmitting equipment. In the case of a noncommercial educational FM broadcast station with authorized transmitter output power of 10 watts or less such operator(s) shall nevertheless be available on call to make or supervise any needed adjustments.

(d) When a CONELRAD Alert is called, a person holding any class of radio operator license or permit who is authorized thereunder to perform limited operation of a standard broadcast station may make any adjustments necessary to effect operation on a CONELRAD frequency in accordance with the station's CONELRAD authorization: *Provided,* That the station's responsible first-class radiotelephone operator(s) shall have previously instructed such person in the adjustments to the transmitter which are necessary to accomplish CONELRAD operation.

§ 13.63 Operator's responsibility. The licensed operator responsible for the maintenance of a transmitter may permit other persons to adjust a transmitter in his presence for the purpose of carrying out tests or making adjustments requiring specialized knowledge or skill, provided that he shall not be relieved thereby from responsibility for the proper operation of the equipment.

§ 13.64 Obedience to lawful orders. All licensed radio operators shall obey and carry out the lawful orders of the master or person lawfully in charge of the ship or aircraft on which they are employed.

§ 13.65 Damage to apparatus. No licensed radio operator shall willfully damage, or cause or permit to be damaged, any radio apparatus or installation in any licensed radio station.

§ 13.66 Unnecessary, unidentified, or superfluous communications. No licensed radio operator shall transmit unnecessary, unidentified, or superfluous radio communications or signals.

§ 13.67 **Obscenity, indecency, profanity.** No licensed radio operator or other person shall transmit communications containing obscene, indecent, or profane words, language, or meaning.

§ 13.68 **False signals.** No licensed radio operator shall transmit false or deceptive signals or communications by radio, or any call letter or signal which has not been assigned by proper authority to the radio station he is operating.

§ 13.69 **Interference.** No licensed radio operator shall willfully or maliciously interfere with or cause interference to any radio communication or signal.

§ 13.70 **Fraudulent licenses.** No licensed radio operator or other person shall obtain or attempt to obtain, or assist another to obtain an operator's license by fraudulent means.

Miscellaneous

§ 13.71 **Issue of duplicate or replacement licenses.** (a) An operator whose license, permit or authorization has been lost, mutilated or destroyed shall immediately notify the Commission. A properly executed application for duplicate should be submitted to the office of issue, embodying a statement of the circumstances involved in the loss, mutilation or destruction of the license or permit for which a duplicate is desired. If the license or permit 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 will be returned for cancellation. The applicant should also submit documentary evidence of the service that has been obtained under the original license or permit, or a statement under oath or affirmation embodying that information.

(b) The holder of any license, permit or authorization whose name is legally changed may make application for replacement document to indicate the new legal name, by submitting a properly executed application to the office of issue, accompanied by the license, permit or authorization affected and by documentary evidence of the legality of the name change.

§ 33.72 **Exhibiting signed copy of application.** 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.

§ 13.73 **Verification card.** 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.

§ 13.74 **Posting requirements for operator.** (a) Performing duties other than, or in addition to, service or maintenance, at two or more stations. The holder of any class of radio operator license or permit of the diploma form (as distinguished from the card form) who performs any radio operating duties, as contrasted with but not necessarily exclusive of service or maintenance duties, at two or more stations at which posting of his license or permit is required shall post at one such station his operator license or permit and shall post at all other such stations a duly issued verified statement (Form 759).

(b) Performing service or maintenance duties at one or more stations. The holder of a radiotelephone or radiotelegraph first- or second-class radio operator license who performs, or supervises, and is responsible for service or maintenance work on any transmitter of any station for which a station license is required, shall post his license at the transmitter involved whenever the transmitter is in actual operation while service or maintenance work is being performed: *Provided,* That in lieu of posting his license, he may have on his person either his license or a verification card (Form 758-F): *And provided further,* That if he performs operating duties in addition to

service or maintenance duties he shall, in lieu of complying with the foregoing provisions of this paragraph, comply with the posting requirements applicable to persons performing such operating duties, as set forth in paragraph (a) of this section, and in the rules and regulations applicable to each service.

(c) One or more verified statements (Form 759), as necessary, will be issued to the holder of a restricted radiotelephone operator permit (card form license) who because of an operator license posting requirement at one station would not otherwise be able to comply with a license posting requirement or to carry his permit on his person when so required at another station or stations.

§ 13.75 **Record of service and maintenance duties performed.** 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

§ 13.91 **Endorsement of service record.** 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.

§ 13.92 **Aviation service endorsement.** 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.

§ 13.93 **Service acceptability.** 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.

§ 13.94 **Statement in lieu of service endorsement.** The holder of a radiotelegraph license or a restricted radiotelegraph operator permit 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 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 or the application, 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.

Part 6

FEDERAL COMMUNICATIONS COMMISSION
PART 17 — CONSTRUCTION, MARKING, AND LIGHTING OF ANTENNA STRUCTURES

TITLE 47—TELECOMMUNICATION

Chapter I—Federal Communications Commission

Part 17—Construction, Marking, and Lighting of Antenna Structures

NOTE: All functions of the Civil Aeronautics Administration (CAA) referred to in Part 17 of the FCC Rules have now been assumed by the Federal Aviation Authority (FAA). Reference to the CAA should therefore be interpreted to mean the FAA.

Subpart A—General Information

§ 17.1 Basis and purpose. (a) The rules in this part are issued pursuant to the authority contained in Title III of the Communications Act of 1934, as amended, which vests authority in the Federal Communications Commission to issue licenses for radio stations when it is found that the public interest, convenience or necessity would be served thereby, and to require the painting, and/or illumination of radio towers if and when in its judgment such towers constitute, or there is a reasonable possibility that they may constitute, a menace to air navigation.

(b) The purpose of the rules in this part is to prescribe certain procedures and standards with respect to the Commission's consideration of proposed antenna structures which will serve as a guide to persons intending to apply for radio station licenses. The standards have been worked out in conjunction with the Civil Aeronautics Administration, the Department of Defense and other Government agencies.

§ 17.2 Definitions. (a) *Airport reference point.* The airport reference point is a point selected and marked at the approximate geometric center of the airport landing area.

(b) *Antenna structures.* The term antenna structures includes the radiating system, its supporting structures and any surmounting appurtenances.

(c) *Approach surfaces and approach areas.* The approach surface is an imaginary inclined plane through the air space located directly above the approach area. The dimensions of the approach area are measured horizontally. This inclined plane extends upward and outward from the beginning of the approach area starting at the elevation of the runway end.

(1) *Length.* The approach area has a length of 10,000 feet beginning 200 feet (1,000 feet for regular Department of Defense Air Bases) from the end of each runway and extending outward, ending at a point 10,200 feet (11,000 feet for regular Department of Defense Air Bases) from the end of the runway on the extended center line of the runway. In addition the approach areas of all runways which may be used for instrument operation shall extend outward an additional 40,000 feet. The approach area requirements for instrument runways shall apply to all runways which may be used for instrument operations and to both ends of such runways.

(2) *Width.* The approach area is symmetrically located with respect to the extended runway center line, and for all instrument runways has a total width of 1,000 feet (1,500 feet for regular Department of Defense Air Bases) at the end adjacent to the runway. The approach area flares uniformly to a total width of 4,000 feet at the end of the 10,000-foot section and to a total width of 16,000 feet at the end of the additional 40,000-foot section. For all other runways not designated for instrument operation, the approach area has a total width at the end adjacent to the runway, and at the approach end, respectively, as follows: For express air carrier service and larger airports, 500 feet and 2,500 feet; for trunk line air carrier service airports, 400 feet and 2,400 feet; for feeder air carrier service airports, 300 feet and 2,300 feet; for secondary airports, 250 feet and 2,250 feet.

(3) *Slope.* For instrument runways the slope of the approach surface along the runway center line extended is 50:1 (an elevation of 1 foot for each 50 feet of hori-

zontal distance) for the inner 10,000-foot section and 40:1 (an elevation of 1 foot for each 40 feet of horizontal distance) for the outer 40,000-foot section. All other runways, not designated for instrument operation which meet or exceed the minimum runway length requirements for feeder air carrier service shall have a slope of 40:1. On airports with shorter runway lengths than those specified for feeder air carrier service, the slope of the approach surface is 20:1 (an elevation of 1 foot for each 20 feet of horizontal distance) for all runways.

(d) *Conical surface.* The conical surface is an imaginary surface through the air space extending upward and outward from the periphery of the horizontal surface and having a slope of 20:1 measured in a vertical plane passing through the airport reference point. Measuring radially outward, from the periphery of the horizontal surface, the conical surface extends for a horizontal distance of 7,000 feet for intercontinental express airports, intercontinental airports and Department of Defense Air Bases; and 5,000 feet for continental, express, trunk line and feeder airports, and 3,000 feet for all smaller airports.

(e) *Designated air traffic control areas.* Areas established and designated by the Administrator of Civil Aeronautics for air traffic control purposes. Information concerning the location of these areas can be obtained from CAA publications and by contacting the CAA regional office.

(f) *Established airport elevation.* The established elevation of the airport is the elevation of the highest point of the usable landing area.

(g) *Established coastal corridors.* Certain established corridors in which low level flight is required for Department of Defense and Coast Guard air operations conducted from air stations located within 20 statute miles of the Atlantic, Pacific and Gulf Coast. These corridors will be ten miles in width extending from coastal air stations to the nearby sea coast. Information with respect to these established corridors will be published along with the information on civil airways.

(h) *Civil airways.* A system of aerial routes designated by the Administrator of Civil Aeronautics for Air Navigation and Traffic Control purposes. Information concerning the location of civil airways can be obtained from aeronautical charts, CAA publications, and by contacting the CAA regional offices.

(i) *Final approach minimum flight altitude.* An altitude designated by appropriate federal authority which is normally established from the highest point within five statute miles of the center line of the final approach course of the radio facility used for final let-down for an airport, and extending for a distance of ten statute miles along this course outward from the radio facility. The radio facilities used for final let-down and the final approach minimum flight altitudes are published in Instrument Approach and Landing Charts and the Flight Information Manual.

(j) *Horizontal surface.* The horizontal surface is an imaginary plane through the air space, circular in shape, with its height 150 feet above the established airport elevation and having a radius from the airport reference point as indicated in the following table:

	Feet
Intercontinental express airports and Department of Defense Air Bases	13,000
Intercontinental airports	11,500
Continental airports	10,000
Express airports	8,500
Trunk line airports	7,000
Feeder airports	6,000
All smaller airports	5,000

The category of every airport in accordance with the above classification is designated by the Administrator of Civil Aeronautics.

(k) *Instrument approach area.* An approach area where instrument approaches are authorized. The dimensions of the approach area and instrument approach area are contained in paragraph (c) of this section.

(l) *Landing area.* A landing area means any locality, either of land or water,

including airports and intermediate landing fields, which is used, or approved for use,[1] for the landing and takeoff of aircraft whether or not facilities are provided for the shelter, servicing, or repair of aircraft, or for receiving or discharging passengers or cargo.

(m) *Minimum flight altitude.* Minimum altitudes designated by the Administrator of Civil Aeronautics to provide aircraft a safe clearance of all obstructions within the area designated. The necessary information concerning the locations of these areas and the established minimum flight altitude can be obtained from the CAA publications and by contacting the CAA regional offices.

(n) *Transitional surfaces.* The transitional surfaces are imaginary inclined planes through the air space having a slope of 7:1 (an elevation of 1 foot for each 7 feet of horizontal distance) measured upward and outward in a vertical plane at right angles to the axis of the runway. The transitional surfaces, symmetrically located on either side of the runway, extend upward and outward from a line on either side of the runway which is parallel to and level with the runway center line. These parallel lines are at a horizontal distance from the runway center line equal to one-half of the minimum width of the approach area indicated in paragraph (c)(2) of this section. Transitional surfaces extend from the edges of all approach surfaces upward and outward to the intersection with the horizontal surface or the conical surface. The approach surfaces for instrument runways projecting through and beyond the limits of the conical surface shall have 7:1 transitional surfaces extending a distance of 5,000 feet measured horizontally from the edge of the approach surfaces and at right angles to the runway axis.

§ 17.3 Form to be used to describe proposed antenna structures. Applications for radio facilities in the Radio Broadcast Services shall be accompanied by FCC Form 301, Section V-G (antenna); applications in the Aviation Services shall be accompanied by FCC Form 406 (Part 11); and applications in all other services shall be accompanied by FCC Form 401-A (revised) when:

(a) The antenna structures proposed to be erected will exceed an over-all height of 170 feet above ground level, except that where the antenna is mounted on top of an existing man-made structure other than an antenna structure and does not increase the over-all height of such man-made structure by more than 20 feet, no Form 401-A need be filed, or

(b) The antenna structures proposed to be erected will exceed an over-all height of 1 foot above the established airport (landing area) elevation for each 200 feet of distance, or fraction thereof, from the nearest boundary of such landing area, except that, where the antenna does not exceed 20 feet above the ground or if the antenna is mounted on top of an existing man-made structure, other than an antenna structure, or natural formation and does not increase the over-all height of such man-made structure or natural formation by more than 20 feet, no Form 401-A need be filed.

§ 17.4 Commission consideration of proposed antenna structure with respect to possible hazard to air navigation. (a) All applications which in the light of the criteria set forth in Subpart B require special aeronautical study will be referred by the Commission through appropriate channels to the Airspace Subcommittee of the Air Coordinating Committee for its recommendation.

(b) All applications which do not require special aeronautical study in view of the criteria set forth in Subpart B will be deemed not to involve a hazard to air navigation and will be considered by the Commission without reference to the Airspace Subcommittee of the Air Coordinating Committee.

(c) Whenever a recommendation for approval of any application that has been submitted to the Airspace Subcommittee of the Air Coordinating Committee has been received from that Committee, the application will be deemed not to involve a hazard to air navigation and will be processed by the Commission accordingly.

(d) Whenever a report recommending denial of any application or any report

[1] Consideration to aeronautical facilities not in existence at the time of the filing of the application for radio facilities will be given only when proposed airport construction or improvement plans are on file with the CAA as of the filing date of the application for such radio facilities.

which indicates a lack of agreement among the members of the Airspace Subcommittee of the Air Coordinating Committee has been received from that Committee, the applicant will be so advised and the Commission will take such further action as might be appropriate.

Subpart B—Criteria for Determining Whether Applications for Radio Towers Require Special Aeronautical Study

§ 17.11 Antenna structures over 500 feet in height. Antenna structures over 500 feet in height above the ground will require special aeronautical study irrespective of their location.

§ 17.12 Antenna structures over 170 feet up to and including 500 feet in height. Antenna structures over 170 feet up to and including 500 feet in height above the ground will not require special aeronautical study except:

(a) Where antenna structures less than 500 feet in height would necessitate the raising of the minimum flight altitude within the Civil Airways and designated air traffic control areas in the country.

(b) In areas of established coastal corridors.

(c) Where the antenna structure would project above the landing area, or the limiting heights or surfaces, specified in § 17.15, of all airports now in existence or provided for in approved plans.[1]

§ 17.13 Antenna structures 170 feet in height and under. Antenna structures 170 feet and under in height above the ground will not require special aeronautical study, except in the areas outlined in § 17.15.

§ 17.14 Certain antenna structures exempt from special aeronautical study. Antenna structures 20 feet or less in height mounted on top of natural formations, and antenna structures increasing by 20 feet or less the height of existing man-made structures other than an existing antenna structure, will not require special aeronautical study.

§ 17.15 Antenna structures in airports and approach areas. Antenna structures in the vicinity of airports and approach areas will require special aeronautical study if they project above the following heights above ground or surfaces (in case of conflict the lowest height will prevail).

(a) In instrument approach areas, more than 100 feet above the ground or 100 feet above the elevation of the approach end of the runway, whichever gives the higher elevation of the structure, within three statute miles of the runway end, and increasing in height above ground in the proportion of 25 feet for each additional statute mile of distance outward from the runway but not to exceed 250 feet within ten miles of the runway end. The approach area requirements for instrument runways shall apply to both ends of such runways.

(b) More than 170 feet above the ground or the established airport elevation, whichever gives the higher elevation of the structure within three statute miles of the reference point of a feeder or larger class airport and increasing in height above ground in the proportion of 100 feet for each additional statute mile of distance from the airport but not to exceed a maximum of 500 feet above ground.

(c) Antenna structures of an elevation which would increase the final approach minimum flight altitude.

(d) In addition to the requirements mentioned above, antenna structures which project above the landing area or any of the following imaginary surfaces will require special aeronautical study:

(1) Approach surface.

(2) Horizontal surface.

(3) Conical surface.

(4) Transitional surface.

(e) Under most conditions, the limits prescribed in paragraphs (a), (b) and (c) of this section will be the determining factor. However, in the areas immediately adjacent to the runways and under certain conditions where the terrain rises rapidly in the airport area, the surfaces specified in paragraph (d) of this section become a more limiting factor from the absolute height of requirements.

§ 17.16 Shielded antenna structures. In any special aeronautical study conducted under the provisions of this subpart, the circumstances that the antenna structure will be shielded by natural formations or existing man-made structures will be taken into account.

§ 17.17 Existing structures. (a) Nothing in these criteria concerning antenna structures or locations shall apply to those structures now existing or to those structures authorized prior to the effective date of these criteria.

(b) No change in any of these criteria or relocation of airports shall at any time impose a new restriction upon any then existing or authorized antenna structure or structures.

Subpart C—Specifications for Obstruction Marking and Lighting of Antenna Structures

§ 17.21 Painting and lighting, when required. Antenna structures shall be painted and lighted when:

(a) They require special aeronautical study; or

(b) They exceed 170 feet in height above the ground.

(c) The Commission may modify the above requirement for painting and/or lighting of antenna structures, when it is shown by the applicant that the absence of such marking would not impair the safety of air navigation, or that a lesser marking requirement would insure the safety thereof.

§ 17.22 Particular specifications to be used. (a) Where special aeronautical study is not required, the Commission will assign painting and lighting specifications as set forth in this subpart.

(b) Where special aeronautical study is required, the Commission will, insofar as is consistent with the safety of life and property in the air, also assign painting and lighting specifications listed in this subpart.

(c) However, where antenna installations are of such a nature that their painting and lighting in accordance with these specifications are confusing or endanger rather than assist airmen or are otherwise inadequate, the Commission will specify the type of painting and lighting or other marking to be used in the individual situation.

§ 17.23 Specifications for the painting of antenna structures in accordance with § 17.21. Antenna structures shall be painted throughout their height with alternate bands of aviation surface orange and white, terminating with aviation surface orange bands at both top and bottom. The width of the bands shall be approximately one-seventh the height of the structure, provided however, that the bands shall not be more than 40 feet nor less than 1½ feet in width.

§ 17.24 Specifications for the lighting of antenna structures up to and including 150 feet in height. (a) Antenna structures up to and including 150 feet in height above the ground located in areas set forth in § 17.15 shall be lighted as follows:

(1) There shall be installed at the top of the tower at least two 100- or 111-watt lamps (#100 A21/TS or #111 A21/TS, respectively) enclosed in aviation red obstruction light globes. The two lights shall burn simultaneously from sunset to sunrise and shall be positioned so as to insure unobstructed visibility of at least one of the lights from aircraft at any angle of approach. A light sensitive control device or an astronomic dial clock and time switch may be used to control the obstruction lighting in lieu of manual control. When a light sensitive device is used, it should be adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

§ 17.25 Specifications for the lighting of antenna structures over 150 feet up to and including 300 feet in height. (a) Antenna structures over 150 feet up to and including 300 feet in height above the ground shall be lighted as follows:

(1) There shall be installed at the top of the structure one 300 m/m electric code beacon equipped with two 500- or 620-watt lamps (PS-40, Code Beacon type), both lamps to burn simultaneously, and equipped with aviation red color filters. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the structure and it is determined that this additional construction does not permit unobstructed visibility of the code beacon

from aircraft at any angle of approach, there shall be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any angle of approach. The beacon shall be equipped with a flashing mechanism producing not more than 40 flashes per minute nor less than 12 flashes per minute with a period of darkness equal to one-half of the luminous period.

(2) At the approximate mid point of the over-all height of the tower there shall be installed at least two 100- or 111-watt lamps (#100 A21/TS or #111 A21/TS, respectively) enclosed in aviation red obstruction light globes. Each light shall be mounted so as to insure unobstructed visibility of at least one light at each level from aircraft at any angle of approach.

(3) All lights shall burn continuously or shall be controlled by a light sensitive device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

§ 17.26 Specifications for the lighting of antenna structures over 300 feet up to and including 450 feet in height. (a) Antenna structures over 300 feet up to and including 450 feet in height above the ground shall be lighted as follows:

(1) There shall be installed at the top of the structure one 300 m/m electric code beacon equipped with two 500- or 620-watt lamps (PS-40, Code Beacon type), both lamps to burn simultaneously, and equipped with aviation red color filters. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the structure and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any angle of approach, there shall be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any angle of approach. The beacons shall be equipped with a flashing mechanism producing not more than 40 flashes per minute nor less than 12 flashes per minute with a period of darkness equal to one-half of the luminous period.

(2) On levels at approximately two-thirds and one-third of the over-all height of the tower, there shall be installed at least two 100- or 111-watt lamps (#100 A21/TS or #111 A21/TS, respectively) enclosed in aviation red obstruction light globes. Each light shall be mounted so as to insure unobstructed visibility of at least one light at each level from aircraft at any angle of approach.

(3) All lights shall burn continuously or shall be controlled by a light sensitive device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

§ 17.27 Specifications for the lighting of antenna structures over 450 feet up to and including 600 feet in height. (a) Antenna structures over 450 feet up to and including 600 feet in height above the ground shall be lighted as follows:

(1) There shall be installed at the top of the structure one 300 m/m electric code beacon equipped with two 500- or 620-watt lamps (PS-40, Code Beacon type), both lamps to burn simultaneously, and equipped with aviation red color filters. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the structure and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any angle of approach, there shall be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any angle of approach. The beacons shall be equipped with a flashing mechanism producing not more than 40 flashes per minute nor less than 12 flashes per minute with a period of darkness equal to one-half of the luminous period.

(2) At approximately one-half of the over-all height of the tower one similar flashing 300 m/m electric code beacon shall be installed in such position within the tower proper that the structural members will not impair the visibility of this beacon from aircraft at any angle of approach. In the event this beacon cannot be installed in a manner to insure unobstructed visibility of it from aircraft at any angle of approach, there shall be installed two such beacons. Each beacon shall be mounted on the outside of diagonally opposite corners or opposite sides of the tower at the prescribed height.

(3) On levels at approximately three-fourths and one-fourth of the over-all height of the tower, at least one 100- or 111-watt lamp (#100 A21/TS or #111 A21/TS, respectively) enclosed in an aviation red obstruction light globe shall be installed on each outside corner of the tower at each level.

(4) All lights shall burn continuously or shall be controlled by a light sensitive device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

§ 17.28 Specifications for the lighting of antenna structures over 600 feet up to and including 750 feet in height. (a) Antenna structures over 600 feet up to and including 750 feet in height above the ground shall be lighted as follows:

(1) There shall be installed at the top of the structure one 300 m/m electric code beacon equipped with two 500- or 620-watt lamps (PS-40, Code Beacon type), both lamps to burn simultaneously, and equipped with aviation red color filters. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the structure and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any angle of approach, there shall be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any angle of approach. The beacon shall be equipped with a flashing mechanism producing not more than 40 flashes per minute nor less than 12 flashes per minute with a period of darkness equal to one-half of the luminous period.

(2) At approximately two-fifths of the over-all height of the tower one similar flashing 300 m/m electric code beacon shall be installed in such position within the tower proper that the structural members will not impair the visibility of this beacon from aircraft at any angle of approach. In the event this beacon cannot be installed in a manner to insure unobstructed visibility of it from aircraft at any angle of approach, there shall be installed two such beacons. Each beacon shall be mounted on the outside of diagonally opposite corners or opposite sides of the tower at the prescribed height.

(3) On levels at approximately four-fifths, three-fifths and one-fifth of the over-all height of the tower, at least one 100- or 111-watt lamp (#100 A21/TS or #111 A21/TS, respectively) enclosed in an aviation red obstruction light globe shall be installed on each outside corner of the tower at each level.

(4) All lights shall burn continuously or shall be controlled by a light sensitive device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

§ 17.29 Specifications for the lighting of antenna structures over 750 feet up to and including 900 feet in height. (a) Antenna structures over 750 feet up to and including 900 feet in height above the ground shall be lighted as follows:

(1) There shall be installed at the top of the structure one 300 m/m electric code beacon equipped with two 500- or 620-watt lamps (PS-40, Code Beacon type), both lamps to burn simultaneously, and equipped with aviation red color filters. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the structure and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any angle of approach, there shall be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any angle of approach. The beacons shall be equipped with a flashing mechanism producing not more than 40 flashes per minute nor less than 12 flashes per minute with a period of darkness equal to one-half of the luminous period.

(2) On levels at approximately two-thirds and one-third of the over-all height of the tower one similar flashing 300 m/m electric code beacon shall be installed in such position within the tower proper that the structural members will not impair the visibility of this beacon from aircraft at any angle of approach. In the event these beacons cannot be installed in a manner to insure unobstructed visibility of the beacons from aircraft at any angle of approach, there shall be installed two such beacons at each level. Each beacon shall be mounted on the outside of

diagonally opposite corners or opposite sides of the tower at the prescribed height.

(3) On levels at approximately five-sixths, one-half, and one-sixth of the over-all height of the tower, at least one 100- or 111-watt lamp (#100 A21/TS or #111 A21/TS, respectively) enclosed in an aviation red obstruction light globe shall be installed on each outside corner of the tower at each level.

(4) All lights shall burn continuously or shall be controlled by a light sensitive device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

§ 17.30 Specifications for the lighting of antenna structures over 900 feet up to and including 1,050 feet in height. (a) Antenna structures over 900 feet up to and including 1,050 feet in height above the ground shall be lighted as follows:

(1) There shall be installed at the top of the structure one 300 m/m electric code beacon equipped with two 500- or 620-watt lamps (PS-40, Code Beacon type), both lamps to burn simultaneously, and equipped with aviation red color filters. Where a rod or other construction of less than 20 feet in height and incapable of supporting this beacon is mounted on top of the structure and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any angle of approach, there shall be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any angle of approach. The beacons shall be equipped with a flashing mechanism producing not more than 40 flashes per minute nor less than 12 flashes per minute, with a period of darkness equal to one-half of the luminous period.

(2) On levels at approximately four-sevenths and two-sevenths of the over-all height of the tower one similar flashing 300 m/m electric code beacon shall be installed in such position within the tower proper that the structural members will not impair the visibility of this beacon from aircraft at any angle of approach. In the event these beacons cannot be installed in a manner to insure unobstructed visibility of the beacons from aircraft at any angle of approach, there shall be installed two such beacons, at each level. Each beacon shall be mounted on the outside of diagonally opposite corners or opposite sides of the tower at the prescribed height.

(3) On levels at approximately six-sevenths, five-sevenths, three-sevenths and one-seventh of the over-all height of the tower at least one 100- or 111-watt lamp (#100 A21/TS or #111 A21/TS, respectively) enclosed in an aviation red obstruction light globe shall be installed on each outside corner of the structure.

(4) All lights shall burn continuously or shall be controlled by a light sensitive device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

§ 17.31 Specifications for the lighting of antenna structures over 1,050 feet up to and including 1,200 feet in height. (a) Antenna structures over 1,050 feet up to and including 1,200 feet in height above the ground shall be lighted as follows:

(1) There shall be installed at the top of the structure one 300 m/m electric code beacon equipped with two 500- or 620-watt lamps (PS-40, Code Beacon type), both lamps to burn simultaneously, and equipped with aviation red color filters. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the structure and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any angle of approach, there shall be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any angle of approach. The beacon shall be equipped with a flashing mechanism producing not more than 40 flashes per minute nor less than 12 flashes per minute with a period of darkness equal to one-half of the luminous period.

(2) On levels at approximately three-fourths, one-half and one-fourth of the over-all height of the tower one similar flashing 300 m/m electric code beacon shall be installed in such position within the tower proper that the structural members will not impair the visibility of this beacon from aircraft at any angle of approach. In the event these beacons cannot be installed in a manner to insure unobstructed visi-

bility of the beacons from aircraft at any angle of approach, there shall be installed two such beacons, at each level. Each beacon shall be mounted on the outside of diagonally opposite corners or opposite sides of the tower at the prescribed height.

(3) On levels at approximately seven-eighths, five-eighths, three-eighths, and one-eighth of the over-all height of the tower, at least one 100- or 111-watt lamp (#100 A21/TS or #111 A21/TS, respectively) enclosed in an aviation red obstruction light globe shall be installed on each outside corner of the structure.

(4) All lights shall burn continuously or shall be controlled by a light sensitive device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

§ 17.32 Specifications for the lighting of antenna structures over 1,200 feet up to and including 1,350 feet in height. (a) Antenna structures over 1,200 feet up to and including 1,350 feet in height above the ground shall be lighted as follows:

(1) There shall be installed at the top of the structure one 300 m/m electric code beacon equipped with two 500- or 620-watt lamps (PS-40, Code Beacon type), both lamps to burn simultaneously, and equipped with aviation red color filters. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the structure and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any angle of approach, there shall be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any angle of approach. The beacons shall be equipped with a flashing mechanism producing not more than 40 flashes per minute nor less than 12 flashes per minute with a period of darkness equal to one-half of the luminous period.

(2) On levels at approximately two-thirds, four-ninths and two-ninths of the over-all height of the tower one similar flashing 300 m/m electric code beacon shall be installed in such position within the tower proper that the structural members will not impair the visibility of this beacon from aircraft at any angle of approach. In the event these beacons cannot be installed in a manner to insure unobstructed visibility of the beacons from aircraft at any angle of approach, there shall be installed two such beacons at each level. Each beacon shall be mounted on the outside of diagonally opposite corners or opposite sides of the tower at the prescribed height.

(3) On levels at approximately eight-ninths, seven-ninths, five-ninths, one-third and one-ninth of the over-all height of the tower, at least one 100- or 111-watt lamp (#100 A21/TS or #111 A21/TS, respectively) enclosed in an aviation red obstruction light globe shall be installed on each outside corner of the tower at each level.

(4) All lights shall burn continuously or shall be controlled by a light sensitive device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

§ 17.33 Specifications for the lighting of antenna structures over 1,350 feet and up to and including 1,500 feet in height. (a) Antenna structures over 1,350 feet up to and including 1,500 feet in height above the ground shall be lighted as follows:

(1) There shall be installed at the top of the structure one 300 m/m electric code beacon equipped with two 500- or 620-watt lamps (PS-40, Code Beacon type), both lamps to burn simultaneously, and equipped with aviation red color filters. Where a rod or other construction of not more than 20 feet in height and incapable of supporting this beacon is mounted on top of the structure and it is determined that this additional construction does not permit unobstructed visibility of the code beacon from aircraft at any angle of approach, there shall be installed two such beacons positioned so as to insure unobstructed visibility of at least one of the beacons from aircraft at any angle of approach. The beacon shall be equipped with a flashing mechanism producing not more than 40 flashes per minute nor less than 12 flashes per minute with a period of darkness equal to one-half of the luminous period.

(2) On levels at approximately four-fifths, three-fifths, two-fifths, and one-fifth of the over-all height of the tower one similar flashing 300 m/m electric code beacon

shall be installed in such position within the tower proper that the structural members will not impair the visibility of this beacon from aircraft at any angle of approach. In the event these beacons cannot be installed in a manner to insure unobstructed visibility of the beacons from aircraft at any angle of approach, there shall be installed two such beacons at each level. Each beacon shall be mounted on the outside of diagonally opposite corners or opposite sides of the tower at the prescribed heights.

(3) On levels at approximately nine-tenths, seven-tenths, one-half, three-tenths, and one-tenth of the over-all height of the tower, at least one 100- or 111-watt lamp (#100 A21/TS or #111 A21/TS, respectively) enclosed in an aviation red obstruction light globe shall be installed on each outside corner of the tower at each level.

(4) All lights shall burn continuously or shall be controlled by a light sensitive device adjusted so that the lights will be turned on at a north sky light intensity level of about 35 foot candles and turned off at a north sky light intensity level of about 58 foot candles.

§ 17.34 Specifications for the lighting of antenna structures over 1,500 feet in height. Antenna structures over 1,500 feet in height above the ground shall be lighted in accordance with specifications to be determined by the Commission after aeronautical study which will include lighting recommendations.

§ 17.35 Antenna farms and multiple structure antenna arrays. In the case of antenna structures which are so grouped as to present a common potential menace to air navigation, the foregoing requirements for painting and lighting may be modified as a result of aeronautical study.

§ 17.36 Temporary warning lights. During construction of an antenna structure, for which obstruction lighting is required, at least two 100- or 111-watt lamps (#100 A21/TS or #111 A21/TS, respectively) enclosed in aviation red obstruction light globes, shall be installed at the uppermost point of the structure. In addition, as the height of the structure exceeds each level at which permanent obstruction lights will be required, two similar lights shall be installed at each such level. These temporary warning lights shall be displayed nightly from sunset to sunrise until the permanent obstruction lights have been installed and placed in operation, and shall be positioned so as to insure unobstructed visibility of at least one of the lights at any angle of approach. In lieu of the above temporary warning lights, the permanent obstruction lighting fixtures may be installed and operated at each required level as each such level is exceeded in height during construction.

§ 17.37 Inspection of tower lights and associated control equipment. The licensee of any radio station which has an antenna structure requiring illumination pursuant to the provisions of section 303(q) of the Communications Act of 1934, as amended, as outlined elsewhere in this part:

(a) (1) Shall make an observation of the tower lights at least once each 24 hours either visually or by observing an automatic and properly maintained indicator designed to register any failure of such lights, to insure that all such lights are functioning properly as required; or alternatively;

(2) Shall provide and properly maintain an automatic alarm system designed to detect any failure of such lights and to provide indication of such failure to the licensee.

(b) Shall report immediately by telephone or telegraph to the nearest Airways Communication Station or office of Civil Aeronautics Administration any observed or otherwise known failure of a code or rotating beacon light or top light not corrected within thirty minutes, regardless of the cause of such failure. Further notification by telephone or telegraph shall be given immediately upon resumption of the required illumination.

(c) Shall inspect at intervals not to exceed 3 months all automatic or mechanical control devices, indicators and alarm systems associated with the tower lighting to insure that such apparatus is functioning properly.

§ 17.38 Recording of tower light inspections in the station record. 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 required by § 17.37:

(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 failure of a tower light:

(1) Nature of such failure.

(2) Date and time the failure was observed, or otherwise noted.

(3) Date, time and nature of the adjustments, repairs, or replacements were made.

(4) Identification of Airways Communication Station (Civil Aeronautics Administration) notified of the failure of any code or rotating beacon light or top flight not corrected within 30 minutes, and the date and time such notice was given.

(5) Date and time notice was given to the Airways Communication Station (Civil Aeronautics Administration) that the required illumination was resumed.

(d) Upon completion of the periodic inspection required at least once each three 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.

§ 17.39 **Cleaning and repainting.** All towers shall be cleaned or repainted as often as necessary to maintain good visibility.

§ 17.40 **Time when lights shall be exhibited.** All lighting shall be exhibited from sunset to sunrise unless otherwise specified.

§ 17.41 **Spare lamps.** A sufficient supply of spare lamps shall be maintained for immediate replacement purposes at all times.

§ 17.42 **Lighting equipment.** The lighting equipment, color of filters, and shade of paint referred to in the specifications are further defined in the following government and/or Army-Navy Aeronautical Specifications, Bulletins, and Drawings: (Lamps are referred to by standard numbers.)

Aviation red	Army-Navy Specifications	AN-C-56.[1]
Outside white	Federal Specifications	TT-P-40, Type 1 or 2.[2]
Aviation surface orange	do	TT-P-59.[2,3]
Code beacon	CAA Specifications	446 (sec. II-d-Style 4).[4]
Obstruction light globe, prismatic.	Army-Navy Drawing	AN-L-10A [1] or CAA Specification L-810.
Obstruction light globe, Fresnel	do	
Single multiple obstruction light fitting assembly.	do	
Obstruction light fitting assembly.	do	
100-watt lamp		#100 A21/TS.[5]
111-watt lamp		#111 A21/TS (3,000 hours).
500-watt lamp		#500 PS 40/45.[5]
620-watt lamp		#620 PS 40/45 (3,000 hours).

[1] Copies of Army-Navy Specifications or drawings can be obtained by contacting Commanding General, Air Matériel Command, Wright Field, Dayton, Ohio, or the Bureau of Aeronautics, Navy Department, Washington 25, D.C. Information concerning Army-Navy Specifications or drawings can also be obtained from the Office of Federal Airways, Civil Aeronautics Administration, Department of Commerce, Washington 25, D.C.

[2] Copies of this specification can be obtained from the Government Printing Office for 5 cents.

[3] At the Air Routes and Ground Aids Division Meeting of the International Civil Aviation Organization during November 1949, the designation "Aviation Surface Orange," was adopted to replace "International Orange."

[4] Copies of this specification can be obtained from the Office of Federal Airways, Civil Aeronautics Administration, Department of Commerce.

[5] It is strongly recommended that the 111-watt and 620-watt, 3,000-hour lamps, be used instead of the 100-watt and 500-watt lamps whenever possible in view of the extended life, lower maintenance cost, and greater safety which they provide.

(c) Except as set forth in paragraphs (a) and (b) of this section, nothing in the criteria set forth in §§ 17.11 to 17.17 or this subpart concerning antenna structures or locations shall apply to painting and lighting those structures authorized prior to March 30, 1953 except where lighting and painting requirements are reduced, in which case the lesser requirements may apply.

§ 17.43 Painting and lighting existing structures. (a) All existing antenna structures required to be painted in accordance with the terms of an instrument of authorization dated prior to March 30, 1953, shall be painted in the manner set forth in § 17.23 at the time when the antenna structure is required to be repainted (see § 17.39) or in no event later than January 1, 1960.

(b) All existing antenna structures required to be lighted in accordance with the terms of an authorization requiring only the following lighting specifications shall be changed to the lighting specifications set forth below as soon as practicable or in no event later than one year from the date of the first instrument of authorization that is issued to the station after January 1, 1954:

Existing Lighting Specifications FCC Form No.	*New Lighting Specifications Rule No.*
715-1	§ 17.24(a)(1).
715-2 or B (6)-2	§§ 17.24(a)(1) and 17.26(a)(2).
715-4 or B (6)-4	§§ 17.24(a)(1) and 17.26(a)(2).

§ 17.44 Maintenance of lighting equipment. Replacing or repairing of lights, automatic indicators or automatic alarm systems shall be accomplished as soon as practicable.

§ 17.45 Report of radio transmitting antenna construction, alteration and/or removal. Any permittee or licensee who, pursuant to any instrument of authorization from the Commission to erect or make changes affecting antenna height or location of an antenna tower for which obstruction marking is required, shall, prior to start of tower construction and upon completion of such construction or changes, fill out and file with the Director, U.S. Coast and Geodetic Survey, C. & G. S. Form 844 (Report of Radio Transmitting Antenna Construction, Alteration and/or Removal) in order that antenna tower information may be provided promptly for use on Aeronautical Charts and related publications in the interest of safety of air navigation.

SPECIFIC CRITERIA TO BE USED BY RADIO/TELEVISION AND AVIATION INTERESTS RELATIVE TO HEIGHT AND LOCATION OF NEW ANTENNA STRUCTURES AND NEW AIRPORTS

A Report by the Joint Industry/Government Tall Structures Committee

Foreword

The following Report is the result of almost three years of work by the members of the JIGTSC. In its present form it is advisory and recommendatory in nature. The Report was forwarded as a recommendation to the Federal Communications Commission in regard to the amendment of Part 17 of their Rules and Regulations. The FCC has issued notices of proposed rule making in Docket 11665 (dated March 29, 1956 and November 22, 1957) in the matter of amendment of Parts 1 and 17 of the Commission's Rules to encourage the grouping of antenna towers and the multiple use of structures for supporting antennas, and amendment of Part 17 to pro-

vide new criteria for determining whether applications for antenna towers will require special aeronautical study.

As a member of the JIGTSC, the NAB was authorized by its Board of Directors to tentatively accept the Report for a one-year trial period during which time the JIGTSC would remain a standing committee. At the conclusion of this period, the JIGTSC would reconvene to re-evaluate the efficacy of the provisions of the Report. That period expired during July, 1958.[1] The above-mentioned proposed rule making in Docket 11665 is in accordance with the provisions of the Administrative Procedures Act whenever a change in the rules is proposed. These changes per Docket 11665, were proposed on the Commission's own motion. At the time this is being written, the FCC has not yet finalized their action in this docket. For final action in this regard, broadcasters are referred to this docket and subsequent revisions in Parts 1 and 17 of the FCC Rules and Regulations.

It should be pointed out that regardless of the amendments of the Commission's Rules, the Washington Airspace Panel and the Regional Airspace Subcommittees are considering broadcast tower applications coming before them on the basis of the recommendations contained in the following Report.

Preface

While it is recognized that the radio/television industry has a definite requirement for tall antenna towers in order to provide the degree of public service contemplated by the Communications Act of 1934, as amended, these tall skeletal structures and their supporting guy wires are hazardous to aviation because they are peculiarly difficult for pilots to see.

Accordingly, the Joint Industry/Government Tall Structures Committee (JIGTSC) has agreed to the following general concepts, procedures, and specific criteria as a guide to be used by both radio/television and aviation interests in their consideration of their mutual problems relating to the height and location of proposed new antenna structures and new airports.

Memorandum of Agreement

A. General

The present system of determining whether a transmitting tower constitutes an air hazard should be continued. (Ref.: Part 17, FCC Rules)

It is specifically understood that the principles subscribed to here apply only to new or modified antenna tower proposals.

B. Tower "Farms"

The adoption of the single structure multiple antenna, and/or antenna tower "farm"[2] concept for radio and television transmitting towers is necessary wherever possible in order to avoid a conflict of airspace interest between the aviation and broadcast industries.

1. Control of Transmitting Towers. The FCC has stated that it has the authority to require radio and television transmitting antennas to be placed in "farm" areas or to require the use of multiple antennas on a single supporting structure if the record shows that such action will be in the public interest, convenience, and necessity. Obviously there are some types of towers which would be excepted, as for example, standard broadcast directional antennas and towers for micro-wave transmission.

The Committee recommends that the FCC initiate a rule-making proceeding[3] to

[1] Extended to July, 1960.

[2] An antenna "farm" is an area where antenna towers having a common impact on aviation may be grouped.

[3] The FCC on March 29, 1956, issued a Notice of Proposed Rule Making concerning the antenna "farm" concept (Docket 11665) and final action on this rule making is being postponed pending action on the attached recommended criteria.

amend its rules to require that any future application for a transmitting tower in excess of 500′ in height above the ground should be reviewed by the ACC Airspace Panel to determine the aeronautical hazards involved, retaining the right of the applicant to submit evidence to the FCC as to why his tower should not be located in a "farm" area or his antenna should not be located on an existing structure. "Farm" areas should be so spaced in relation to each other as to present the least hazard to aviation.

The Committee recommends the location of all transmitting towers, government and non-government, regardless of height, in antenna "farms" wherever possible. However, this recommendation should not be interpreted as modifying FCC Part 17 or CAA TSO-N18 except as may be necessary to implement the criteria as set forth under section F of this paper.

II. Control of Receiving Antenna Towers. Since the FCC does not have authority to control the erection of receiving antenna towers, except where such receiving antenna is on the same tower as a transmitting antenna (as in a micro-wave system), legislation should be requested which would control the installation, height, and location of receiving antenna towers. Such legislation should not provide any more stringent restrictions on receiving antennas than on transmitting antennas, and should be developed and coordinated within the ACC structure.

In the event the FCC should not desire to control receiving antenna towers under such legislation, there would be no objection to a move on the part of the Federal agencies concerned to have similar authority vested in some other agency, either at Federal, or possibly State, level.

The object of such legislation would be to have the same criteria and principles apply to all tower structures. Such legislation should be sought by the FCC, with support of other interested agencies.[1]

C. Control of Unused or Abandoned Towers

FCC authority to control the lighting, marking, or removal of unused or abandoned towers is not clear except where the person involved is a licensee of another station(s). This question is presently under consideration in the Commission. Accordingly, the FCC should require the removal or appropriate marking and lighting of unused or abandoned towers if such authority exists, and if such authority does not exist, the FCC should seek appropriate legislation to attain this objective.[2]

D. Additional Lighting and Marking

Full cooperation exists between the broadcast and aviation industries toward improvement in the lighting and marking of radio and television antenna towers and experimentation is in the initial stages of implementation in the ACC structure.

E. Other Structures

Aviation authorities contend that appropriate legislation should be drafted to cover the erection, location, and height of other obstructions to aviation. Such legislation should be sought by the Department of Commerce, with the support of other interested agencies.

[1] The FCC on May 1, 1957, initiated request for legislation for the control of receiving antenna towers.

[2] The FCC on December 12, 1956, initiated a request for legislation to require that abandoned or unused radio towers continue to meet the same painting and lighting requirements that would be applicable if such towers were being used pursuant to license issued by FCC.

F. Air Hazard Criteria for Determining Height and Location (See Att. A)

At the meeting of the JIGTSC on October 3, 1955, it was agreed that criteria would be developed to serve the purpose stated in the Preface hereto, and to have the following objectives:

(*a*) To provide protection for low altitude inter-city air routes;
(*b*) To provide additional protection for high density air traffic areas, present and forecast;
(*c*) To provide increased protection for airways and much used "fly-ways";
(*d*) To provide additional protection for areas in the vicinity of airports;
(*e*) To provide areas for the erection of radio and television towers.

Specific criteria in respect to the areas described in items (*a*), (*c*), and (*d*), above are set forth in Attachment A hereto. In respect to high density air traffic areas, item (*b*), it was found that the objective was generally satisfied by the criteria developed for the other three areas. Specific criteria for this problem area could not be satisfactorily expressed in separate form as the interpretation of "high density air traffic areas" could not be precisely defined. Originally, the interpretation was held that a "high density air traffic area" was a large geographical area in which the complexity and extent of airways, controlled areas, control zones and flight operations were of a relatively higher degree than elsewhere. This concept does not lend itself to any practical approach other than the establishment of a blanket limit on structure heights.

A second interpretation of a "high density air traffic area" is that applied to the control zone of certain busy airports, such as Washington National. In such cases, the objective stated in item (*d*) would serve to satisfy the problem in this area. Accordingly, it is believed that the problem confronting aviation and radio/television interests can be resolved by application of the criteria specified for the areas described in items (*a*), (*c*) and (*d*) above.

It should be clearly understood that the criteria set forth in Attachment A are designed for the following purposes and no other:

1. As a guide for use by radio/television interests in selecting sites for antenna towers;
2. As a guide to aviation interests in conducting special aeronautical studies of applications for construction of antenna towers and in considering the effect of existing antenna towers in planning and construction of new airports;
3. To be used as a basis for recommending amendments to Part 17 of the Federal Communications Commission's Rules as it applies to the requirement for special aeronautical study of proposed towers under 500′ above ground; and
4. To be used as a basis for action by the Civil Aeronautics Administration, as appropriate, to implement paragraph 2 above.

These criteria, per se, are not intended as a rigid standard to be arbitrarily applied by the Airspace Panel in approving or disapproving applications for tower construction, and it is not intended that these criteria shall apply to existing antenna structures.

Exceptions will be made by the Airspace Panel for the purpose of establishing or adding to antenna "farm" areas, as appropriate, and where existing conditions of terrain, obstructions or other circumstances would make application of these criteria inappropriate.

It would be to the advantage of all tower applicants to consult State and local aviation officials before committing themselves to specific locations.

G. Improving Airspace Panel Procedures

If the Airspace Panel (ASP) reaches the conclusion, based solely on technical aviation considerations, that a certain tower as proposed would be a hazard, it should then determine whether or not the tower can be moved or shortened, or whether aviation adjustments should be made. At this point in its deliberations it will obviously be necessary for ASP to consider the direct cost of some physical relocation either on the part of television or aviation, in order that it may determine whether

the economic burden should rest with television or aviation interests. In some cases, the Airspace Panel should not limit its consideration of antenna tower proposals solely to the question of aviation hazards involved, but should continue its present practice of considering economic and other factors in reaching a compromise mutually satisfactory to both broadcasting and aviation.

It is the position of aviation that radio and television antenna towers in excess of 1000′ above the ground are, per se, considered to be unwarranted hazards (obstructions, menaces, etc.) to air navigation. On the other hand, it is the position of the broadcast industry that this determination can be made only in the light of all the facts surrounding the utilization of a particular tower. However, it is mutually agreed that under certain conditions antenna towers in excess of 1000′ above the ground may be required in the public interest, convenience, and necessity. In view of this, on all proposals considered by the Airspace Panel which would require towers in excess of 500′ above the gronnd, the applicant shall have the right to, and should, present complete justification, excluding all economic considerations except the direct costs of physical relocation. If the applicant does not submit justification to the Airspace Panel, the Panel will consider the application only from the aeronautical hazard perspective.

ACC coordination and cooperation should be maintained with State and local officials, who will be afforded opportunity to appear and present information with respect to State laws and local ordinances relating specifically to obstructions to air navigation.

In addition, the Airspace Panel may wish the applicant to cite the particular page and paragraph of any FCC rule to which he may allude as an FCC requirement.

The FCC should, insofar as practical, provide additional engineering and technical assistance at Airspace meetings.[1]

The National Association of Radio and Television Broadcasters should have associate membership on the Washington Airspace Panel.[2]

H. Booster and Satellite Stations

While the use of booster and satellite stations may in specific instances serve to resolve conflicts between the television and aviation industries, it is generally agreed that their use does not offer a satisfactory solution to the problem of broad area coverage.

Attachment A

Criteria

A. Protection for Areas in the Vicinity of Public-use Civil Airports

1. Classification of Airports. For the purpose of aeronautical study of proposed antenna structure, airports shall be classified in three categories: *large, small* and *personal* airports.[3]

a. Large airports shall be those having one or more existing or planned [4] runways of 3,500 feet in length or greater.

b. Airports with runways of 2,000 to 3,500 feet in length shall be classified as small.

c. All other airports shall be considered as personal airports.

2. Obstruction Limit Surfaces (JIGTSC). To provide for acceptable clearance between aircraft flight paths and antenna structures, such structures shall not extend

[1] This suggestion was acted upon favorably by the FCC.

[2] The NAB is now an Associate Member of the Washington Airspace Panel.

[3] All runway lengths used in the criteria are basic runway lengths for sea level sites under standard atmospheric conditions.

[4] Consideration to aeronautical facilities not in existence at the time of the filing of the application for radio facilities will be given only when reasonable notice of proposed airport construction or improvement plans are on file with the CAA as of the filing date of the application for such radio facilities.

above the imaginary surfaces defined below except where approved after aeronautical study:

(*a*) *Instrument Approach Areas (JIGTSC) (See Exhibit A).*

Instrument approach areas shall have the same definition and dimensions as set forth in FCC Part 17 as of this date, with the following exceptions:

Slope: The slope of the approach surface only along the runway center line extended shall be 50:1 and shall begin 2,000 feet outward from the end of existing or planned * runways.

NOTE: The over-all plan view length and width of the approach area remains as defined in Part 17 in that it begins 200 feet from the existing or planned * end of the runway (1,000 feet for military air bases), and extends outward for 50,000 feet. The change made herein affects only the sloping surface in that it starts at a greater distance outward from the runway.

(*b*) *Approach Areas (JIGTSC)—Other than Instrument Runway (See Exhibit A).*

(1) *Length:* Length of approach area shall be as presently defined in FCC Part 17.

(2) *Slope:* The slope of the approach area surface shall be 40:1 for Large, Small, and Personal type airports.

(3) *Width:* The width of the approach area shall be 500 feet at the end adjacent to the runway and 2,500 feet at the outward, or approach end. This shall apply to Large, Small and Personal airports.

NOTE: When application of the various criteria results in two or more surfaces intersecting, then the lower surface shall be considered as the significant surface for aeronautical study.

(*c*) *Circular Area Extending Outward from Airport Reference Point.* The surfaces established herein shall replace the horizontal and conical surfaces presently defined in FCC Part 17, and shall have the following dimensions (see Exhibit B).

(1) A *horizontal* surface, circular in shape, with its height 150 feet above the airport elevation and having a radius from the airport reference point as follows:

(*a*) For Large airports —2½ miles (13,200′)
(*b*) For Small airports —1½ miles (7,920′)
(*c*) For Personal airports—1½ miles (7,920′)

(2) An *inner* conical surface extending upward and outward from the periphery of the horizontal surface and having a slope of 40:1 for large and small airports, and 30:1 for personal airports. Measured radially outward from the periphery of the horizontal surface, the inner conical surface shall extend for a horizontal distance as follows:

(*a*) For Large airports —2½ miles (13,200′)
(*b*) For Small airports —1½ miles (7,920′)
(*c*) For Personal airports—2 miles (10,560′)

NOTE: The airport traffic pattern is considered to be within the area of 5 miles radius of large, and 3 miles for small and personal airports.

(3) An *outer conical* surface extending outward and upward from the periphery of the inner conical surface and having a slope of 100:1 for large and small airports, and 50:1 for personal airports. Measured radially outward from the periphery of the inner conical surface, the outer conical surface shall extend for a horizontal distance as follows:

(*a*) For Large airports —10 miles (52,800′)
(*b*) For Small airports — 2 miles (10,560′)
(*c*) For Personal airports— 1½ miles (7,920′)

3. **Approach and Landing Minimums.** Various criteria are employed in the establishment of initial approach altitudes, altitude over the facility on final approach, for holding and procedure turns, and landing minima. The base for the establishment of these values is the height of critical obstructions, including terrain within certain defined areas. Surfaces presently defined in FCC Part 17, together with the surfaces established or modified by the preceding criteria will serve to set the requirement for

aeronautical study of any proposed antenna structure that may have an adverse effect on the above minima.

B. Protection of Areas in the Vicinity of Military and Joint-use Airports

1. Obstructions 500 Feet and Under. That portion of the criteria in Section "A" which affects obstructions 500 feet or under applies to both public-use civil airports and military airports and is to be used as a basis for proposing amendments to Part 17 of the FCC Rules.

2. Obstructions Over 500 Feet. That portion of the criteria in Section "A" which affects obstructions over 500 feet applies only to public-use civil airports. The criteria for military and joint-use airports [1] are contained in AFR-86-3 and BUAER-11012.1. Whenever these criteria overlap due to proximity of airports, the more restrictive criteria will apply in the overlapping portion of airspace.

NOTE: Latest issues of AFR-86-3 and BUAER 11012.1 may be obtained from Departments of the Air Force and Navy.

C. Protection for Areas in the Vicinity of Heliports

Cognizance must be given to the operating characteristics of rotor-wing aircraft and to the requirements of aircraft with comparable operating characteristics with respect to the development and establishment of landing areas and routes which, insofar as civil operations are concerned, will normally be in built-up areas of dense population.

1. Heliports. A conical surface extending upward and outward to a horizontal distance of 4,000 feet from the edge of the existing or proposed heliport and having a slope of 20:1. Exceptions to the 20:1 slope may be made when proposed antenna construction is shielded by existing structures or obstructions of a permanent nature. For the purposes of these criteria, the edge of a heliport is considered to be 500 feet from its center, or the edge of the existing or planned [2] heliport, if the latter is greater than 500 feet from its center and shown on local aeronautical charts.

NOTE: Because of the early developmental stage of helicopter operations, no helicopter airways or flyways have been established. However, future needs for helicopter airways or flyways should be considered in analyzing the location and height of antenna structures.

D. Protection of Federal Airways Traffic (See Exhibit C)

1. On Airways. Unless adequately shielded by terrain or existing man-made structures, any proposal for new construction extending over 500 feet in height above ground, and located within the limits of designated civil airways or routes (5 miles each side of the center line) must be thoronghly weighed to determine whether or not such a tower would represent a hazard to air navigation.

2. Adjacent to Airways. In considering safety of flight along airways, the location and height of structures immediately adjacent to an airway are considered to offer a potential hazard to flight to a degree related to the longitudinal distance from the radio navigational aid, and lateral distance from the boundary of the airway. Structures which extend through the following-described planes adjacent to airways will be considered hazardous to air navigation, unless shielded by terrain or existing man-made structures, or approved by special aeronautical study.

a. Starting at a point 25 miles beyond the air navigation facility along the outer edges and 500 feet above the ground of an airway or route extending outward

[1] See Appendix 11 for June 1, 1957, list of Joint-Use Airports.

[2] Consideration to aeronautical facilities not in existence at the time of the filing of the application for radio facilities will be given only when reasonable notice of proposed airport construction or improvement plans are on file with the CAA as of the filing date of the application for such radio facilities.

and upward at a slope of 50:1 right angles to the airway for a horizontal distance of 5 miles each side of the airway.

b. Within 25 miles of a NAV Aid: This portion of the off-airway boundary narrows down to the width of the airway (10 miles) at a point right angles to the navigational aid.

3. In addition to the above, consideration shall be given to the following:

a. Cardinal altitudes (i.e., 1,000 feet; 2,000 feet; 3,000 feet, etc.) as presently established will not normally be modified to a non-cardinal figure (e.g., 1,200 feet; 1,500 feet; 2,400 feet; 2,900 feet).

b. Existing minimum en route altitudes, established at 1,500 feet MSL, will not normally be altered upward. (This will be particularly true in coastal dense traffic areas.)

c. Certain airways will be protected below the present established "Minimum En Route Altitude" where planning information indicates a requirement which may be satisfied by an additional VOR or through provision of DME or other aids.

d. The degree of change which may be tolerated for non-cardinal altitudes is dependent on factors, such as (a) density of en route and terminal air traffic, (b) prevailing weather conditions, (c) terrain, and a number of others. It is not believed practicable to establish a mechanical formula for application to this problem.

e. As a general rule civil airways extend on direct lines between adjacent air navigation radio aids. For air traffic control reasons, or to facilitate other operational advantages, airways are sometimes aligned to other than a direct routing. Where moving an airway could be accomplished without unreasonable penalty to aviation, to accommodate tall structures justified as a public need, such action may be taken.

E. Protection of Low-altitude Inter-city Routes

There are a few closely spaced large and medium size cities which generate a considerable amount of inter-city low-level traffic (such as Dallas-Forth Worth, San Francisco-Oakland, and Winston Salem-Raleigh) where it is necessary to keep the lower altitudes below the minimum en route airway altitude relatively free of obstructions in such areas to permit maximum flexibility in handling of air traffic. In other instances, the existence of a reasonably low MEA will often eliminate the necessity of inter-city instrument flight, by permitting flight underneath cloud levels. The following general procedures will be followed in aeronautical study of structures in these areas:

1. The minimum authorized altitude between closely spaced cities having substantial inter-city traffic will not normally be increased.

2. Structures extending over 500 feet above the ground should not be located within five miles of a direct line between two closely spaced airports where CAA has authorized or indicates plans for authorization of special low-altitude inter-city aircraft operation to expedite aircraft operations.

F. Protection of Flyways and Military Corridors

1. There are some areas, particularly in deserts, forests, large swamps, or mountainous country, where aircraft operating VFR are normally flown around large areas where emergency landings would be difficult, or down valleys, along rivers, through canyons, etc., at relatively low level to avoid hazardous terrain. Where this type of operation is relatively large, the routes flown are termed "Flyways." Airway radio aids are often utilized for weather information on these "Flyways," but not necessarily for air navigation. Where traffic on these "Flyways" is substantial and they are shown on aeronautical charts, specific aeronautical study shall be given to applications for towers over 170 feet above ground within five miles of the normal center line of these routes.

2. The general criteria for Federal Airways shall be applied to established military corridors in which low-level flight operations are required for military and Coast

Guard Air Stations. These corridors will normally be ten statute miles in width, extending from the stations to the coastal areas or between two military installations.

G. Provision of "Farm Areas" for the Erection of Radio and Television Towers

The above criteria are adopted with the understanding that "farm areas" [1] will be established in every community. In the establishment of the height of towers in these "farm areas," aviation interests will compromise their needs to the fullest extent possible in order to provide the tower heights required to deliver the maximum service to the public. To meet this objective, the above-noted criteria (JIGTSC, AFR-86-3 and BUAER 11012.1) will not apply.

[1] An antenna "farm" is an area where antenna towers having a common impact on aviation may be grouped.

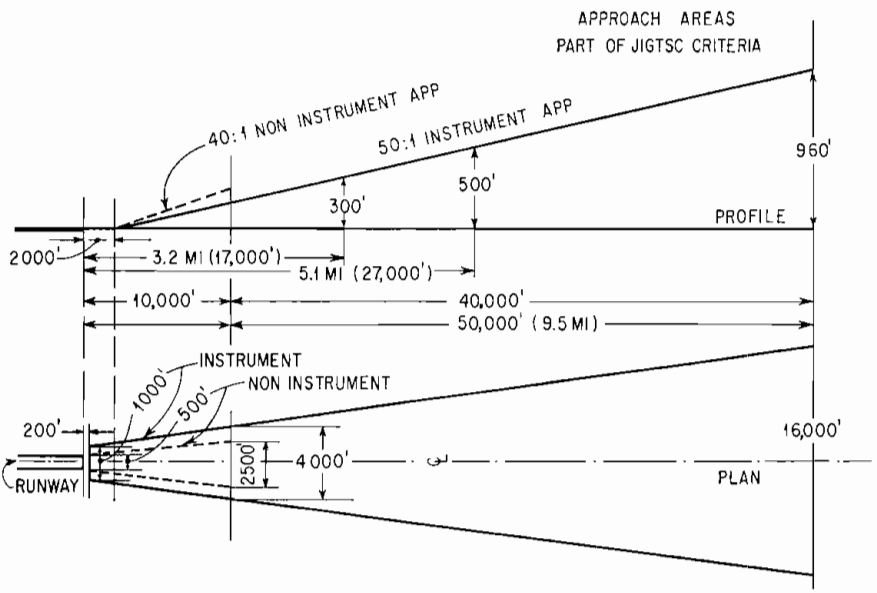
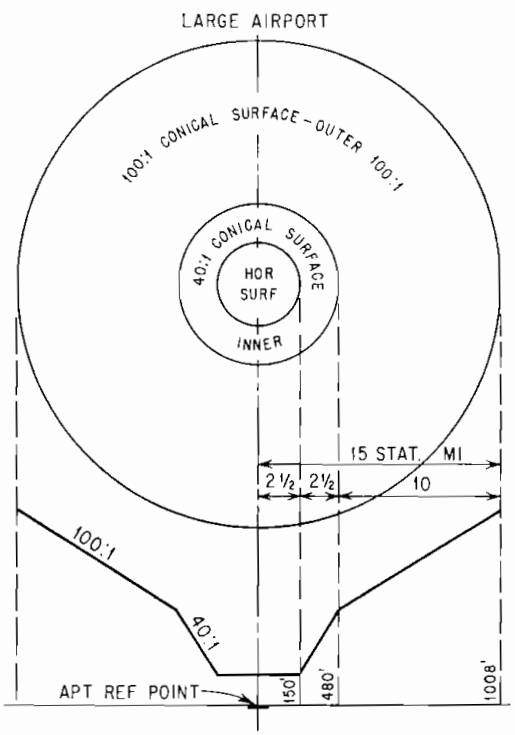


Exhibit A

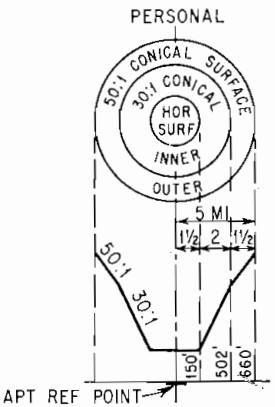


CIRCULAR AREAS
PART OF JIGTSC CRITERIA

AIRPORT CLASSIFICATION

1 PERSONAL SIZE APT. = RUNWAYS LESS THAN 2000'
2 SMALL SIZE APT. = " 2000 TO 3500
3 LARGE SIZE APT. = " 3500 & GREATER

NOTE:
ALL RUNWAY LENGTHS USED IN THE CRITERIA ARE BASIC RUNWAY LENGTHS FOR SEA LEVEL SITES UNDER STANDARD ATMOSPHERIC CONDITIONS



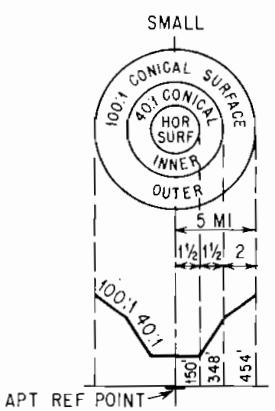


EXHIBIT B

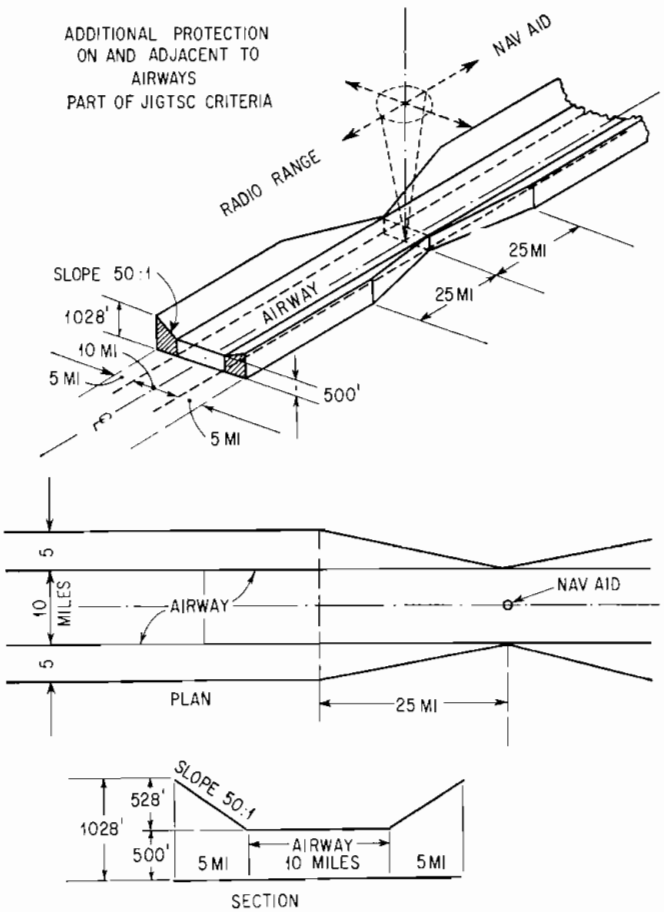

ADDITIONAL PROTECTION
ON AND ADJACENT TO
AIRWAYS
PART OF JIGTSC CRITERIA
NAV AID
RADIO RANGE
SLOPE 50:1
1028'
10 MI
5 MI
AIRWAY
25 MI
25 MI
500'
5 MI
5
10 MILES
5
AIRWAY
NAV AID
PLAN
25 MI
SLOPE 50:1
528'
1028'
500'
5 MI
AIRWAY
10 MILES
5 MI
SECTION

EXHIBIT C

Appendix I

Comparison of Part 17 and Proposed Amendments

(Sections of Part 17 not shown herein remain unchanged)

Part 17	*Proposed Amendments*
17.2(c) Approach surfaces and approach areas. The approach surface is an imaginary inclined plane through the air space located directly above the approach area. The dimensions of the approach area are measured horizontally. This inclined plane extends npward and outward from the beginning of the approach area starting at the elevation of the runway end.	17.2(c) No change.
17.2(c)(1) Length. The approach area has a length of 10,000 feet beginning 200 feet (1,000 feet for regular Department of Defense Air Bases) from the end of each runway and extending outward, ending at a point 10,200 feet (11,000 feet for regular Department of Defense Air Bases) from the end of the runway on the extended center line of the runway. In addition the approach areas of all runways which may be used for instrument operation shall extend outward an additional 40,000 feet. The approach area requirements for instrument runways shall apply to all runways which may be used for instrument operations and to both ends of such runways.	17.2(c)(1) No change.
17.2(c)(2) Width. The approach area is symmetrically located with respect to the extended runway center line, and for all instrument runways has a total width of 1,000 feet (1,500 feet for regular Department of Defense Air Bases) at the end adjacent to the runway. The approach area flares uniformly to a total width of 4,000 feet at the end of the 10,000-foot section and to a total width of 16,000 feet at the end of the additional 40,000-foot section. For all other runways not designated for instrument operation, the approach area has a total width at the end adjacent to the runway, and at the approach end, respectively, as follows: For express air carrier service and larger airports, 500 feet and 2,500 feet; for trunk line air carrier service airports, 400 feet and 2,400 feet; for feeder air carrier service airports, 300 feet and 2,300 feet; for secondary airports, 250 feet and 2,250 feet.	17.2(c)(2) Width. The approach area is symmetrically located with respect to the extended runway center line, and for all instrument runways has a total width of 1,000 feet (1,500 feet for regular Department of Defense Air Bases) at the end adjacent to the runway. The approach area flares uniformly to a total width of 4,000 feet at the end of the 10,000-foot section and to a total width of 16,000 feet at the end of the additional 40,000-foot section. For all other runways not designated for instrument operation on both large and small airports, the approach area has a total width of 500 feet at the end adjacent to the runway and 2,500 feet at the outward, or approach end.
17.2(c)(3) Slope. For instrument runways the slope of the approach surface along the runway center line extended is 50:1 (an elevation of 1 foot for each 50 feet of horizontal distance) for the inner 10,000-foot section and 40:1 (an elevation of 1 foot for each 40 feet of horizontal dis-	17.2(c)(3) Slope. For instrument runways the slope of the approach surface along the runway center line extended is 50:1 (an elevation of 1 foot for each 50 feet of horizontal distance) beginning at a point 2,000 feet from the end of each runway. For non-instrument runways the slope of the

Part 17

tance) for the outer 40,000-foot section. All other runways, not designated for instrument operation which meet or exceed the minimum runway length requirements for feeder air carrier service shall have a slope of 40:1. On airports with shorter runway lengths than those specified for feeder air carrier service, the slope of the approach surface is 20:1 (an elevation of 1 foot for each 20 feet of horizontal distance) for all runways.

17.2(d) Conical surface. The conical surface is an imaginary surface through the air space extending upward and outward from the periphery of the horizontal surface and having a slope of 20:1 measured in a vertical plane passing through the airport reference point. Measuring radially outward, from the periphery of the horizontal surface, the conical surface extends for a horizontal distance of 7,000 feet for intercontioental express airports, intercontinental airports and Department of Defense Air Bases; and 5,000 feet for continental, express, trunk line and feeder airports, and 3,000 feet for all smaller airports.

17.2(j) Horizontal surface. The horizontal surface is an imaginary plane through the airspace, circular in shape, with its height 150 feet above the established airport elevation and having a radius from the airport reference point as indicated in the following table:

Proposed Amendments

approach surface is 40:1 beginning at a point 2,000 feet from the end of each runway.

17.2(d)(1) *Inner Conical Surface.* The inner conical surface is an imaginary surface through the airspace extending upward and outward from the periphery of the horizontal surface and having a slope of 40:1 for large and small airports and 30:1 for personal airports. Measuring radially outward, from the periphery of the horizontal surface, the conical surface extends for a horizontal distance as follows:

(*a*) Large airports —2½ miles (13,200′)
(*b*) Small airports —1½ miles (7,920′)
(*c*) Personal airports—2 miles (10,560′)

17.2(d)(2) *Outer Conical Surface.* The outer conical surface is an imaginary surface through airspace extending upward and outward from the periphery of the inner conical surface and having a slope of 100:1 for large and small airports and 50:1 for personal airports. Measuring radially outward from the periphery of the inner conical surface, the outer conical surface shall extend for a horizontal distance as follows:

(*a*) Large airports —10 miles (52,800′)
(*b*) Small airports —2 miles (10,560′)
(*c*) Personal airports—1½ miles (7,920′)

17.2(d)(3) *Conical Surface for Heliports.* The conical surface for heliports is an imaginary surface through the airspace extending upward and outward from the edge of the heliport and having a slope of 20:1. Measuring radially outward from the edge of the heliport, the conical surface for heliports extends for a horizontal distance of 4,000 feet. The edge of a heliport is considered to be 500 feet from the center, or the edge of the existing or planned heliport, if the latter is greater than 500 feet from its center and shown on local aeronautical charts.

17.2(j) *Horizontal Surface.* The horizontal surface is an imaginary plane through the air space, circular in shape with its height 150 feet above the established airport elevation and having a radius from the airport reference point as follows:

Part 17

	Feet
Intercontinental express airports and Dept. of Defense Air Bases	13,000
Intercontinental airports	11,500
Continental airports	10,000
Express airports	8,500
Trunk line airports	7,000
Feeder airports	6,000
All smaller airports	5,000

The category of every airport in accordance with the above classifieation is designated by the Administrator of Civil Aeronautics.

17.2(n) Transitional surfaces. The transitional surfaces are imaginary inclined planes through the airspace having a slope of 7:1 (an elevatoin of 1 foot for each 7 feet of horizontal distance) measured upward and outward in a vertical plane at right angles to the axis of the runway. The transitional surfaces, symmetrically located on either side of the runway, extend upward and outward from a line on either side of the runway which is parallel to and level with the runway center line. These parallel lines are at a horizontal distance from the runway center line equal to one-half of the minimum width of the approach area indicated in paragraph (c)(2) of this section. Transitional surfaces extend from the edges of all approach surfaces upward and outward to the intersection with the horizontal surface or the conical surface. The approach surfaces for instrument runways projecting through and beyond the limits of the conical surface shall have 7:1 transitional surfaces extending a distance of 5,000 feet measured horizontally from the edge of the approach surfaces and at right angles to the runway axis.

NONE

NONE

NONE

Proposed Amendments

(1) Large airports —2½ miles (13,200')
(2) Small airports —1½ miles (7,920')
(3) Personal airports—1½ miles (7,920')

17.2(n) No change.

17.2(o) Low Altitude Inter-city Route. A low altitude Inter-city Route is a route authorized by CAA for air carrier operation between two closely located cities (airports) at an altitude or altitudes generally lower than the minimum enroute altitude authorized for flight on the airway joining the two cities.

17.2(p) Flyways. A flyway is a "Natural" route between two points, shown on Aeronautical charts and extensively flown in VFR operations to avoid high terrain, or to follow natural landmarks (rivers) where radio navigational facilities are not available.

17.2(q) Large Airports. For the purpose of this part, large airports are those having one or more runways of 3,500 feet in length, or greater.

Part 17	*Proposed Amendments*
NONE	17.2(r) Small Airports. For the purpose of this part, small airports are those having runways of 2,000 to 3,500 feet in length.
NONE	17.2(s) Personal Airports. For the purpose of this part, personal airports are those having all runways of less than 2,000 feet in length.
17.12(a) Where antenna structures less than 500 feet in height would necessitate the raising of the minimum flight altitude with the Civil Airways and designated air traffic control areas in the country.	17.12(a) Where antenna structures less than 500 feet in height would necessitate the raising of the minimum flight altitude within: (1) the Civil Airways, (2) designated air traffic control areas, and (3) CAA authorized low altitude inter-city routes.
17.12(b) In areas of established coastal corridors.	17.12(b) In areas of established coastal corridors (normally 10 miles in width).
17.12(c) Where the antenna structure would project above the landing area, or the limiting heights or surfaces, specified in paragraph 17.15, of all airports now in existence or provided for in approved plans.	17.12(c) No change.
NONE	17.12(d) Where the antenna structure is located within 5 miles of the center line of established and published flyways.

Appendix II

A. U.S. Air Force Bases Permitting Civil Use °

Air Force installations used by civil aircraft:

California
AF Plant No. 42, Palmdale
Colorado
Lowry AFB, Denver
Delaware
Dover AFB, Dover
Florida
Palm Beach AFB, Palm Beach
Georgia
Hunter AFB, Savannah
Kansas
McConnell AFB, Wichita
Louisiana
Lake Charles AFB, Lake Charles
Maine
Dow AFB, Bangor
Presque Isle AFB, Presque Isle
Massachusetts
Westover AFB, Chicopee Falls
Michigan
Kinross AFB, Kinross
Nebraska
Lincoln AFB, Lincoln
New Hampshire
Grenier AFB, Manchester
New Mexico
Clovis AFB, Clovis
Holloman AFB, Alamogordo
Kirtland AFB, Albuquerque
Nevada
Stead AFB, Reno
Oklahoma
Ardmore AFB, Ardmore
South Carolina
Charleston AFB, Charleston
Myrtle Beach AFB, Myrtle Beach
Texas
Amarillo AFB, Amarillo
Harlingen AFB, Harlingen
Kelly AFB, San Antonio
Laredo AFB, Laredo
Webb AFB, Big Spring
Sheppard AFB, Wichita Falls
Washington
Fairchild AFB, Spokane
McChord AFB, Tacoma
Paine AFB, Everett

° As of June 1, 1957.

B. Civil Airfields with U.S. Army, Navy, Air Force, and Air National Guard on Tenant Status *

Civil airfields on which the Department of Defense has a current requirement:

Airport Name	*Location*	*Military Activity*		
	Alabama			
Bates Field	Mobile			USA
Birmingham	Birmingham	USN †	ANG	USA
Huntsville	Huntsville			USA
Dannelly	Montgomery		ANG	
	Arizona			
Bisbee-Douglas Int.	Douglas			USA
Sky Harbor	Phoenix		ANG	USA
Tucson	Tucson		ANG	USA
	Arkansas			
Fort Smith	Fort Smith	USN	ANG	
Adams Field	Little Rock		ANG	
	California			
Chico	Chico	USAF		
Fresno Air Terminal	Fresno	USN †	ANG	
Hayward	Hayward		ANG	
Lindberg	San Diego	USN		
Long Beach	Long Beach	USAF USN		USA
Los Angeles Int.	Los Angeles	USN		
Mills	San Francisco	USN		
Monterey Peninsula	Monterey	USN		
Oakland Int.	Oakland	USN		
Ontario Int.	Ontario		ANG	
San Fernando Valley	Los Angeles/Van Nuys		ANG	USA
Sacramento	Sacramento	USN		
Stockton	Stockton			USA
Tracy	Tracy			USA
	Colorado			
Peterson Field	Colorado Springs	USAF		USA
	Connecticut			
Bridgeport	Bridgeport			USA
Brainard Field	Hartford			USA
Bradley Field	Windsor Locks	USN	ANG	USA
	Delaware			
New Castle County	Wilmington	USAF	ANG	USA
	District of Columbia			
Washington National	Washington	USAF USN		
	Florida			
Imeson Field	Jacksonville		ANG	USA
Lodwick Field	Lakeland			USA
Miami Int.	Miami	USAF		USA
Orlando	Orlando	USAF USN		
Pinellas County Int.	St. Petersburg	USAF		
Tampa Int.	Tampa			USA
Milton OLF	Milton	USN		
Pensacola OLF (Hagler)	Pensacola	USN		

* As of June 1, 1957.
† Navy use two days per month.

Georgia

Airport Name	*Location*	*Military Activity*		
Fulton County	Atlanta		USN	USA
Muscogee County	Columbus			USA
Cochran Field	Macon			USA
Travis Field	Savannah		ANG	USA

Idaho

Boise Air Terminal	Boise		ANG	USA
Caldwell	Caldwell			USA
Idaho Falls	Idaho Falls			USA
Nez Perce County	Lewiston			USA
Pocatello	Pocatello			USA
Joslin Field	Twin Falls			USA

Illinois

Chicago-Hammond	Chicago			USA
O'Hare-Chicago Int.	Chicago	USAF	ANG	
Lewis-Lockport	Lockport			USA
Greater Peoria	Peoria		ANG	
Qual City	Rock Island			USA
Capital	Springfield		USN ANG	
Midway	Chicago		ANG	
Illinois Urbana	Urbana			USA

Indiana

Dress Memorial	Evansville	USAF	USN	USA
Baer Field	Fort Wayne		USN ANG	
Stout Field	Indianapolis			USA
Weir Cook	Indianapolis		USN	
Hulman Field	Terre Haute		USN ANG	

Iowa

Atlantic	Atlantic			USA
Boone	Boone			USA
Denison	Denison			USA
Des Moines	Des Moines		USN ANG	
Fairfield	Fairfield			USA
Fort Dodge	Fort Dodge			USA
Ottumwa	Ottumwa		USN	
Sibley	Sibley			USA
Waterloo	Waterloo			USA
Sioux City	Sioux City	USAF	USN ANG	

Kansas

Dodge City	Dodge City			USA
Fort Scott	Fort Scot			USA
Great Bend	Great Bend		USN	
Hiawatha	Hiawatha			USA
Hutchinson	Hutchinson			USA
Iola	Iola			USA
Conard Field	Ottawa			USA
Philip Billard	Topeka			USA

Kentucky

Blue Grass	Lexington			USA
Bowman Field	Louisville		USN	USA
Standiford Field	Louisville		ANG	

Louisiana

Lafayette	Lafayette			USA
New Orleans	New Orleans		ANG	USA
Shreveport-Downtown	Shreveport		USN	

Maine

Airport Name	*Location*	*Military Activity*		
P & M Airfield	Fort Fairfield			USA
Port of Maine	South Portland			USA
Augusta State	Augusta			USA

Maryland

Friendship Int.	Baltimore	USAF			
Harbor Field	Baltimore		USN	ANG	USA
Hagerstown	Hagerstown		USN		

Massachusetts

Hanscom	Bedford	USAF			
Logan	Boston			ANG	
Barnes	Westfield		USN	ANG	

Michigan

Collins	Alpena			ANG	
Kellogg Field	Battle Creek		USN	ANG	
Detroit-Wayne Major	Detroit			ANG	
Willow Run	Detroit	USAF	USN		
Abrams	Grand Ledge				USA
Kent County	Grand Rapids		USN		
McNamara Field	Grayling				USA
K. I. Sawyer	Marquette	USAF			
Brooks Field	Marshall				USA

Minnesota

Bemidgi	Bemidgi		USN [a]		
Duluth	Duluth	USAF		ANG	
Minneapolis-St. Paul Int.	Minneapolis	USAF	USN		
Holman Field	St. Paul			ANG	USA

Mississippi

Hawkins Field	Jackson		USN	ANG	USA
Key Field	Meridian			ANG	
Gulfport Mun.	Gulfport			ANG [a]	

Missouri

Memorial	Cape Girardeau		USN		USA
State Line	Kansas City				USA
Southwest	St. Louis				USA
Lambert Field	St. Louis		USN	ANG	USA
Rosecrans Field	St. Joseph			ANG	
Maryville Memorial	Maryville				USA
Sky Haven	Warrensburg				USA
Mexico Memorial	Mexico				USA

Montana

Billings	Billings				USA
Gallatin Field	Bozeman				USA
Glasgow	Glasgow				USA
Great Falls	Great Falls			ANG	
Helena	Helena				USA
Flathead County	Kalispell				USA
Missoula County	Missoula				USA

Nevada

Reno	Reno			ANG	USA

New Hampshire

Manchester-Grenier	Manchester				USA

[a] Summer Cruise Station.

Airport Name	*Location*	*Military Activity*			
		New Jersey			
Atlantic City	Atlantic City		USN		
Mercer County	Trenton		USN		USA
Newark	Newark			ANG	
Linden	Linden				USA
Monmouth County	Belmar				USA
		New York			
Albany	Albany				USA
Zahns	Amityville				USA
Niagara Falls	Niagara Falls	USAF	USN	ANG	USA
Dutchess County	Poughkeepsie				USA
Monroe County	Rochester				USA
Schenectady	Schenectady		USN	ANG	
Hancock	Syracuse			ANG	USA
Westchester County	White Plains			ANG	USA
Gruman	Bethpage, L.I.		USN		
		North Carolina			
Douglas	Charlotte		USN	ANG	USA
Greensboro-High Point	Greensboro		USN		USA
Jackson	Kinston				USA
Lenoir	Lenoir				USA
Franklin	Louisburg				USA
Raleigh-Durham	Raleigh				USA
Rocky Mount	Rocky Mount				USA
Washington	Washington				USA
New Hanover County	Wilmington		USN		
		North Dakota			
Bismarck	Bismarck				USA
Hector	Fargo		USN *	ANG	
		Ohio			
Akron	Akron		USN		
Akron-Cantnn	Akron			ANG	
Cincinnati-Lunken	Cincinnati		USN		USA
Cuyahogan County	Cleveland				USA
Port Columbus	Columbus		USN		
Ohio State University	Columbus				USA
Mansfield	Mansfield			ANG	
Springfield	Springfield			ANG	
Toledo Mun.	Toledo				USA
Toledo Express	Toledo			ANG	
Youngstown	Youngstown	USAF			
Zanesville	Zanesville		USN		
		Oklahoma			
Davis Field	Muscogee	USAF			
Westheimer	Norman		USN		USA
Will Rogers	Oklahoma City		USN	ANG	
Tulsa	Tulsa		USN	ANG	
Tishomingo	Tishomingo		USN		
		Oregon			
Klamath Falls	Klamath Falls	USAF			
Portland Int.	Portland	USAF		ANG	USA
McNary	Salem		USN		

* Navy use two days per month.

Pennsylvania

Airport Name	*Location*	*Military Activity*			
Wings Field	Ambler				USA
Port Erie	Erie				USA
Harrisburg-State	Harrisburg				USA
New Castle	New Castle				USA
Taylor	New Kingstown				USA
Philadelphia Int.	Philadelphia			ANG	USA
Greater Pittsburgh	Pittsburgh	USAF	USN	ANG	
Allegheny County	Pittsburgh				USA
General Spaatz	Reading			ANG	
Mifflin County	Reedsville				USA
York	Thomasville				USA
Washington	Washington				USA
Wyoming Valley	Wilkes-Barre				USA

Rhode Island

Green	Providence			ANG	USA

South Carolina

Columbia	Columbia		USN		
Florence	Florence				USA
Memorial	Spartanburg				USA

South Dakota

Halley	Rapid City				USA
Foss Field	Sioux Falls			ANG	

Tennessee

McMinn County	Athens				USA
Lovell Field	Chattanooga				USA
Outlaw Field	Clarksville				USA
Putnam County	Cookeville				USA
McKellar Field	Jackson				USA
McGhee-Tyson	Knoxville	USAF	USN		
Gill-Dove	Martin				USA
Memphis	Memphis	USAF		ANG	USA
Murfreesboro	Murfreesboro				USA
Berry Field	Nashville			ANG	USA
Northern Field	Tullahoma	USAF			

Texas

Alice Mun.	Alice		USN		
Aransas County	Rockport		USN		
El Paso Int.	El Paso				USA
Houston Int.	Houston		USN		
Mineral Wells	Mineral Wells				USA
San Antonio Int.	San Antonio				USA
Mathis Field	San Angelo				USA

Utah

Cedar City	Cedar City				USA
Logan-Cache County	Logan				USA
Ogden	Ogden				USA
Provo	Provo				USA
Salt Lake City #1	Salt Lake City		USN	ANG	USA

Vermont

Burlington	Burlington	USAF		ANG	USA

Virginia

Covington	Covington				USA
Danville	Danville				USA

Airport Name	*Location*	*Military Activity*		
Norfolk	Norfolk			USA
Byrd Field	Richmond	USAF	ANG	USA
Woodrum Field	Roanoke	USN		USA
	Washington			
Bellevue	Bellevue			USA
Chehalis County-City	Chehalis			USA
Felts Field	Spokane			USA
Geiger	Spokane	USAF	USN ANG	
Kitsap County	Bremerton	USN		
Pearson Airpark	Vancouver			USA
	West Virginia			
Kanawha County	Charleston	USN	ANG	USA
Tri-State	Huntington			USA
Martinsburg	Martinsburg		ANG	
Morgantown	Morgantown			USA
Wheeling-Ohio County	Wheeling			USA
	Wisconsin			
Ean Claire	Eau Claire			USA
Kenosha	Kenosha			USA
Truax Field	Madison	USAF	ANG	
General Mitchell	Milwaukee	USAF	USN ANG	
Curtiss Wright	Milwaukee			USA
Phillips	Phillips			USA
Stevens Point	Stevens Point			USA
Richard Bong	Superior			USA
	Wyoming			
Casper Air Terminal	Casper		ANG	USA
Cheyenne	Cheyenne		ANG	USA
Douglas	Douglas			USA
Brees	Laramie			USA
Sheridan County	Sheridan			USA

C. U.S. Navy Bases Permitting Civilian Use *

Location	*Airlines Landing Regularly*	*NOy(R)*	
Adak, Alaska	Northwest Airlines, Inc	49144	
	Reeve Aleutian Airways, Inc.	45787	43266
	Northwest Orient Airlines	Process	
Agana, Guam	Pacific Overseas Airlines	43383	
	Transocean Air Lines	43324	
	Pan American Airways, Inc.	43380	
	Seaboard and Western Airlines, Inc.	48368	
Kodiak, Alaska	Alaska Air Lines, Inc.	43371	
	Reeve Aleutian Airways, Inc.	43265	
	Pacific Northern Airlines	43335	43336
	Aviation Corp. of Seattle	45473	
	Northern Consolidated Airlines, Inc.	43379	44873
	Transocean Air Lines	45166	
	Pan American World Airways	44770	
Green Cove Springs, Florida	Airway Service of Florida, Inc.		
San Clemente, Cal.	Avalon Air Transport (to 1 November 1957)		
Honolulu, T.H.	South Pacific Air Lines	49384	
Iwakuni, Japan	Civil Air Transport, Inc.	Process	

* Current as of 1 June 1957. Authorized under SECNAV Instruction 3770.1 of 20 May 1952.

NAVAL AIRFIELDS WHERE CIVIL USE IS PERMITTED *

Active Navy owned and/or controlled airfields where civil use is permitted under joint-use agreements:

NAS Atlantic City, N.J.	City of Atlantic City	49190
OLF North Perry, Florida	Broward County, Florida	60237
NAAS Chase Field, Beeville, Texas	City of Beeville	48949

Inactive Navy owned or controlled airfields where civilian use is permitted by contract:

Arlington, Washington	Town of Arlington	44857
	Town of Arlington	45179
Cuddihy Field, Texas	City of Corpus Christi	60302
Ottumwa, Iowa	City of Ottumwa	42997
Shelton, Washington	Mason County	44787
Tillamook, Oregon	Tillamook County	36691
	Tillamook County	42821
Richmond, Florida	University of Miami	60127
Martha's Vineyard, Mass.	Transferred in fee to Dukes County	46432

Appendix III

AFR 86–3 †

AIR FORCE REGULATION
NO. 86–3

DEPARTMENT OF THE AIR FORCE
WASHINGTON, *14 AUGUST 1956*

Installation Planning and Development

Criteria for Determining Obstructions to Air Navigation

Purpose: This regulation establishes the criteria for determining if an object or structure is an obstruction to air navigation. (Airfield zoning is described in AFR 86–11.)

1. RESPONSIBILITY FOR COMPLIANCE. Echelons of command responsible for the use of navigable airspace, airfield clearances, and airfield planning will comply with this regulation.

2. DEFINITIONS. Any natural object or man-made structure that protrudes above the planes or surfaces defined below and in paragraph 3 is considered an obstruction to air navigation. The attachments to this regulation illustrate the following definitions. If conflict exists between the definition and the illustration, the definition will govern.

a. Air Force Airfield—An area on the ground designated and used to accommodate take-offs, landings, servicing, and parking for Air Force aircraft.

b. Airfield Reference Point—A designated point on an Air Force airfield from which distances relating to specific criteria referred to in this regulation are measured. For the purpose of this regulation, the airfield reference point will be the existing control tower or a point upon which such a tower normally would be erected. (See attachment 1.)

c. Established Airfield Elevation—The elevation, in feet above mean sea level, of the highest point on the landing area which is used or intended to be used for takeoff and landing operations.

d. Landing Area—A specially prepared surface within the boundaries of an airfield designed for aircraft takeoff and landing operations. It includes the paved surface (runway and shoulders) and the safety zones immediately adjacent thereto which have been cleared of all above-ground obstructions. In no case will the width of the landing area be less than the width of the approach area at the end of the runway. (See attachments 2 and 3.)

e. Clear Zone—The areas immediately adjacent to ends of a runway which have been cleared of all above-ground obstructions and graded to prevent damage to aircraft which undershoot or overrun the runway. The standard clear zone dimensions are 1,000 feet long

* Current as of 1 June 1957.

† This regulation supersedes AFR 86–3, 9 May 1956.

(measured along the extended runway center line) and 2,000 feet wide (1,000 feet on each side of the extended runway center line). (See attachments 2 and 3.)

f. Approach Zone—An area beyond each clear zone, extending on the ground for a distance of 25,000 feet along and symmetrical about the exteuded center line of the runway. The width of the approach zone at the end of the clear zone is 2,000 feet; it flares to 4,000 feet at 10,000 feet from the end of the clear zone; and it remains 4,000 feet wide for the additional 15,000 feet. (See attachments 2 and 3.)

g. Approach Surface—An imagiuary plane above the approach zone, beginning at the end of the clear zone at the elevation of the end of the runway and rising over the approach zone on a slope of 50 to 1 (known as the glide angle) for a horizontal distance of 10,000 feet (200 feet above elevation of end of runway). From this point the controlling elevation of the approach surface will remain at 200 feet until the end of the approach zone (25,000 feet from the end of the clear zone). (See surfaces lettered A and B.)

h. Approach Area—The clear zone and the approach zone combined. The standard approach area is symmetrical about the extended center line of the runway.

i. Inner Horizontal Surface—An imaginary plane located 150 feet above the established airfield elevation. The extent of this surface will be limited to an area included within a circle having a radius of 10,000 feet measured from the airfield reference point. (See surfaces lettered D.)

j. Transitional Surface—Joins the landing area, the clear zone, and the approach surface to the inner and outer horizontal surfaces and the inner conical surface. The slope of the transitional surfaces is 7 to 1 outward and upward measured at right angles to the axis of the runway except at the extreme end of the approach surface where this slope is measured parallel to the runway axis. To determine the elevation for the beginning of the transitional surface slope at any point along the lateral boundary of the landing area including the clear zone, draw a line from the point to the runway center line. This line will be at right angles to the runway axis. The elevation at the runway center line is the elevation for the beginning of the 7 to 1 slope. (See surfaces lettered C and E.)

k. Inner Conical Surface—An imaginary surface extending outward and upward from the periphery of the horizontal surface for a distance of 7,000 feet. The slope of the conical surface will be 20 to 1. (See surfaces lettered F.)

l. Outer Horizontal Surface—An imaginary plane located 500 feet above the established airfield elevation. The extent of this surface will be limited to an area included between a circle having a radius of 17,000 feet, the upper and outer periphery of the inuer conical surface, and a circle having a radius of 50,000 feet from the airfield reference point. (See areas lettered G.)

m. Outer Conical Surface—An imaginary surface extending outward and upward from the periphery of the outer horizontal surface for a distance of 100,000 feet, measured horizontally from the airfield reference point. The slope of the outer conical surface will be 100 to 1. (See surfaces lettered H.)

3. Objects or Structures Beyond 100,000 Feet. Objects or structures which are, or are proposed to be, located at a distance greater than 100,000 feet from the airfield reference point are considered obstructions to air navigation if:

a. The top protrudes above the 100 to 1 slope of the outer conical surface (see paragraph 2*m*) extended and, for man-made structures, the top elevation is more than 500 feet above the grounnd elevation at the site; or

b. The top elevation is more than 1,000 feet above the ground elevation at the site.

4. Removal of Obstructions. Natural and man-made obstructions will be removed where removal is both feasible and economical. Where such removal is not feasible or economical, obstructions will be lighted and marked in accordance with AFR 91–14 and AFR 91–19.

5. Waivers on Air Force Controlled Property:

a. Permanent. Deviations of a permanent nature from the provisions of this regulation for obstructions, including the granting of a waiver, will not be permitted without the written permission of Headqnarters USAF. Requests for such deviations will be submitted through channels to the Director of Real Property, Headquarters USAF, Washington 25, D.C.

b. Temporary. Temporary deferment of the enforcement of this regulation for obstructions may be approved by the major air command concerned in the following instances and after the request for waiver has been concurred in by the interested operational, safety, and maintenance officer and the installations engineer at both base and command level.

(1) Enforcement of the criteria is to be deferred pending construction of a new facility which has been authorized and funded by the Congress.

(2) Enforcement of the criteria is to be deferred pending minor new construction or rehabilitatiou of a facility which has been approved and funded at the appropriate Air Force level.

(3) Waivers to permit use of experimental equipment will be limited to 1 years' duration.
(4) Deferment of enforcement of the criteria required by circumstances not covered above will be limited to 1 year's duration.

c. Major Air Command Authority for Temporary Waiver. The major air commands in exercising the authority herein granted will:

(1) Insure that the spirit and intent of this regulation are observed to the maximum extent to maintain hazard-free airfields, and
(2) Stipulate and require conformance with all reasonable safeguards to maintain a high degree of safety, and
(3) Maintain for record purposes a copy of all correspondence, maps, drawings, and other pertinent information concerning the granting of the waiver. Such records will include the certification of appropriate staff coordination of the action taken at base and each level of command.

6. WAIVERS ON OTHER PROPERTY. The control of the erection of structures which are or will be obstructions on land not under the jurisdiction of the Air Force will be governed by the provisions of AFRs 55–103, 86–2, and 86–11.

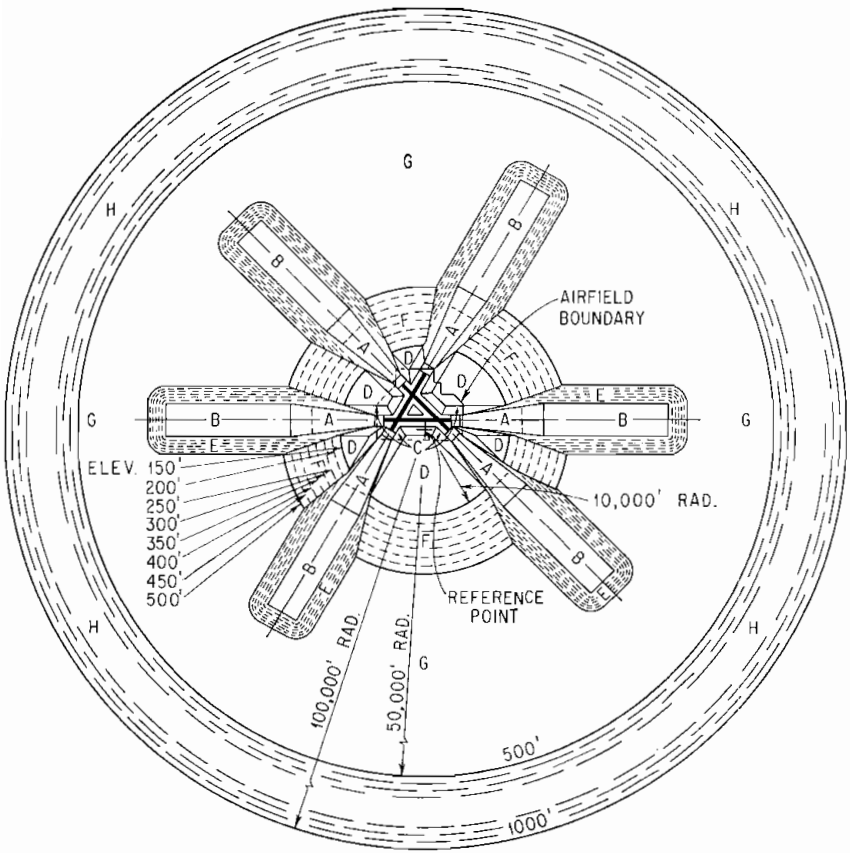
BY ORDER OF THE SECRETARY OF THE AIR FORCE:

OFFICIAL:

N. F. TWINING
Chief of Staff, United States Air Force

E. E. TORO
Colonel, USAF
Air Adjutant General

4 Attachments:
1. Airspace Control Surfaces—Plan
2. Standard Runway Approach Zone—Plan
3. Standard Runway Approach Zone—Transverse Elevation
4. Airspace Control Surfaces—Sectional Perspective



PLAN

FIGURE 1. Airspace control surfaces.

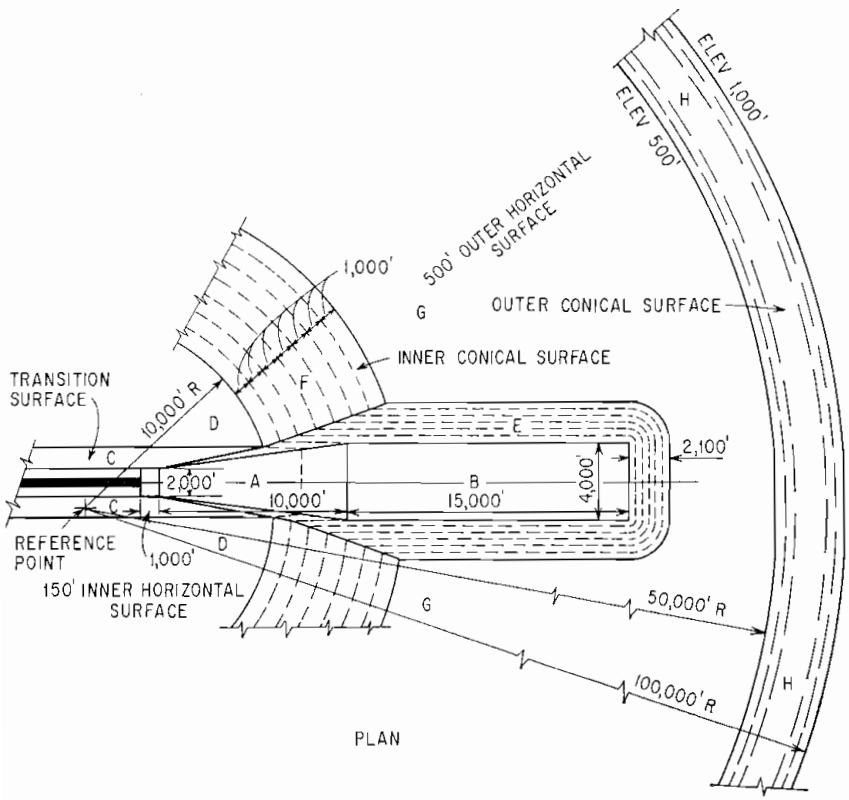


FIGURE 2. Standard runway approach zone.

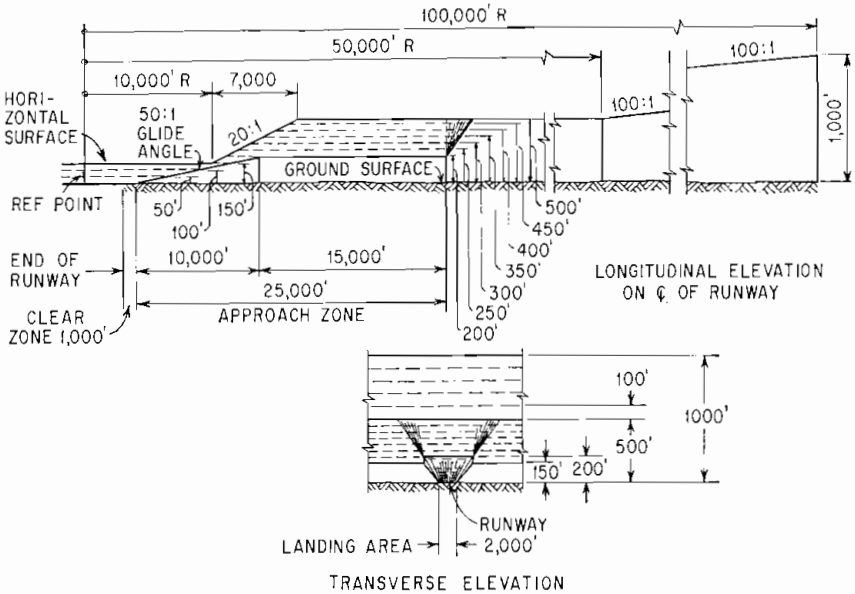


FIGURE 3. Standard runway approach zone.

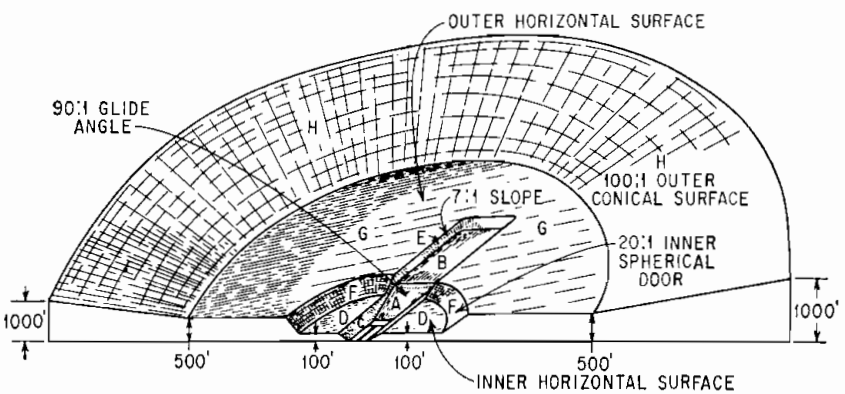
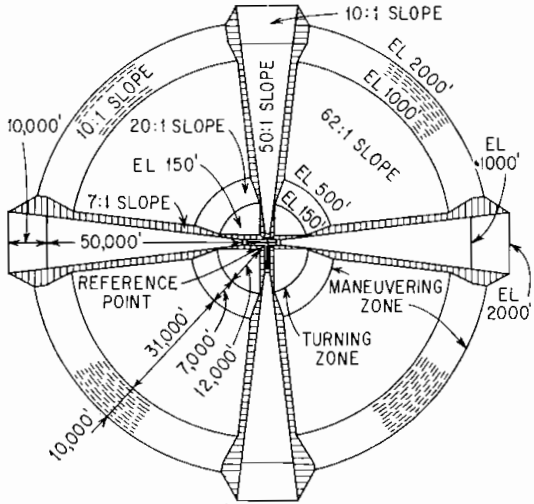
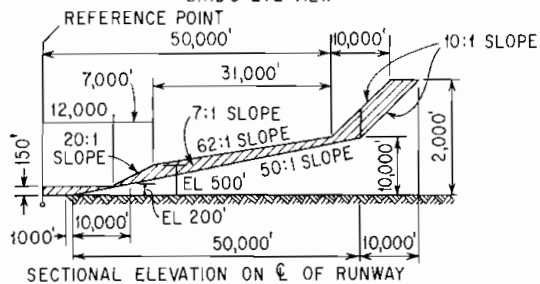


FIGURE 4. Airspace control surfaces (sectional perspective).



BIRD'S EYE VIEW

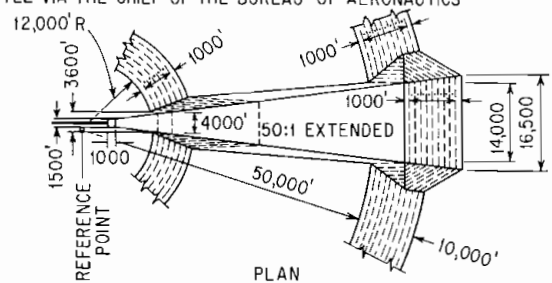


SECTIONAL ELEVATION ON ℄ OF RUNWAY

NOTES

1. TERRAIN OR STRUCTURES WHICH PROJECT ABOVE ANY OF THE IMAGINARY SURFACES SHALL BE CONSIDERED AS OBSTRUCTIONS TO AIR NAVIGATION
2. MAN MADE STRUCTURES OTHER THAN PROVIDED FOR IN SPECIAL NOTE BELOW WHICH ARE LOCATED FURTHER THAN 19,000 FEET FROM THE AIRFIELD REFERENCE POINT AND OUTSIDE OF THE APPROACH ZONES AND PROJECT ABOVE THE 62:1 OR 10:1 IMAGINARY SURFACES SHALL BE SUBJECT TO LOCAL AERONAUTICAL STUDY TO DETERMINE IF THEY ARE HAZARDOUS TO LOCAL OPERATIONS INCLUDING INSTRUMENT PROCEDURES
3. THE AIRFIELD REFERENCE POINT IS A POINT SELECTED AND MARKED AS THE APPROXIMATE CENTER OF THE USABLE LANDING AREA WHICH IS FORMED BY JOINING RUNWAY ENDS
4. SEE SPECIAL NOTE BELOW FOR SITING OF LOW VISIBILITY OBSTRUCTIONS

SPECIAL NOTE: IN ADDITION TO THE RESTRICTIONS NOTED ABOVE AND SHOWN ON THIS DRAWING, OTHER MAN MADE STRUCTURES WHICH BY THEIR NATURE ARE DIFFICULT TO SEE (SUCH AS ANTENNA TOWERS), AND ARE LOCATED WITHIN 80,000 FT OF THE AIRFIELD REFERENCE POINT SO AS TO PROJECT ABOVE IMAGINARY SURFACES BEGINING AT A 12,000 FT RADIUS FROM THE AIRFIELD REFERENCE POINT AT 150 FT ABOVE AIR STATION ELEVATION, AND RISING AT A 50:1 SLOPE FOR AN ADDITIONAL 18,000 FT AND BEYOND THAT AT A 100:1 SLOPE FOR AN ADDITIONAL 50,000 FT SHALL BE CONSIDERED AS UNACCEPTABLE HAZARDS TO AIR NAVIGATION UNLESS A SPECIFIC AERONAUTICAL STUDY DETERMINES OTHERWISE. SUCH A STRUCTURE, BEYOND THE 80,000 FT RADIUS, WHICH IS IN EXCEES OF 1000 FT ABOVE THE TERRAIN, WILL ALSO BE CONSIDERED TO BE AN UNACCEPTABLE HAZARD TO AIR NAVIGATION UNLESS A SPECIFIC AERONAUTICAL STUDY DETERMINES OTHERWISE. WHERE AN AERONAUTICAL STUDY IS INDICATED, FULL PARTICULARS WILL BE FORWARDED TO THE AIRSPACE PANEL OF THE AIR COORDINATING COMMITTEE VIA THE CHIEF OF THE BUREAU OF AERONAUTICS



PLAN

Guide for determining obstructions to air navigation.

ACC/AGA RECOMMENDATIONS FOR MARKING AND LIGHTING *

Foreword

Most problems arising between the Broadcast and Aviation Industries in the joint use of airspace (towers vs aircraft) stem fundamentally from the great difficulty of detecting and identifying the broadcast tower while flying at aircraft velocities during both day and night conditions. This is particularly acute in areas of high density air traffic and in the vicinity of airports. During marginal conditions, such as at daybreak, dusk, and during conditions of poor visibility, the ability to detect and identify such structures is made more difficult.

The following report was the recommendation of the committee composed of experts in the field of marking and lighting, camouflage, identifiability of objects, psychological and physiological factors involved. It was the desire of some of the Committee members to immediately amend the National Standards AGA-NS3 and AGA-NS4 incorporating the pertinent provisions of this report. However, it was agreed that first a field evaluation program should be conducted to make a practical assessment of these recommendations which were recognized to be based upon sound theoretical considerations. Such a program is in progress, although it is moving very slowly because of the requisite developmental and installation work involved which costs many thousands of dollars.

Any broadcaster interested in furthering the evaluation program should contact the NAB Department of Engineering for information concerning authorization to mark and/or light broadcast towers in accordance with the provisions of this report.

Problem

In the interest of safety, regularity and efficiency of aircraft operations, and in compliance with applicable directives of the ACC/AGA Subcommittee: (1) To organize a detailed plan for the development, installation, assessment and operational evaluation of the special lighting and marking systems for tall towers recommended as changes in National Standards AGA-NS3 and AGA-NS4; and (2) To transmit to the Subcommittee a description of the detailed plan and the specific recommendations of the Ad Hoc Group regarding the conduct of the evaluation program.

Recommendations

The Ad Hoc Group recommends to the AGA Subcommittee that:

1. The program of development, assessment and evaluation as described in the present report be approved and initiated under the auspices of the Subcommittee, with administratively appropriate modifications as required;
2. The Subcommittee approve that the towers listed in section *1* of the program plan be requested by AFCCE and NAB to cooperate in the program in the manner described in sections *2, 3,* and *4;*
3. The questionnaire forms described in section 5 and presented in Attachment G be distributed by the agency designated in accordance with recommendation 4 to ATA, ALPA, AOPA, NBAA, and military organizations including their reserve components, and that these questionnaires be accompanied by appropriate instructions for their use and return;
4. The Subcommittee recommend the assignment to an appropriate agency, having aircraft and statistical analysis facilities available to it, of the responsibilities for conducting the controlled test observations described in section 6 and the complete evaluation of the questionnaire data in accordance with section 7;

* Program for operational and field evaluation of special lighting and marking techniques for tall towers, presented by Ad Hoc Group studying special requirements for lighting and marking of obstructions to air navigation, Air Coordinating Committee, Technical Division, Subcommittee on Aerodromes, Air Routes and Ground Aids.

5. The Subcommittee consider this report to be the final report of the Ad Hoc Group and the work of the Ad Hoc Group completed in accordance with its original terms of reference and objectives.

Background and Procedures

In its report AGA/AHG 54-1B, dated August 25, 1954, the Ad Hoc Group conveyed to the Subcommittee its finding that the present standards AGA-NS3 and AGA-NS4 are not adequate to assure detectability of tall towers on the part of aircraft in their vicinities. In its report AGA/AHG 55-1A, dated May 3, 1955, the Ad Hoc Group presented detailed recommendations for immediate changes in the standards and also a series of marking and lighting features which it recommended be subjected to operational evaluation as a means of verifying the Ad Hoc Group's judgment that these features would aid significantly in increasing the detectability and conspicuity of tall towers. In the latter report, the Ad Hoc Group also recommended that it be directed to prepare the specifications for a complete development and operational evaluation program for the approval of the Subcommittee.

It is the understanding of the Ad Hoc Group that the Subcommittee and the Technical Division of ACC desire that no changes be made in the present standards AGA-NS3 and AGA-NS4 without corroborative field evidence regarding the efficacy of the proposed changes. It is further understood that the Ad Hoc Group is charged with the responsibility of designing a program of development and evaluation. On the basis of the results from this program, the Subcommittee should be able to make appropriate decisions regarding the acceptability for implementation of the particular changes in the National Standards that are operationally demonstrated to afford sufficiently increased detectability and conspicuity of tall towers to significantly decrease their hazard to air navigation.

In accordance with the above mentioned objectives, the Ad Hoc Group met on October 13, 1955, to discuss alternative ways of organizing the required program. The Group discussed in detail the requirements for evaluation, sources of financial and development aid, and means of further formulation of the specifications for the program.

It was indicated that the radio and TV tower owners would make certain of their towers available for experimental lighting and marking and would defray the costs of development of the required systems and their installation. The responsibility for the costs and activities of the operational evaluations, including controlled tests and analyses data, must be assigned elsewhere.

It was realized by the Ad Hoc Group that the process of field evaluation could take the form of a rigorously controlled and long range experimental investigation, the costs of which would be great and the time required for which would be more extensive than the problem warrants in terms of the confidence held in the technical recommendations previously made. The writing committee was instructed to plan a program which would require a minimum of time consistent with the adequacy of the results for the process of decision by the Subcommittee.

Program of Development, Assessment, and Evaluation

As a general and summary description of the program, it is proposed that a certain few tall towers be chosen for the appropriate characteristics of background, prevailing visibility conditions and administrative feasibility. These towers will have their current systems of lighting and marking modified to include those features previously recommended in AGA/AHG 55-1A. These additions will be arranged in a manner sufficiently flexible to allow variations of the devices to be made during the testing procedures. Assessment in terms of feasibility will be made by the tower owners and engineers with respect to costs, materiel procurement and system maintenance. Evaluations will be made by observations taken in controlled tests at various specified altitudes and under various visibility conditions and also by observations taken in uncontrolled tests (in normal and routine flying) in the areas of the experimental

towers. Records will be designed for recording the primary check data from these flights. Analyses of the accumulated records will be made to determine the nature and degree of increments in detectability and conspicuity of the towers afforded by the individual features of the additional lighting aud marking systems.

1. Tower Selection

The towers will be chosen for their altitudes, terrain background, and prevailing visibility conditions, as being appropriate for the evaluation program. The owners of the selected towers will be requested to aid in the program by defraying the costs of necessary development and by adding the required lighting and marking features to their towers.

2. Development and Installation of Marking Systems

The particular marking systems that are recommended for inclusion in the program of development, assessment and evaluation are presented in detail in Attachment A. It is these modifications that are recommended as possibilities for the National Standards AGA-NS3 and AGA-NS4.

3. Development and Installation of Lighting Systems

There are two lighting systems involved in the program: identification lighting system and obstruction lighting system. The purpose, requirements and installation instructions for the identification lighting system are presented in Attachment B. The procurement specifications for this system are presented in Attachment C. The purpose, requirements and installation instructions for the obstruction lighting system are presented in Attachment D. The procurement specifications for an improved hazard beacon are presented in Attachment E.

The steady-burning obstruction lights shall conform to all requirements of specification L-810 of the Civil Aeronautics Administration except that they shall meet the following candlepower distribution requirements:

Angle of Elevation (Degrees)	*Minimum Candlepower (Red)*
−5 to −2	5
−2 to 1	25
1 to 5	40
5 to 8	25
8 to 15	5
15 to 30	5
30 to 90	2

4. Assessment by Tower Owners and Engineers

This assessment will be made by detailed questionnaires submitted to the owners and engineers of the towers cooperating in the investigation. The interest in these assessments has to do with the judgments of practicality and financial burden occasioned by the new techniques of marking and lighting. Sample questionnaire is presented as Attachment F.

5. Assessment by Pilots in Uncontrolled Tests

This assessment will be made by detailed questionnaires submitted through the Army, Navy, Air Force, ALPA, ATA, AOPA and NBAA to pilots who fly in the areas of the towers subjected to experimental treatment. Sample questionnaire is presented as Attachment G.

In designing the questionnaires for pilots in uncontrolled and in controlled tests several factors were considered as sources of variation in the data and thus were

included as specific questions in order to fractionate the final data to assess the influence of these factors and sources of contamination.

The factors *external* to the aircraft are specifically as follows:

a. Weather-visibility: miles visibility, ceiling, clouds, smoke, haze, fog;
b. Time of day and position of sun with respect to aircraft attitude;
c. Background of tower: terrain, confusion lights and objects;
d. Altitude of tower;
e. Marking and lighting of tower: by prior standards, additional marking, additional lighting, combined additional lighting and marking viewed under daylight and early twilight conditions.

The factors *internal* to the aircraft or flight observation are specifically as follows:

f. Altitude of flight;
g. Type of aircraft;
h. Ground speed of aircraft;
i. Level of experience of observer;
j. Active vs. passive observation (seeking vs. "happen to see");
k. Concurrent activity of observer (pilot or copilot at control, pilot or copilot not at control, passenger);
l. Type and condition of windscreen;
m. Attitude of observer, prior to flight, regarding adequacy of current standards for marking and lighting tall towers.

6. Assessment by Pilots in Controlled Tests

It is necessary that an adequate number of observations be recorded throughout a wide range of visibility conditions, altitudes of flights, and diurnal conditions. It is therefore required that controlled tests be undertaken in which the ranges of these factors are assessed in a more systematic manner than can be done by depending upon the more haphazard conditions of the uncontrolled test observations. In order to meet this objective, a series of controlled tests is planned to take place under the complete variety of these interacting factors. The primary questionnaire form to be used for the controlled tests is the same as that for the uncontrolled tests, shown in Attachment C, with the exception of the descriptive material presented at the beginning of the questionnaire.

7. Evaluation of the Questionnaire Data

The questionnaires obtained from tower owners and engineers will be analyzed to determine opinions and facts regarding feasibility and practicality of development, procurement, installation and maintenance of the proposed items of modification for AGA-NS3 and AGA-NS4.

It is obvious in the design of the investigation that the primary relationship to be evaluated is the dependence of the recorded "distance at which tower is detected" (dependent variable) upon the marking and lighting of the tower (factor *e* in section 5 above). Because this dependence is contaminated with the several other factors listed in section 5, these factors are also to be evaluated as determiners of the dependent variable.

The questionnaires from the uncontrolled and from the controlled tests will be analyzed with respect to the relationships (contingencies) among these factors. The prediction offered by the Ad Hoc Group is that the features recommended as changes in the National Standards AGA-NS3 and AGA-NS4, and presented as features for development and installation in sections 2 and 3 of the program plan above, will increase the detectability and conspicuity of tall towers. The evidence upon which this hypothesis will be tested will be taken as a statistically significant increment in the "distance at which tower is detected" for the experimentally treated towers in comparison with their untreated condition, when the other determining factors are controlled or statistically minimized.

Evidence regarding *acceptance* of the proposed changes in the National Standards will be evaluated from the appropriate recorded material in the questionnaires from the tower owners and the pilots.

A. Development and Installation of Marking System

1. Purpose

The purpose of the marking system is to identify the space surrounding the tower within the confines of the guy cables as a hazardous area by markers and by color coding on the ground and tower as indicated below.

2. Operational Requirements

During daylight conditions when the north horizon sky brightness exceeds 100 foot lamberts and the reported visibility exceeds 5 miles, the marking system shall be visible and indentifiable (except where the line of sight is blocked by a hill or other obstruction not under the control of the tower management) throughout a zone having a minimum radius (measured horizontally from the vertical axis of the tower) of 3 miles and extending from the ground to an altitude of 1500 feet higher thau the tower.

3. Technical Requirements

3.1 The tower structure, antenna, and other appendages shall be marked in alternate bands of aviation surface white, aviation surface orange, and black as described below.

3.1.1 The lowest segment of the structure shall be colored in three major bands of color in the order of orange, white, and orange; each 40 feet in vertical dimension.

3.1.2 The top segment of the tower for a band between 40 and 100 feet shall be colored orange. The antenna and other projections from the top of the tower shall be colored orange. The exact dimension of the band will be determined by the requirements of 3.1.3 and 3.1.4 below.

3.1.3 The intermediate segment of the structure shall be colored in alternate major bands of orange and white beginning and ending with white. Each band shall have a minimum of 100 feet and a maximum of 150 feet vertical dimension.

3.1.4 A band of black color of 2 feet vertical dimension shall be placed between the major color bands specified above.

3.2 The ground area beneath the structures within the guyed area shall be marked as described below.

3.2.1 The ground area at the base of the structure, consisting of a circular area of 150-foot radius extending from the center of the structure for structures 500 to 1000 feet in height and of 200-foot radius for structures over 1000 feet in height, shall be treated to provide a textured surface such as would be obtained by harrowing and be colored white.

3.2.3 The ground area forming a 75-foot wide annulns for towers of 500 to 1000 feet in height and a 100-foot wide annulus for towers over 1000 feet, concentric to the center of the structure and with an outside radius equal to the distance from the structure center to the outermost guy cable anchor point, shall be treated to provide a textured surface as above and be colored in 16 alternate equal areas of aviation surface orange and white.

3.3 Rotating ground markers shall be installed on the outer perimeter and at the center of each orange section of the annulus ring and possess the following features:

3.3.1 A main support pole, in each instance of a height greater than any nearby obstruction to line of sight.

3.3.2 A mechanism for horizontally rotating a disk of 8 feet maximum diameter to be affixed to the top or near the top of the main support pole (an acceptable alternate in lieu of a rotating mechanism is a wobble plate system) the objective of

which is to present a target which is continuously changing in angular relationship between a distant observer and the zenith sky. Such mechanism to be adjustable so as to permit rotational speeds to be varied between 10 and 40 revolutions per minute.

3.3.3 A means for altering in one direction the angular pitch of the rotating disk from horizontal (normal to the main support pole length) to 45°.

3.3.4 A means of readily changing disk reflectors to permit disks of different size and type to be tested.

3.3.5 An initial series of four test disks shall be available; 2 of polished (mirrored) metal surface and 2 of sprayed metallic paint surface. One each of both types shall be 4 feet in diameter and the other two 8 feet in diameter.

3.4 All coatings utilized for coloration purposes on the structure shall be of a lusterless nature (semigloss or lower) to minimize glare and to permit the color to be effective at greater angles of observation.

4. Engineering Notes

4.1 The following procedure for controlling weed growth has been found practical for pretreatment of center and annulus-ring ground marking areas.

4.1.1 Disk harrow the area to be treated.

4.1.2 Treat with fire to kill seeds and drive out nitrogen from the soil. The use of road or snow melters now commercially available to burn the soil is thought to be a practical method.

4.1.3 Place on the treated area a layer of crushed rock salt or calcium chloride.

4.1.4 Place surface layer of crushed stone or gravel over salt layer and apply coloration as required.

4.2 The following *ground* coloring agents are offered for consideration in order of their estimated cost from least to most expensive.

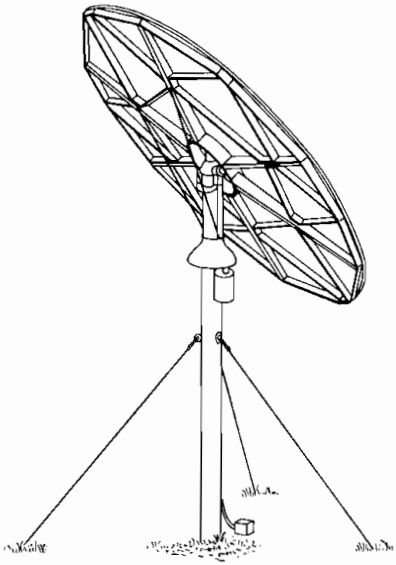
4.2.1 White only—(Whitewash)—Lime, salt (NaCl) and water.

4.2.2 Sodium silicate colored with earth pigments and precipitated upon application with calcium chloride to form an insoluble coating. (Applicable to damp surface.)

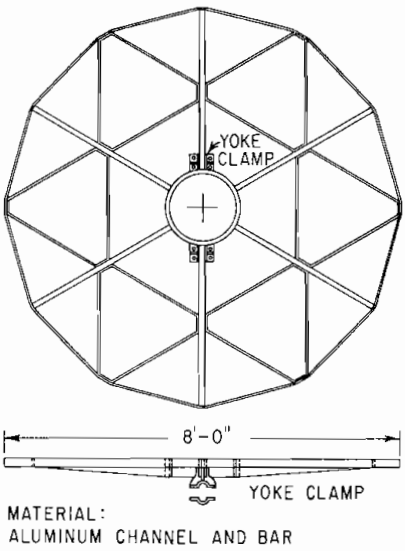
4.2.3 Rubber base paints. (Some types applicable to damp surfaces.)

4.2.4 Oleoresinous emulsifiable paints. (Applicable to damp surfaces.)

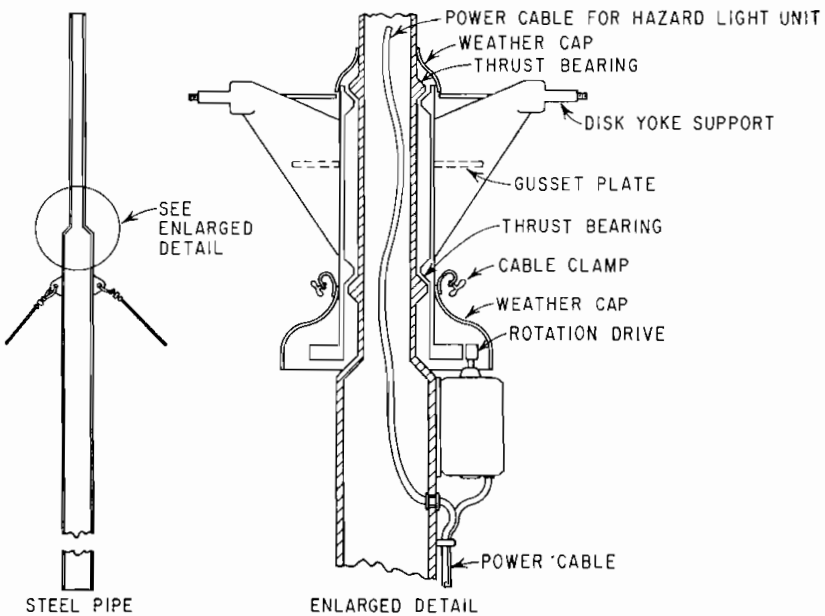
4.3 The following is a sketch in 3 parts of a rotating ground marker included for the purpose of pictorially presenting the features outlined in Paragraph 3.3 above.



Rotating disk—hazard marker.



Substructure for disk.



Rotating sleeve and disk support.

B. Purpose, Requirements, and Installation Instructions for the Identification Lighting System for Tall Towers

1. Purpose

The purpose of the identification lighting system is to identify the space surrounding the tower and guy wires as a hazardous area by the color coding and flashing characteristics of this lighting system.

2. Operational Requirements

2.1 By day and by night when the reported visibility is within the interval 1 to 3 miles, inclusive, the identification lighting system shall be visible from every point (except where the line of sight is blocked by a hill or other obstruction not under the control of the tower management) throughout a warning zone having a minimum radius (measured from the tower) of 1 mile and a maximum radius equal to the reported visibility, and extending from the tower to an altitude given by the following equation:

$$A = H + 400D + 300$$

where A = altitude of warning zone in feet
H = height of tower in feet
D = distance from tower in miles
(D does not exceed the reported visibility and is not less than 1.)

3. Detail Requirements

3.1 Identification beacons conforming to the specifications in Attachment C shall be used. The color coding of the identification beacon shall be alternate white and red flashes and the flash frequency shall be 60 (30 white and 30 red) flashes per minute.

4. Installation Requirements

4.1 One or more identification beacons shall be placed on or near the tower and near the ground level but at a height greater than that of any nearby structures, buildings, trees, etc. One or more identification beacons shall be placed at a height of 700 feet when the height of the total structure of the tower exceeds 800 feet and at a height of 700 and 1400 feet when the height of the total structure of the tower exceeds 1500 feet. One identification beacon may be used at each level when the shadows caused by the tower structural components will not reduce the effective intensity of the beacon in any direction to an effective candlepower less than 80% of the effective candlepower specified in Table 1, Paragraph 3.6 of Attachment C. If shadows caused by the structure of the tower will reduce the effective candlepower of the identification beacon in any direction to an effective candlepower less than 80% of the effective candlepower specified in Table 1 of the specification in Attachment C, two identification beacons placed on opposite sides of the tower shall be installed at each level. In order to provide satisfactory output by the identification beacons, the rated voltage of the lamps used shall correspond to or be within three percent higher than the average voltage across the lamp as measured at the lamp socket during the hours of daylight operation.

5. Operation

5.1 Day Operation. The identification beacons shall be operated with the lamps at their rated voltage whenever the north sky brightness is more than 1.0 footlambert and not more than 100 footlamberts and also when the north sky brightness is more than 100 footlamberts but the reported visibility is less than 5 miles.

5.2 Night Operation. The identification beacons shall be operated with the lamps at a voltage which will produce effective candlepowers at least one-tenth the effective candlepowers specified for daylight use whenever the north sky brightness is less than 1.0 footlambert.

C. Procurement Specifications for Identification Beacons for Tall Towers

1. Applicable Documents

1.1 The following specifications and publication, of the issue in effect on the date of invitation for bids, form a part of this specification and may be obtained upon application to the Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio; or the Commanding Officer, U.S. Naval Air Station, Johnsville, Pennsylvania.

Specifications:

MIL-E-5272	Environmental Testing, Aeronautical and Associated Eqnipment (General Specification For)
MIL-C-25050	Colors, Aeronautical Lights aud Lighting Equipment, General Requirements For

Publications:

Air Force-Navy Aeronautical Bulletin
143 Specifications and Standards, Use of

2. General Requirements

2.1 Objective. The intent of this specification is the development of a beacon suitable for marking and identifying tall towers and other hazards during daylight and bright twilight conditions. The design requirements given herein shall be complied with except that alternate designs and details of construction will be acceptable if they will produce a beacon more satisfactory for the intended application. The design of any beacon shall be approved by the procuring activity prior to fabrication of the beacon.

2.2 Component Parts. The beacon shall consist of the following major components: two or more separate optical systems, a rotating mechanism and a base.

2.3 Selection of Specifications and Standards. Specifications and standards for all materials, parts, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with Bulletin 143, except as provided in the following paragraph:

2.3.1 Standard Parts. AN or MIL standard parts shall be used wherever they are suitable for the purpose and shall be identified by their part numbers. Commercial utility parts, such as screws, bolts, nuts, cotter pins, et cetera, may be used, provided they have suitable properties and are replaceable by the AN or MIL standard parts without alteration and provided the corresponding AN or MIL parts numbers are referenced on the drawings and in the parts lists. In applications for which no suitable corresponding AN or MIL part is in effect on date of invitation for bids, commercial parts may be used provided they conform to the requirements of this specification.

2.4 Material

2.4.1 Protective Treatment. When materials are used in the construction of the beacon that are subject to corrosion in salt air or other atmospheric conditions likely to occur during service usage, they shall be protected against such corrosion in a manner that will in no way prevent compliance with the performance requirements of this specification. Protective coating that will crack, chip, or scale with age or extremes of atmospheric conditions shall not be used.

2.4.2 Metals. Metals shall be of the corrosion-resistant type, unless suitably protected to resist corrosion during normal service life.

2.5 **Design**

2.5.1 **Operating Conditions.** The beacon shall be designed for continuous outdoor operation under all weather conditions, at altitudes not exceeding 10,000 feet. It shall be capable of operating satisfactorily under the following conditions:

a. Temperature ranging from −54° C to +55° C

b. Relative humidity up to 100% including conditions wherein condensation takes place in the form of both water and frost

c. Wind speeds ranging from 0 to 100 mph

2.5.2 **Installation and Servicing.** The design shall be such as to facilitate installation and servicing when the beacon is mounted on a tall, guyed tower.

2.5.3 **Power.** The beacon shall be designed to operate from a two-wire, 120-volt, single phase, 60-cycle, or a three-wire, 240-volt, single phase, 60-cycle power supply. If other voltages are required for lamp and motor operation, the necessary transformers or ballasts shall be provided with the beacon.

2.5.4 **Beams.** The beacon shall provide alternate separate and readily distinguishable beams of white and red light. The beams shall rotate in a horizontal plane about a central axis at a speed which will produce 60 flashes (30 white and 30 red) per minute.

2.6 **Construction.** The beacon shall be constructed so that no parts will work loose in service. It shall be built to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation and service.

3. Optical Systems

3.1 The optical systems shall be identical except for differences incident to the color of the beam produced. Each of the optical systems shall include all lamps, sockets, reflectors, lenses, and minor components required to produce one of the specified beams.

3.2 The optical systems shall be of the fixed, prefocus type, requiring no adjustments during installation, relamping or routine maintenance.

3.3 At least four operating lamps shall be used in each beacon, or lamp changers and spare lamps shall be provided so that the failure of a single lamp does not render the beacon ineffective. Since simultaneous burnout of the 2 or more operating lamps is very unlikely, automatic lamp changers shall not be provided when four or more operating lamps are used. Lamp life shall be not less than 1000 hours, at 5 hours operating time per start. The lamp or combination of lamps in each optical system shall be such that each system will emit at least 5 percent of the specified candlepower within 5 seconds after the power is turned on, and within 5 seconds after power is restored after a momentary failure, at any ambient temperature down to −54° C. Each system shall emit 100 percent of the specified candlepower within 10 minutes, at any ambient temperature down to −54° C. Each optical system may contain either incandescent or arc lamps alone or in combination, provided the above requirements are met.

3.3.1 Any auxiliary equipment required for lamps, such as sockets, ballast, heaters, et cetera, shall be incorporated in the design of the beacon. All such equipment shall be in accordance with high-grade commercial practice and shall be satisfactory for use in the beacon.

3.3.2 Unless otherwise specified, 6 sets of lamps shall be furnished for each of the optical systems.

3.4 The optical systems shall be enclosed in a common housing, or in separate housings mounted upon a single rotating mechanism. The housing and cover glass assembly shall be weatherproof and of such design that driving rain, snow, or sleet cannot be blown inside. If forced ventilation is utilized, adequate baffles and screening shall be provided to keep out moisture, dirt, insects, et cetera. The design shall be such that no condensate or water leaking can drip on the lamps. The housing or housings shall be fabricated from aluminum.

3.4.1 Adequate provisions shall be provided for expansion without breakage of the glass components. All gaskets, caulking compounds, separators, and cements shall be satisfactory for the intended application.

3.4.2 Means shall be provided for readily replacing burned out lamps even under icing conditions. Suitable hinges, door stops, chains, and clamps shall be provided so there will be no danger of any parts being dropped or being damaged during relamping or servicing.

3.5 Alternate optical systems shall be provided with red cover glasses or lenses and with white (clear) cover glasses or lenses.

3.5.1 All cover glasses or lenses shall be in accordance with requirements for non-diffusing ware, type 1 Aviation Colors conforming to Specification MIL-C-25050. The covers and lenses shall have transmission ratios as high as practicable. Design goals are to obtain a transmission ratio of at least 0.17 for red and 0.95 for white (clear).

3.6 The candlepower distribution of each optical system shall be as specified in Table 1 when the lamp or lamps are operated at rated voltage or lnmens.

Table 1

Angle of elevation, degrees	Minimum effective candlepower *	
	White	Red
−2 to −1	25,000	3,500
−1 to 0	100,000	15,000
0 to 8	220,000	33,000
8 to 10	100,000	15,000
10 to 15	25,000	3,500

* The effective candlepower of each flash shall be determined by the followiug formula:

$$I_E = \frac{\int_0^t I dt}{0.2 + t}$$

where I_E = effective candlepower
I = instantaneous candlepower
t = flash duration, in seconds (chosen so that I_E is the maximum)

3.7 The optical systems shall be mounted upon a turntable so that alternate flashes of white and red light are produced as the turntable rotates in the horizontal plane. The centers of the beams shall be equally spaced.

4. Mechanical Construction

4.1 The rotating mechanism shall rotate the optical systems in a horizontal plane at a fixed constant speed which will produce a flash rate of 60 ± 1 flashes per minute. (The speed tolerance is for the initial design only; all units fabricated shall have exactly the same speed.)

4.1.1 The rotating mechanism shall be designed so that the beam stops in the same position each time the unit is de-energized. Thus, all units which are properly aimed will operate in synchronism if simultaneously energized.

4.1.2 The rotating mechanism shall be of the sealed, permanently lubricated type, and shall be designed for at least 5 years operation without need for lubrication or servicing.

4.1.3 A standard, commercial type motor shall be utilized. The motor shall have ample power to operate the mechanism at any ambient temperature from −54° C to +55° C. The motor shall be properly fused so it will not be damaged in the event the rotating mechanism should become jammed.

4.1.4 If all rotating parts are not completely enclosed, a suitable clutch assembly shall be provided to permit the gear train to rotate without injury in case the turntable is prevented from rotating by an ice lock or other obstruction. The clutch design

shall be such that no damage will result to any beacon component if the beacon is operated continuously for 12 hours at rated voltage with the turntable held to prevent rotation.

4.1.5 The collector ring and brush assembly shall be of adequate design and capacity to insure trouble-free operation. The brushes shall be of copper-graphite composition and the collector rings of bronze. Adjustable springs shall be provided so the brushes are held in proper contact pressure against the collector rings.

4.1.6 All bearings shall be high quality, sealed, permanently lubricated commercial bearings.

4.2 The base shall be designed to house components of the rotating mechanism, terminal boards, and any other necessary auxiliary components in a compact manner. It shall be fabricated from aluminum.

4.2.1 The base shall be designed for platform mounting.

4.2.2 The base shall be provided with projections or surfaces upon which a carpenter's level can be placed in order that the beacon light can be accurately leveled at installation.

4.2.3 The base shall be provided with a side entrance and a waterproof fitting for the power supply wires.

4.2.4 The base shall have a removable pan or an access door to permit inspection and servicing of the components.

4.3 Suitable terminal blocks, properly marked or labeled, shall be provided in accessible locations to facilitate making any connections required at installations or during replacement of components.

4.4 The beacon shall be completely wired and connected so that only the power supply wires need be attached at installation. Flexible cord and cables shall be utilized wherever applicable. Suitable insulation shall be utilized on wires which may be exposed to high temperatures.

4.5 Size and weight shall be held to a minimum consistent with performance and reliability requirements. In order that the beacons may be mounted within the structure of tall guyed towers, the maximum horizontal dimension of the light shall not exceed 60 inches. All components shall be rugged and reliable, in order to withstand wind loading and vibration, rough handling during installation, and 5 years operation without any servicing except cleaning and relamping.

4.6 Instruction Plate. A wiring diagram and instruction plate shall be securely attached to the outside of the beacon light. The instruction plate shall contain abbreviated installation, operation, and maintenance instructions.

4.7 Nameplate. A nameplate, permanently and legibly filled in with the following information, shall be securely attached to the beacon:

Light, Rotating Beacon, Tower Identification
Specification
Mfr's Part No.
Mfr's Name or Trademark
Contract or Order No.

5. *Quality Assurance Provisions*

The hazard beacons shall be subject to the following tests:

a. Design Approval Tests
b. Inspection Tests

5.1 Design Approval Tests. The contractor shall conduct tests as necessary to determine that the design of the equipment as proposed by the contractor shall meet the requirements of all applicable specifications. The data obtained by the contractor in conducting these tests shall be included with the design data submitted to the procuring activity. These tests shall include all tests specified under Inspection Tests and, in addition, the tests described below.

5.1.1 Environmental Tests. One light shall be subjected to the following tests in accordance with the specified procedures of Specification MIL-E-5272 to determine

proper operation and lack of damage. No damage which would affect proper operation of the light shall result from these tests.

a. High Temperature: Procedure I except a temperature of 55° C ± 2° C and a period of 7 hours shall be used.

b. Low Temperature: Procedure I.

c. Rain Tests: Procedure I except that the light shall be operated at rated voltage for 2 hours before the rain is started. Operation at rated voltage with rain falling shall be continued for 3 hours.

5.1.2 Photometric Tests. One light shall be subjected to complete photometric tests to determine compliance with Section 3.

5.1.3 One light shall be bolted in place as if in service. A lateral thrust of 500 pounds shall be applied horizontally on any line through the center of the optical system by means of a calibrated spring balance. There shall be no evidence of damage.

5.1.4 The electrical characteristics, speed of rotation, and synchronism of two lights shall be checked to determine compliance with Section 4.

5.2 Inspection Tests. Each light shall be subjected to the following tests. The contractor shall be responsible for conducting the required tests.

5.2.1 Examination of Product. The light assembly and filters shall be examined to determine compliance with this specification with respect to materials and workmanship.

5.2.2 Operation. Each light shall be completely assembled and operated. It shall be inspected to determine proper operation.

5.2.3 Photometric Tests. Sufficient photometric tests shall be conducted on each light to determine whether the light is properly adjusted and focussed.

D. Purpose, Requirements, and Installation Instructions for the Obstruction Lighting System for Tall Towers

1. Purpose

The purpose of the obstruction lighting system is to identify the structure as a tower by the configuration, the color and the flashing characteristics of this lighting system, and to mark the extremities of the guy-wire system.

2. Operational Requirements

2.1 At night or twilight (sky brightness 17.5 footlamberts and lower) when the reported visibility is 3 miles, the obstruction lighting system shall be visible from every point (except where the line of sight is blocked by a hill or other obstruction not under the control of the tower management) throughout a warning zone having a radius of 3 miles (measured from the tower) and extending to an altitude 1500 feet higher than the top of the total structure.

3. General Requirements

3.1 The obstruction lighting system shall consist of two types of lighting units, steady-burning obstruction lights and flashing hazard beacons conforming to the specifications of Attachment E. The color of both types of lights shall be aviation red. The hazard beacons shall appear to flash approximately 40 times per minute.

4. Installation Requirements

4.1 One or more flashing hazard beacons shall be placed at the top of the total structure, and at approximately equal intervals not exceeding 300 feet along the structure.

4.1.1 One hazard beacon may be used at each level when the shadows caused by the tower structural components will not reduce the effective intensity of the

beacon in any direction to an effective candlepower less than 80% of the effective candlepower specified in Table 1, Paragraph 3.6 of Attachment E. If shadows caused by the structure of the tower will reduce the effective candlepower of the hazard beacon in any direction to an effective candlepower less than 80% of the effective candlepower specified in Table 1 of Attachment E, two or more hazard beacons placed on opposite sides of the tower shall be installed at each level.

4.1.2 The number and arrangement of the hazard beacons at each level shall be such that in event of failure of the lamp(s) in a hazard beacon, the effective candlepower of at least one other hazard beacon at that level in any direction is not reduced by shadows caused by the tower structural components to less than 80% of the effective candlepower specified in Table 1 of Attachment E; or a lamp changer and spare lamps shall be provided for each hazard beacon.

4.2 One or more hazard beacons shall be placed at the base of each guy wire high enough to clear surrounding trees, buildings, etc.

4.3 One steady-burning obstruction light shall be installed at each outside corner of the vertical members of the structure, at each level which is midway between the hazard beacon levels.

4.4 Hazard beacons and obstruction lights may be omitted from any level which is within 75 feet of the level at which an identification beacon (see Attachments B and C) is mounted.

4.5 In order to provide satisfactory output by the obstruction lighting system, the rated voltage of the lamps used shall correspond to or be within three percent higher than the average voltage across the lamp, measured at the lamp socket, during the hours of operation.

5. *Operation*

5.1 The hazard beacon shall be operated with the lamps at design voltage whenever the north sky brightness is less than 100 footlamberts.

E. Procurement Specifications for Hazard Beacons for Tall Towers

1. *Applicable Documents*

1.1 The following specifications and publication, of the issue in effect on the date of invitation for bids, form a part of this specification and may be obtained upon application to the Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio; or the Commanding Officer, U.S. Naval Air Station, Johnsville, Pennsylvania.

Specifications:

MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment (General Specification For)
MIL-C-25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirements For

Publications:

Air Force-Navy Aeronautical Bulletin
143 Specifications and Standards, Use of

2. *General Requirements*

2.1 Objective. The intent of this specification is the development of a hazard beacon suitable for marking and identifying tall towers and other hazards during twilight and night conditions. The design requirements given herein shall be complied with except that alternate designs and details of construction will be acceptable if they will produce a hazard beacon more satisfactory for the intended application. The design of any beacon shall be approved by the procuring activity prior to fabrication of the beacon.

2.2 **Component Parts.** The beacon shall consist of the following major components: One or more separate optical systems, a rotating mechanism, and a base.

2.3 **Selection of Specifications and Standards.** Specifications and standards for all materials, parts, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with ANA Bulletin 143, except as provided in the following paragraph:

2.3.1 **Standard Parts.** AN or MIL standard parts shall be used wherever they are suitable for the purpose and shall be identified by their part numbers. Commercial ntility parts, such as screws, bolts, nuts, cotter pins, et cetera, may be used, provided they have suitable properties and are replaceable by the AN or MIL standard parts without alteration and provided the corresponding AN or MIL part numbers are referenced on the drawings and in the parts lists. In applications for which no suitable corresponding AN or MIL part is in effect on date of invitation for bids, commercial parts may be used provided they conform to the requirements of this specification.

2.4 **Material**

2.4.1 **Protective Treatment.** When materials are used in the construction of the beacon that are subject to corrosion in salt air or other atmospheric conditions likely to occur during service usage, they shall be protected against such corrosion in a manner that will in no way prevent compliance with the performance requirements of this specification. Protective coatings that will crack, chip, or scale with age or extremes of atmospheric conditions shall not be used.

2.4.2 **Metals.** Metals shall be of the corrosion-resistant type, unless suitably protected to resist corrosion during normal service life.

2.5 **Design**

2.5.1 **Operating Conditions.** The hazard beacon shall be designed for continuous outdoor operation under all weather conditions, at altitudes not exceeding 10,000 feet. It shall be capable of operating satisfactorily under the following conditions:

a. Temperature ranging from −54° C to +55° C

b. Relative humidity up to 100 per cent including conditions wherein condensation takes place in the form of both water and frost

c. Wind speeds ranging from 0 to 100 mph

2.5.2 **Installation and Servicing.** The design shall be such as to facilitate installation and servicing when the beacon is mounted on a tall, guyed tower.

2.5.3 **Power.** The beacon shall be designed to operate from a two-wire, 120-volt, single phase, 60-cycle power supply. If other voltages are required for lamp and motor operation, the necessary transformers or ballasts shall be provided with the beacon.

2.5.4 **Flash Characteristics.** The hazard beacon shall produce separate and readily distinguishable flashes of red light by rotating the beam(s) of the beacon in a horizontal plane about a central axis at a speed which will produce 40 flashes per minute.

2.6 **Construction.** The beacon shall be constructed so that no parts will work loose in service. It shall be built to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and service.

3. *Optical Systems*

3.1 If more than one optical system is used, the optical systems shall be identical and each optical system shall include all lamps, sockets, reflectors, lenses and minor components required to produce one of the beams.

3.2 The optical systems shall be of the fixed, prefocus type, requiring no adjustments during installation, relamping or routine maintenance.

3.3 Lamp life shall be not less than 2,000 hours, at 5 hours operating time per start. The lamp or combination of lamps in each optical system shall be such that each system will emit at least five per cent of the specified candlepower within five seconds after the power is turned on, and within five seconds after power is restored

after a momentary failure, at any ambient temperature down to −54° C. Each system shall emit 100 per cent of the specified candlepower within 10 minutes, at any ambient temperature down to −54° C. Each optical system may contain either incandescent or arc lamps alone or in combination, provided the above requirements are met.

3.3.1 Any auxiliary equipment required for lamps, such as sockets, ballast, heaters, et cetera, shall be incorporated in the design of the beacon. All such equipment shall be in accordance with high-grade commercial practice and shall be satisfactory for use in the beacon.

3.3.2 Unless otherwise specified, six sets of lamps shall be furnished for each of the optical systems.

3.4 The optical systems shall be enclosed in a common housing, or in separate housings mounted upon a single rotating mechanism. The housing and cover glass assembly shall be weatherproof and of such design that driving rain, snow, or sleet cannot be blown inside. If forced ventilation is utilized, adequate baffles and screening shall be provided to keep out moisture, dirt, insects, et cetera. The design shall be such that no condensate or water leaking can drip on the lamps. The housing or housings shall be fabricated from aluminum.

3.4.1 Adequate provision shall be made for expansion without breakage of the glass components. All gaskets, caulking compounds, separators, and cements shall be satisfactory for the intended application.

3.4.2 Means shall be provided for readily replacing burned out lamps even under icing conditions. Suitable hinges, door stops, chains, and clamps shall be provided so there will be no danger of any parts being dropped or being damaged during relamping or servicing.

3.5 The optical systems shall be provided with aviation red cover glasses or lenses.

3.5.1 All cover glasses or lenses shall be in accordance with requirements for nondiffusing ware, type 1 Aviation Colors conforming to Specification MIL-C-25050. The covers and lenses shall have transmission ratios as high as practicable. The design goal is to obtain a transmission ratio of at least 0.17 after the light has been on operation and temperatures have become stabilized.

3.6 The candlepower distribution of each optical system shall be as specified in Table 1 when the lamp or lamps are operated at rated voltages or lumens.

Table 1

Angle of Elevation, Degrees	*Minimum Effective Candlepower (Red) Flashing Light* *
−5 to −2	100
−2 to 1	250
1 to 5	625
5 to 8	250
8 to 15	100
15 to 30	50
30 to 90	. . .

* The effective candlepower of each flash shall be determined by the following formula:

$$I_E = \frac{\int_0^t I dt}{0.2 + t}$$

where I_E = effective candlepower
I = instantaneous candlepower
t = flash duration, in seconds (chosen so that I_E is the maximum)

3.7 The optical system(s) shall be mounted upon a turntable so that flashes of red light are produced as the turntable rotates in the horizontal plane. The centers of the beams shall be equally spaced.

4. Mechanical Construction

4.1 The rotating mechanism shall rotate the optical system(s) in a horizontal plane at a fixed constant speed which will produce a flash rate of 40 ± 1 flashes per minute. (The speed tolerance is for the initial design only; all units fabricated shall have exactly the same speed.)

4.1.1 The rotating mechanism shall be designed so that the beam stops in the same position each time the unit is de-energized. Thus, all units which are properly aimed will operate in synchronism if simultaneously energized.

4.1.2 The rotating mechanism shall be of the sealed, permanently lubricated type, and shall be designed for at least 10 years operation without need for lubrication or servicing.

4.1.3 A standard, commercial-type motor shall be utilized. The motor shall have ample power to operate the mechanism at any ambient temperature from −54° C to +55° C at any input voltage from 105 to 130 volts. The motor shall be properly fused so it will not be damaged in the event the rotating mechanism should become jammed.

4.1.4 If all rotating parts are not completely enclosed, a suitable clutch assembly shall be provided to permit the gear train to rotate without injury in case the turntable is prevented from rotating by an ice lock or other obstructions. The clutch design shall be such that no damage will result to any beacon component if the beacon is operated continuously for 12 hours at rated voltage with the turntable held to prevent rotation.

4.1.5 The collector ring and brush assembly shall be of adequate design and capacity to insure trouble-free operation. The brushes shall be of copper-graphite composition and the collector rings of bronze. Adjustable springs shall be provided so the brushes are held in proper contact pressure against the collector rings.

4.1.6 All bearings shall be high quality, sealed, permanently lubricated commercial bearings.

4.2 The base shall be designed to house components of the rotating mechanism, terminal boards, and any other necessary auxiliary components in a compact manner. It shall be fabricated from aluminum.

4.2.1 The base shall be designed for platform mounting.

4.2.2 The base shall be provided with projections or surfaces upon which a carpenter's level can be placed in order that the hazard beacon can be accurately leveled at installation.

4.2.3 The base shall have a removable pan or an access door to permit inspection and servicing of the components.

4.3 Suitable terminal blocks, properly marked or labeled, shall be provided in accessible locations to facilitate making any connections required at installations or during replacement of components.

4.4 The hazard beacon shall be completely wired and connected so that only the power supply wires need be attached at installation. Flexible cord and cables shall be utilized wherever applicable. Suitable insulation shall be utilized on wires which may be exposed to high temperatures.

4.5 Size and weight shall be held to a minimum consistent with performance and reliability requirements. All components shall be rugged and reliable, in order to withstand wind loading and vibration, rough handling during installation, and 10 years operation without any servicing except cleaning and relamping.

4.6 Instruction Plate. A wiring diagram and instruction plate shall be securely attached to the outside of the hazard beacon. The instruction plate shall contain abbreviated installation, operation and maintenance instructions.

4.7 Nameplate. A nameplate, permanently and legibly filled in with the following information shall be securely attached to the beacon:

Light, Beacon, Hazard
Specification
Manufacturer's Part Number

Manufacturer's Name or Trademark
Contract or Order Number

5. *Quality Assurance Provision*

The hazard beacons shall be subject to the following tests:
a. Design Approval Tests
b. Inspection Tests

5.1 Design Approval Tests. The contractor shall conduct tests as necessary to determine that the design of the equipment as proposed by the contractor shall meet the requirements of all applicable specifications. The data obtained by the contractor in conducting these tests shall be included with the design data submitted to the procuring activity. These tests shall include all tests specified under Inspection Tests, and, in addition, the tests described below.

5.1.1 Environmental Tests. One light shall be subjected to the following tests in accordance with the specified procedures of Specification MIL-E-5272 to determine proper operation and lack of damage. No damage which would affect proper operation of the light shall result from these tests.

a. High Temperature: Procedure I except a temperature of 55° C ± 2° C and a period of seven hours shall be used.
b. Low Temperature: Procedure I.
c. Rain Tests: Procedure I except that the light shall be operated at rated voltage for two hours before the rain is started. Operation at rated voltage with rain falling shall be continued for three hours.

5.1.2 Photometric Tests. One light shall be subjected to complete photometric tests to determine compliance with Section 3.

5.1.3 One light shall be bolted in place as if in service. A lateral thrust of 50 pounds shall be applied horizontally on any line through the center of the optical system by means of a calibrated spring balance. There shall be no evidence of damage.

5.1.4 The electrical characteristics, speed of rotation, and synchronism of two lights shall be checked to determine compliance with Section 4.

5.2 Inspection Tests. Each light shall be subjected to the following tests. The contractor shall be responsible for conducting the required tests.

5.2.1 Examination of Product. The light assembly and filters shall be examined to determine compliance with this specification with respect to materials and workmanship.

5.2.2 Operation. Each light shall be completely assembled and operated. It shall be inspected to determine proper operation.

5.2.3 Photometric Tests. Sufficient photometric tests shall be conducted on each light to determine whether the light is properly adjusted and focussed.

Questionnaire on Development, Installation, and Maintenance of Special Marking and Lighting Techniques

The Air Coordinating Committee appreciates the cooperation and aid given by your broadcasting station in arranging for the development and installation of the special marking and lighting techniques that are being studied. As one of the means of assessing certain factors related to the efficacy of these new techniques, the Committee desires to obtain information from tower owners and engineers cooperating in the investigation. This information is being gathered on the questionnaire presented below, which we ask be completed by your staff and returned to_____ _____.

/s/_____
for the Committee

Station _____. Tower location _____.
Tower height: _____ above ground. _____ above MSL.
(The following table to be presented as attachment and detailed as desired.)

Item (Please list)	Development and Procurement Cost	Installation Cost	Est. Maintenance Cost per Annum

From ground observations and air observations (if possible) of your tower *before* and *after* installation of the special techniques, please offer your judgments as to whether the new factors appear significantly to increase the detectability and conspicuity of the tower.

_____

_____

_____

_____

_____.

It is hoped that the above judgment can be based on observations at varying distances and under a variety of conditions of reported visibility and times of day and night. Please describe the general nature of the conditions of observation upon which the above judgment was made. (Use space below, or attach report.)

If the majority of the new techniques were established as additional requirements in the National Standards AGA-NS3 and AGA-NS4, is it the feeling of your company that the costs of procurement, installation and maintenance of the new factors would place an excessive burden on tower owners, or would the additional assurance of minimizing hazards to air navigation and to the towers appear to you to warrant these expenditures in ultimate revision of the tower? (Use space below, or attach report.)

Questionnaire for Flights in Areas of Specially Marked and Lighted Tall Towers

Please complete Section I of this questionnaire before making tower observation flight.

Section I

Name (Optional):_____. Date of observation flight_____.
Origin and destination of flight during which tower was observed:_____

_____

What is your attitude regarding the adequacy of present lighting and marking techniques for tall towers which may be hazards to air navigation? (Check appropriately below.)

___ Have responded on previous questionnaire.
___ Believe present techniques adequate for purpose.
___ Believe present techniques need some slight changes to make visibility of towers adequate.

___ Believe present techniques need complete revision to produce adequate visibility of towers.

___ Believe present techniques now so inadequate as to be dangerous.

Experience of pilot-observer: Number of hours_____; Type of license/rating held_____

_____.

READ THE FOLLOWING SECTION CAREFULLY BEFORE OBSERVATION FLIGHT.

Section II

Tower Observed (*Check*)	*Height above MSL*	*Bearing and Distance from* [1] (*Named Airport*)
___ WTVH, Peoria, Ill.	1283′	_____ _____ _____
___ WFBM, Indianapolis, Ind.	1849′	_____ _____ _____
___ WJBK, Detroit, Mich.	1730′	_____ _____ _____
___ WNBK, Cleveland, O.	1945′	_____ _____ _____
___ WFMJ, Youngstown, O.	2048′	_____ _____ _____
___ WHAS, Louisville, Ky.	1440′	_____ _____ _____

[1] Information to be included in final questionnaire prepared by agency of jurisdiction. It may be desirable, in cases where two or more tall towers are in close proximity, to include additional geographic data in order to insure positive identification of the tower under study.

Type of aircraft:_____.

Miles reported visibility at weather station nearest tower: _____.

Reported ceiling:_____.

Pilot's estimate of visibility:_____.

Pilot's estimate of ceiling:_____.

Type of cloud cover: clear (_____)
scattered (_____)
broken (_____)
thin overcast (_____)
thick overcast (_____)

For daytime observation, pilot's estimate of general brightness level: ___ very bright day
___ bright day
___ average day
___ dull day
___ very dark day.

Special weather, visibility, and atmospheric conditions; e.g., smoke, industrial haze:_____

_____

Distance at which obstruction was detected_____.

Distance at which obstruction was identified as a tower_____.

Distance at which total hazard area was defined (i.e., structure of tower and area encompassed by ground anchorage of guy wires):_____.

(Please obtain as accurate an estimate of these distances as possible from ground cues, chart details, and time-speed computations.)

Altitude of flight at time of tower detection:_____ feet above MSL.

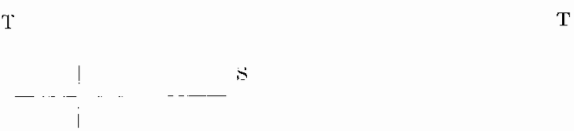
Ground speed at time of tower detection:_____ MPH, or_____ knots.

Time tower was observed:_____.

Direction (compass heading) of flight at time of tower detection:_____.

Relative compass bearing of tower from aircraft at time of detection:_____.

Diagram position of sun, tower, plane heading, and line of vision, at time of tower detection, as indicated in sample on left in which plane is flying west.



What feature of the tower or its marking or lighting was seen first? (Check with numeral 1.) What feature produced first identification of the object as a possible hazard? (Check with numeral 2.)

___ marking (paint) on tower
___ general structure of tower
___ ground marking at base of tower: (circle___, annulus___, "HAZ" signs___) and buildings___
___ reflectors on outside ground ring
___ total marking and structural configuration of tower
___ lights at base of tower
___ lights on tower
___ total lighting configuration of tower

Comments: _____

Tower observed by (check one): ___ pilot or co-pilot at controls
___ pilot or co-pilot not at controls
___ passenger-observer

Was observer of tower seeking to observe tower (_____) or did he merely happen to see the tower in course of routine flight (_____)?

Tower observed through windscreen of: ___ plate glass
___ plexiglass
___ other, specify: _____.

Condition of windscreen: dirty or scarred_____; clean and clear_____; rain_____.

What is your judgment about the adequacy of the experimental lighting and/or marking of the tower you have observed and reported on above?

___ believe no better or more visible than regular techniques
___ believe a little better than regular techniques
___ believe considerably better than regular techniques
___ believe adequate for *new* standards.

Comments or remarks: _____

Part 7

STANDARDS OF INTEREST TO BROADCAST ENGINEERS

FOREWORD

Standards relating to various areas of communication engineering and equipment are sponsored and developed through the efforts of many organizations. Among these are the National Association of Broadcasters (NAB), the International Radio Consultative Committee (CCIR), American Standards Association (ASA), the Institute of Radio Engineers (IRE), Electronic Industries Association (EIA, formerly RETMA), and Society of Motion Picture and Television Engineers (SMPTE).

In general, standards are developed by committees consisting of members representing manufacturers, consumers, technical bodies and government agencies. Included in this section are the complete Recording and Reproducing Standards of the National Association of Broadcasters and the International Radio Consultative Committee. Also included are pertinent standards from other organizations such as ASA, IRE, EIA and SMPTE.

NAB RECORDING AND REPRODUCING STANDARDS

For Mechanical, Magnetic, and Optical Recording and Reproducing Including a Glossary of Terms and Definitions

The NAB Recording and Reproducing Standards Committee was originally organized in 1941. Standards proposals issuing from the Committee have been adopted by the Board of Directors in 1942, 1949, and 1950. Standards as contained herein were adopted by the Board on June 19, 1953.

These standards and recommended good engineering practices are for the benefit and welfare of the broadcasting industry, and represent the contributions of more than 100 of the nation's authorities on the various phases of recording as used by the industry. The NAB Recording and Reproducing Standards Committee has also benefitted by contributions made by the administrations belonging to the International Radio Consultative Committee (Study Group X). The approach taken to many of the problems in the development of these standards was suggested by the work of CCIR Study Group X, particularly in the case of the methods of measuring the magnetization of a tape. The committee is open to participation by any interested individual or organization and consists of representatives from the manufacturers, broadcasters and producers. Close liaison has been maintained with other organizations (as well as foreign countries) to insure the maximum degree of coordinated understanding and recommended standardization, to permit interchangeability and, at the same time, to embrace the latest technological advances of the art.

Nothing in these standards prohibits or discourages continued progress or advancement of the art. On the contrary, the standards are so molded as to provide a stimulus for continued scientific exploration in the field of recording. It is anticipated that when necessary the NAB Recording and Reproducing Standards Committee will review its work of the past decade, looking toward any needed amendments and additions to keep pace with the art as it affects all forms of broadcasting—AM, FM, and Television.

Section 1

Mechanical Recording and Reproducing Standards *

NOTE: For the purpose of distinguishing between those recordings using a 2 mil or larger reproducing stylus and those requiring a 1 mil or smaller reproducing stylus, all Standards specifically relating to those recordings requiring the smaller stylus will use the term "fine groove."

Turntable Speed (RPM)

1.05 It shall be standard that the average speed of the turntable be either 33⅓, 45 or 78.26 RPM ± 0.3%.

1.05.01 Method of Measurement: This measurement shall be made by means of a stroboscopic disk illumined by a neon lamp or equivalent operated from the same power source as the turntable. The stroboscopic disk for 33⅓ RPM speed measurement shall have 216 spots in 360°; for 45 RPM speed it shall have 160 spots in 360°; and for 78.26 RPM speed it shall have 92 spots in 360°.

At either 33⅓, 45 or 78.26 RPM, not more than 21 dots per minute in either direction may pass or "drift" by a reference point.

Turntable and Disk Rotation

1.06 It shall be standard that disk records intended for broadcasting application be rotated in a clockwise direction as viewed from the side being reproduced.

WOW Factor (Recording)

1.10 It shall be standard that the instantaneous peak deviation from the mean speed of the recording turntable, when making the recording, shall not exceed +0.1% of the mean speed.

WOW Factor (Reproducing)

1.11 It shall be standard that the instantaneous peak deviation from the mean speed of the reproducing turntable when reproducing shall not exceed ±0.2% of the mean speed.

Disk Reproducing System Rumble

1.12 It shall be a good engineering practice that the low-frequency noise output of a turntable, its associated pickup and equalizer, when playing an essentially rumble-free silent groove, shall be more than 35 db below a reference level of 1.4 centimeters per second peak velocity at 100 cycles per second.

A record shall be considered rumble free if its rumble content is at least 8 db below

* For clarification in the use of these standards, the term "transcription" is deemed to mean those disk recordings made primarily for broadcast transmissions; the term "record" is deemed to mean those disk recordings which by virtue of their size, electrical and mechanical characteristics may be used for broadcast transmissions, but may not primarily be manufactured for this purpose.

that of the system being measured. The response of the pickup and equalizer shall conform to the NAB standard reproducing curve; the amplifier and indicating meter shall have uniform response, within ±1 db, between 10 and 250 cycles per second, with 500 cycle response 3 db below the 100 cycle response, an attenuation at the rate of at least 12 db per octave at frequencies above 500 cycles. Amplifier and indicating meter response shall decrease at the rate of at least 6 db per octave below 10 cycles per second. The meter used shall have the same ballistic characteristics as the standard VU meter. If the meter reading fluctuates, both average and maximum values shall conform to this requirement.

1.12.01 This measurement is intended to give a measure of the electrical effect of the low-frequency noise output of a turntable-pickup combination. Since the result depends on the equalizer and pickup characteristics as much as on the turntable itself, it is not feasible to standardize the turntable alone.

The measurement reflects the electrical effects, not the aural annoyance value, of low-frequency noise. It has been found that strong low-frequency noise at a frequency and intensity below audibility will create severe intermodulation distortion in an audio system, and that in modern systems with extended low-frequency response, this is more serious than the audibility of the low frequency.

The reference level of 1.4 centimeters per second at 100 cps corresponds in amplitude to 7 centimeters per second at 500 cps, since we are then operating on the constant amplitude portion of the recording characteristic. It is suggested that such noise data be taken periodically for each turntable in a broadcast system, with a change in the indication reflecting a need for maintenance work.

Turntable Recovery Time (Reproducing)

1.15 It shall be standard that the maximum turntable recovery time be 0.3 seconds.

1.15.01 Recovery time shall be defined as the time required after release of a record which has been restrained from rotation until the wows have fallen to 120% of the permissible steady state level.

Turntable Height (Reproducing)

1.20 It shall be good engineering practice that the height of the turntable be 28 inches.

1.20.01 The height of a turntable of the console type is defined as "the vertical distance from the surface on which the turntable rests to the top of the platen."

Turntable Platen (Reproducing)

1.21 It shall be good engineering practice that the diameter of the transcription reproducing turntable platen be substantially the same as that of the largest diameter records for which the turntable is intended.

1.21.01 Turntables for 45 RPM shall be recessed a minimum of 0.030″ to a diameter of $3\frac{7}{8} \pm \frac{1}{32}$″.

Turntable Center Pin Diameter

1.25 It shall be standard that the diameter of the center pin of a transcription turntable be 0.2835″ ± 0.0005″ for $33\frac{1}{3}$ and 78.26 RPM transcriptions. The diameter of the center pin for 45 RPM records shall be 1.500 + 0 − 0.002″.

Outer Record Diameters

1.30 It shall be standard that the outer record diameter fall within the limits specified in the following table:

Nominal	*Finished Records (Pressings or Instantaneous)*
16″	15 5/16″ ± 3/32″
12″	11 7/8″ ± 1/32″
10″	9 7/8″ ± 1/32″
7″	6 7/8″ ± 1/32″

Record Center Hole Diameter

1.35 It shall be standard that the record center hole diameter be 0.286″ ± 0.001″ for 33⅓ and 78.26 RPM records and transcriptions, and 1.504″ ± 0.002″ for 45 RPM records.

Concentricity of Center Hole

1.36 It shall be good engineering practice that the record center hole be concentric with the recorded groove spiral within 0.002 inches.

Record Warp

1.40 It shall be standard that the maximum departure of the surface of a record from a true plane because of warping shall not be in excess of 1/16″.

Frequency Characteristics for Vertical Recordings [1]

1.50 It shall be standard that the recorded frequency characteristics on vertically recorded records be as shown in attached Figure 1.

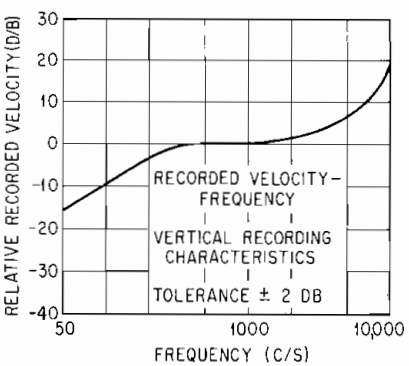


FIGURE 1. Relative recorded velocity (D/B).

Frequency Characteristics for Lateral Recordings [2]

a. A parallel L/R network having a time constant of 3180 microseconds.
b. A series RC network having a time constant of 318 microseconds.
c. A parallel RC network having a time constant of 75 microseconds.

1.55 It shall be standard that the recorded frequency characteristics on laterally recorded records be as shown in attached Figure 2.

[1] The recording characteristics for vertical transcriptions remain as specified in the standards adopted in March 1942, except that in place of "stylus velocity" the words "recorded velocity" should be substituted.

[2] This curve is defined as the algebraic sum of the ordinates of three individual curves which conform to the admittances of the following three networks expressed in db:

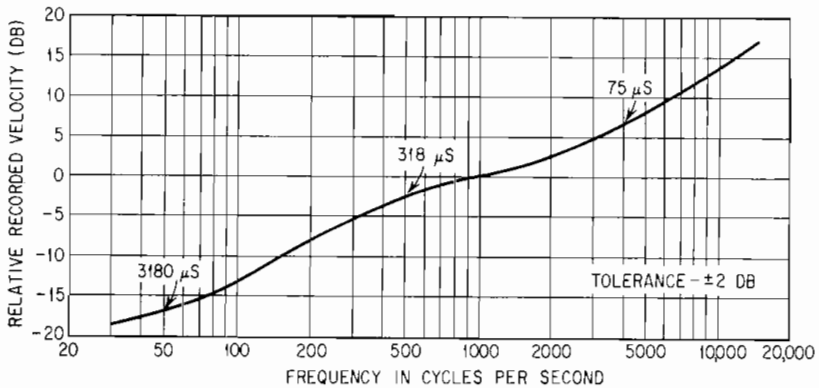


FIGURE 2. NAB lateral disk standard recording characteristic.

Record Groove Shape [1]

1.60 Lateral: It shall be standard that the groove shape for finished lateral records and transcriptions shall have an included angle of 88° ± 5°, and a top width of not less than 4.0 mils for records to be reproduced with a 2.3 mil stylus and not less than 2.0 mils for records to be reproduced with a 1.0 mil stylus.

1.60.01 It shall be good engineering practice on records and transcriptions with less than 136 lines per inch that the groove have a bottom radius of 1.5 mils; for records and transcriptions having more than 136 lines per inch, the groove shall have a bottom radius not less than 0.25 mils.

1.65 Vertical: It shall be standard that the groove shape for finished vertical records shall have an included angle of 88° ± 5°; a radius of 2.0 to 2.3 mils; and a top width of not less than 4.0 mils.

Reproducer Stylus Contour

1.70 33⅓ and 78.26 RPM lateral or vertical transcriptions (other than fine groove): It shall be the primary standard that the stylus for reproducing lateral or vertical transcriptions shall have an included angle of 40° to 55° and a bottom radius of 2.3 ± 0.2 mils.

1.70.01 45 RPM records and fine groove records and transcriptions: It shall be the primary standard that the stylus have an included angle of 40° to 55° and a bottom radius of $1.0 \begin{smallmatrix} +0.1 \\ -0.2 \end{smallmatrix}$ mils.

1.75 Lateral 78 RPM phonograph records and transcriptions: It shall be the secondary standard that the stylus for reproducing lateral 78 RPM phonograph records and transcriptions shall have an included angle of 40° to 55° and a bottom radius of 2.5 ± 0.1 mils.

Recorded Level (Lateral and Vertical) [2]

1.80 It shall be standard that the recorded program level shall produce the same reference deflection on a standard volume indicator (ASA Standard C16.5-1942)

[1] It has been concluded that groove shape standards should apply to the finished record rather than to the recording stylus. It is recognized that in some cases record groove dimensions depart slightly from those of the recording stylus, but such deviations should be anticipated in the recording operation and controlled in the processing plant. In actual practice standards covering reproducer stylus contour have no significance unless the groove standards refer to the finished record.

[2] It is well established that at least a 10 db margin is required between the sine wave load handling capacity of a system and the level of program material measured by a stand-

as that produced by a 1,000-cycle tone recorded at a peak velocity of 7 cm. per second.

Signal-to-noise Ratio [1]

1.85 It shall be standard that the noise level measured with a standard volume indicator (ASA Standard C16.5-1942) when reproducing a record on a flat velocity basis over a frequency range between 500 and 10,000 cycles per second shall be at least 40 db below the level obtained under the same conditions of reproduction using a tone record of 1,000 cycles per second having a peak velocity of 7 centimeters per second. Response of the system at 500 cycles per second shall be 3 db below the response at 1,000 cycles per second, and the response shall fall at the rate of at least 12 db per octave below 500 cycles per second. Response of the system at 10,000 cycles per second shall be 3 db below the response at 1,000 cycles per second, and the response shall fall at the rate of at least 12 db per octave above 10,000 cycles per second.

Outermost Groove Diameter

1.90 It shall be standard that the diameter of the outermost groove be within the limits specified in the following table:

16"—outside start—15½"	± 1/16"
16"—inside start —15 9/16"	maximum
12"—outside start—11½"	± 0.020"
10"—outside start— 9½"	± 0.020"
7"—outside start— 6⅝"	+ 0 — 5/64"

Number of Blank Grooves

1.100 It shall be standard for transcriptions that the number of blank grooves, before and after modulation occurs, shall be not less than two complete revolutions.

Stopping Groove

1.110 For transcriptions, it shall be standard that at the termination of the recording groove spiral a locked concentric stopping groove shall be provided.

Innermost Groove Diameter

1.115 It shall be standard that the diameter of the innermost groove shall be not less than 7½" in the case of 33⅓ RPM transcriptions recorded to be reproduced with a 2.3 mils radius styln, and not less than 4¾" for recordings to be reproduced with a 1 mil stylus. It shall be standard that the diameter be not less than 3¾" for 78.26 RPM recordings and not less than 4¼" for 45 RPM recordings.

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ard volume indicator. This standard would then contemplate program peaks running as high as a velocity of 21 centimeters per second. This is believed to be approximately the maximum velocity which can be traced without excessive distortion at groove speeds encountered at the inner radius of a 33⅓ rpm disk. This has also been substantiated by practical experience. This standard of course applies to both lateral and vertical recording.

[1] This measurement is intended to give a measure of noise in terms of a fixed reference. In this way it becomes a true figure of merit for comparisons of variations in surface noise of disks. It does not, however, take into account the program level which may happen to be recorded on a particular disk nor the dynamic range of the program material. NAB preemphasis will improve the signal to noise ratio by approximately 8 db, thus resulting in an effective signal to noise ratio under minimum conditions of 48 db. It should be remembered that the peak signal to noise ratio will be at least 10 db better than the figure given above when NAB standard of recorded level is used, with normal program material.

Minimum Label Information

1.120 It shall be standard for the label of a recording to contain at least the following technical information:

a. Type of recording—vertical or lateral
b. Speed—78.26, 45, or 33⅓ RPM
c. Direction of feed (start)—outside-in or inside-out
d. Recording frequency characteristic (Example: NAB 1953 Standard.)
e. Recommended type of playback stylus

Section 2

Magnetic Recording and Reproducing Standards

Magnetic Tape Dimensions

2.05 Thickness: It shall be standard that the thickness of magnetic tape shall not exceed 0.0022 inches.

2.10 Width: It shall be standard that the width of magnetic tape shall not exceed 0.250 inches nor shall it be less than 0.244 inches.

Magnetic Tape Speed

Definition: Magnetic tape speed for recording and reproducing is the velocity of the magnetic tape recording medium with respect to the recording or reproducing device.

2.15 Primary standard: It shall be standard that the primary standard magnetic tape speed shall be 15 inches per second.

2.20 Secondary standard: It shall be standard that the secondary magnetic tape speed shall be 7.5 inches per second.

2.25 Supplementary standard: It shall be standard that the supplementary magnetic tape speed shall be 30 inches per second.

Frequency Response Limits

2.30 Primary Frequency Response Limits: It shall be standard that the primary frequency response shall lie between two limits. (See Figure 3-A.) The upper of these limits shall be uniform from 50 to 15,000 cps. The lower shall be uniform from 100 to 7500 cps and 2 db below the upper limit. In addition, the lower limit shall be an additional amount down at 50 and 15,000 cps determined by decrease at a uniform rate of 3 db per octave below 100 cps and above 7500 cps.

2.35 Secondary Frequency Response Limits: (For applications where a restricted frequency response may be tolerated). It shall be standard that the secondary frequency response shall lie between two limits. (See Figure 3-B.) The upper of these limits shall be uniform from 50 to 7500 cps. The lower shall be uniform from 100 to 5000 cps and 2 db below the upper limit. In addition, the lower limit shall be an additional amount down at 50 and 7500 cps determined by a uniform 3 db decrease from 100 to 50 cycles and from 5000 to 7500 cycles.

Flutter and WOW

2.40 It shall be standard that the instantaneous peak flutter and wow shall not exceed 0.2% (peak to peak 0.4%) when recording and reproducing on the same equipment.

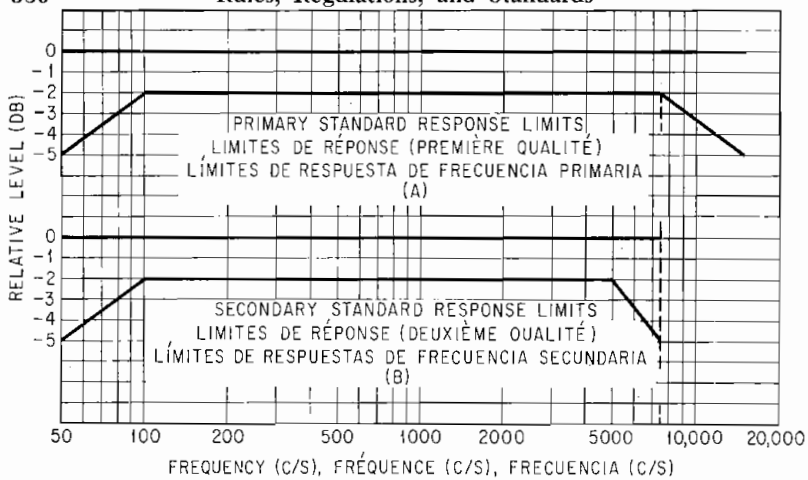


FIGURE 3. Frequency response limits for magnetic tape recording and reproducing systems.

Magnetic Tape Reel

2.45 It shall be standard that the hub carrying magnetic tape shall be in accordance with Figure 4.

Tape Wind

2.46 It shall be standard that magnetic tape, when supplied on reels ready for use, shall be wound with the active magnetic surface on each layer facing toward the center of the reels.

2.50 Primary Standard: It shall be standard where flanges are used that the primary standard flange shall be in accordance with Figure 5.

2.50.01 The primary standard flange provides for the accommodation of sufficient magnetic tape of standard thickness for a nominal 30 minutes of recording.

Erasing Function

2.55 It shall be standard that the erasing function shall be applied to the entire width of the tape.

Magnetic Tape Length

2.60 Length-Primary Standard: It shall be standard that the primary standard length of magnetic tape shall be 2,400 feet, +50 feet −0 feet.

2.60.01 The primary standard length of magnetic tape provides the nominal amount of maximum thickness magnetic tape for the primary standard flange as well as a nominal recording time of 30 minutes (plus a starting and stopping margin) when recording with the primary standard magnetic tape speed.

2.65 Length-Secondary Standard: It shall be standard that the secondary standard length of magnetic tape shall be 1,200 feet, +25 feet −0 feet.

2.65.01 The secondary standard length of magnetic tape provides a nominal recording time of 30 minutes (plns a starting and stopping margin) when recording with the secondary standard magnetic tape speed.

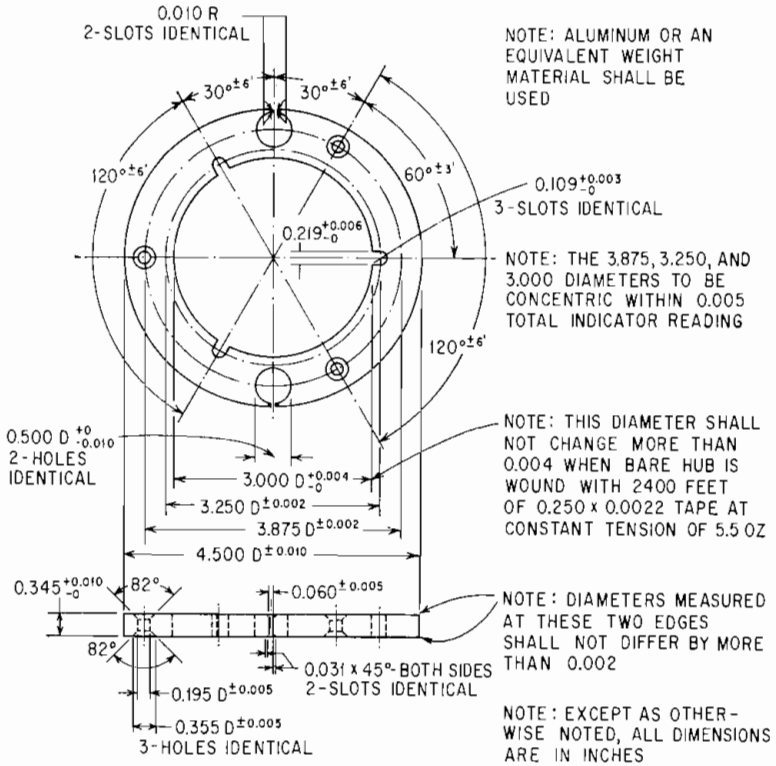


FIGURE 4. NAB standard hub for magnetic tape reel.

Magnetic Sound Track Position

2.75 It shall be standard that the magnetic sound track shall be symmetrically located with respect to the center line of the tape.

Standard Reproducing Characteristic

2.80 It shall be standard that a Standard Reproducing System is one having an "ideal" reproducing head,[1] the EMF of which is amplified in an amplifier with a response curve having the following characteristic:

At a tape speed of 15"/second: The response curve shall be that which results from the superposition of three curves; one that falls with increase of frequency at the rate of 6 db per octave; this curve to be modified at low audio frequencies by a curve that falls with decrease of frequency in conformity with the admittance of a series combination of a capacity and a resistance having a time constant of 3180 microseconds; and this same curve to be modified at high audio frequencies by a curve that rises with increase of frequency in conformity with the admittance of a

[1] An "ideal" reproducing head is defined as a reproducing head the losses of which are negligible. With a normal ferromagnetic head this means that the gap is short and the arc of contact with the tape is long compared to the relevant wavelengths, and the losses in the material of the head are small. With the reproducing heads used in practice, an equalization to compensate for the head losses must be added to the replay amplifier.

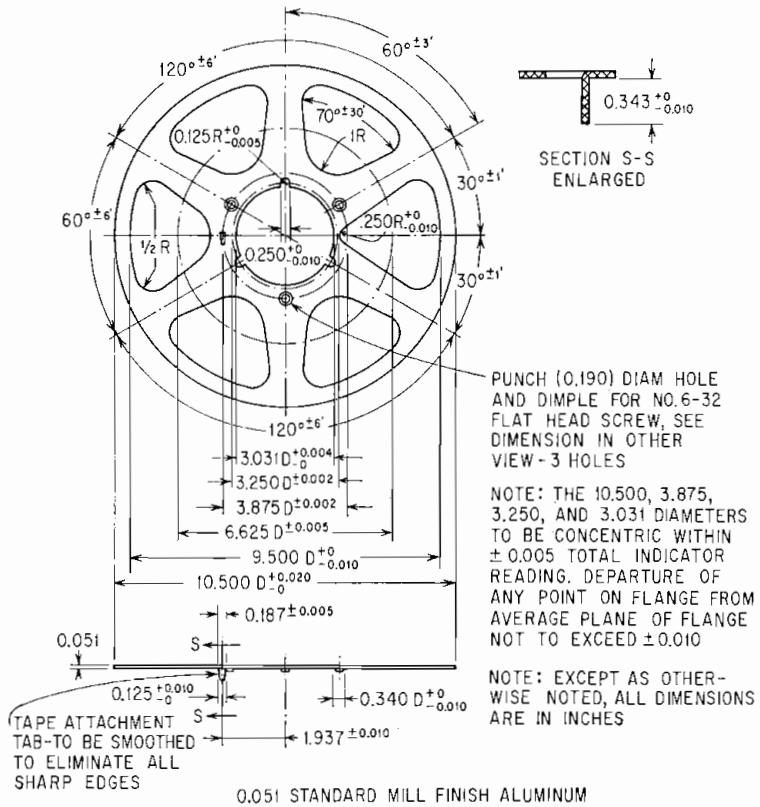


FIGURE 5. NAB standard flange for magnetic tape reel.

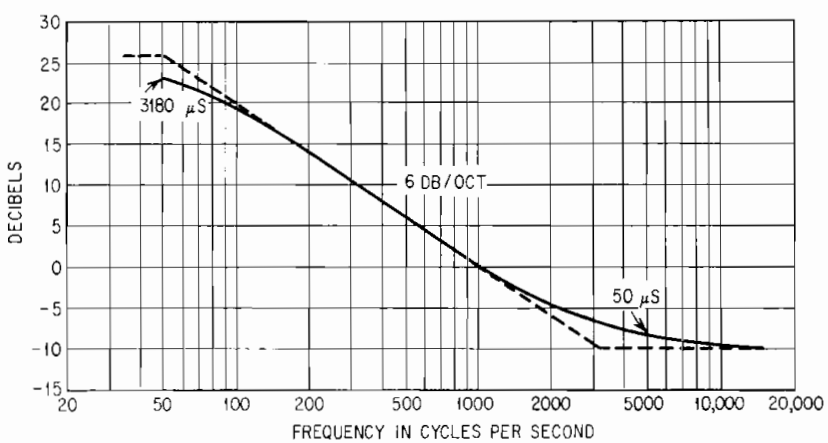


FIGURE 6. NAB magnetic tape standard reproducing characteristic, 15 inches per second.

parallel combination of a capacitance and a resistance having a time constant of 50 microseconds. The combined curve is shown in Figure 6.

Methods of Establishing the Standard Reproducing System

2.85 The relative surface inductions at different frequencies on a tape can be measured by at least three methods that are described in the attached Annex. From such measurements the departure of the response of a reproducing head from the "ideal" can be deduced and consequently a Standard Reproducing System can be established as a primary standard. Test tapes can then be made which can serve as secondary standards for use in normal operation.

Signal-to-noise Ratio

2.90 It shall be standard that the signal-to-noise ratio of a recording system shall be at least 55 db referred to the Standard Reference Level. All frequencies between 50 and 15,000 cycles are to be included in the measurement of the noise. (The standard reference level for signal-to-noise measurements shall be the output level obtained by reproducing tape, produced by a recording system operating under normal conditions, at which two percent total harmonic distortion of the recorded 400 cycle tone occurs using tape that is normally available.)

Annex

Methods of Measuring the Magnetization of a Tape [1]

There are two general ways in which the surface induction [2] vs. frequency characteristic of a tape may be determined:

1. By means which do not affect the surface induction. This implies the use of a non-magnetic reproducing device. For example, reproduction by means of a simple non-magnetic conductor placed in the field at the surface of the moving tape appears to be practicable as a laboratory method and might therefore be used to establish a primary standard which could be used to determine the relative change of surface induction with wavelength created by the presence of a magnetic head.
2. By means of a magnetic reproducing device, which necessarily affects the surface induction of the tape in a manner dependent on recorded wavelength. In this category there are two ways in which conventional magnetic heads have been used, one method involving heads with a short gap, the other involving heads with a long gap. In both cases the gap in the reproducing head must be sufficiently accurate, magnetically, to give well-defined minima of reproduced level, one in the short gap method or several in the long gap method.

(a) **The "Short Gap" Head Method.** The longest wavelength at which a minimum of reproduced level occurs is the effective gap length (d). The necessary correction for the gap length is calculated on the assumption that output is proportional to

$$\frac{\sin \frac{\pi d}{\lambda}}{\frac{\pi d}{\lambda}}$$

[1] These methods resulted from experiments undertaken by members of the NAB Recording and Reproducing Standards Committee following the original work in C.C.I.R. Study Group X on the subject.

[2] In general terms, surface induction is the flux density (B) at right angles to the surface of the tape. It depends not only on the magnetization of the tape but also on the properties of the reproducing device. In the following, surface induction means the surface induction of the tape in space and not in contact with a reproducing device.

This correction must not exceed 5 db at the shortest wavelength considered. Any necessary correction for eddy current losses must also be determined, for example, by comparing output at various tape speeds or by the use of an inducing loop.

It appears that if the correction for gap length does not exceed 5 db, then the surface induction is altered, due to the presence of the head, by an approximately constant factor over the whole range of wavelengths and may therefore be neglected.

Once these corrections are known and applied, the head may be used as an "ideal" head to measure relative surface inductions on the tape over the wavelength range considered. Since surface induction is a measure of flux density, it is proportional to the open circuit induced voltage of an "ideal" short gap head.

(b) The "Long Gap" Method. In this method a head is used with a gap some 50 times as long as that of the normal reproducing head. In practice an erase head can usnally be adapted for the purpose. The response of such a head should show a series of well defined maxima and minima as shown in Figure 7.

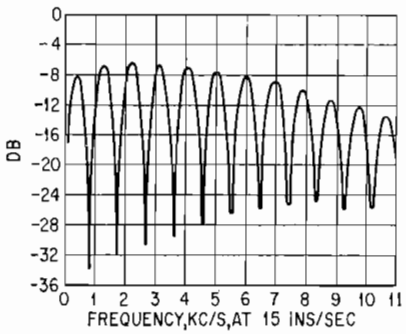


FIGURE 7. Frequency characteristic standardization in magnetic recording.

A curve through the successive maxima is a measure of the surface induction on the tape when the necessary corrections for eddy current losses of the head have been made. This curve falls at approximately 4 db per octave compared with the curve of surface induction vs. frequency in air as determined by a non-magnetic reproducing device, or by a "sharp-gap" head. This correction must be explored further before this method can be applied.

NOTE 1. The "Long Gap" method is included here because of its use in other countries and its possible future use in the U.S.A. The uncertainty of the correction factor makes it unusable as a standard method of measurement at present.

The precise steps by which the procedures of (2) (*a*) and (*b*) may be applied in practice are outlined in the following.

Standardization by the "Short Gap" Magnetic Head

Using the "Short Gap" Method a recording equipment is set to the standard condition in the following way:

1. A "gliding tone" is recorded on a tape and reproduced by means of the head to be used for the measurements. The longest wavelength at which the output disappears is noted. This wavelength will be equal to the effective gap length, from which the necessary gap correction may be deduced. If this correction exceeds 5 db, the head is unsuitable for this measurement.

Since the measurement must take place at a very short recorded wavelength, a high coercivity tape should be used, and a certain amount of pre-emphasis will be found useful. In order to avoid making the measurements at an unnecessarily high frequency, the lowest tape speed available should be used.

2. The tape with the gliding tone is reproduced at two different speeds and the output curves compared. If the curve can be brought to coincidence by displacing

one frequency scale so that equal wavelengths coincide it may be assumed that frequency-dependent losses are negligible. If not, these losses may be deduced from the two curves mentioned or, alternatively, from a measurement with an inducing loop.

3. The frequency response of the reproducing amplifier is now adjusted to consist of the sum of the following:

a. Compensation for the gap loss noted in (1) above.

b. Any compensation for the frequency-dependent losses noted in (2) that may be required.

c. The response curve specified for a Standard Reproducing System with an "ideal" reproducing head and shown in Figure 6.

4. The recording equalization is then adjusted so that a flat overall response is obtained.

Standardization by the "Long Gap" Magnetic Head

Using the "Long Gap" Method a recording equipment is set to the standard condition in the following way:

1. The reproducing head used has a well defined gap long enough to give successive maxima of response at intervals of 1 kc/s or less in the audio frequency range. (With a tape speed of 30 in/sec the gap length required would be about 800 microns.) If the successive minima in the response curve are not equally well defined, the head is not suitable for this measurement.

A short preliminary experiment is carried out to determine the exact frequencies at which the successive maxima occur at the standard tape speed.

2. A "gliding tone" test tape of the audio frequencies of maximum level is then recorded with constant voltage input to the recording chain and the tape is reproduced using the long gap head. The open circuit voltage of the head around these frequencies is then plotted against frequency, and a smooth curve is drawn through the successive maxima.

3. The tape with the gliding tone is reproduced at two different speeds using the long gap head and the output curves compared. If the curves can be brought to coincide by displacing one frequency scale so that equal wavelengths coincide it may be assumed that frequency-dependent losses are negligible. If not, these losses may be deduced from the two curves mentioned or, alternatively, from a measurement with an inducing loop.

4. When the curve drawn in (2) has been corrected by a 6 db/octave rise with increase in frequency, together with the compensation for frequency-dependent losses and a correction of 1 to 2 db/octave falling with increase of frequency, the result defines the surface induction of the tape.

5. The equalization of the recording amplifier is now altered to obtain a characteristic of surface induction vs. frequency that is the inverse of the equalization specified for the reproducing system (without allowance for the reproducing head losses).

6. The reproducing amplifier equalization is then adjusted so that a flat over-all response is obtained when using a normal reproducing head.

Section 4

Glossary of Mechanical, Magnetic, and Optical Terms and Definitions

4.005 Acetate Disks. Acetate disks are mechanical recording disks, either solid or laminated which are made mostly from cellulose nitrate lacquer plus a lubricant.

4.010 Advance Ball. An advance ball is a rounded support (often sapphire) attached to a cutter which rides on the surface of the recording medium so as to maintain a uniform mean depth of cut and correct for small irregularities of the disk surface.

4.015 Aeolight. An aeolight is a glow lamp employing a cold cathode and a

mixture of permanent gases in which the intensity of illumination varies with the applied signal voltage.

4.020 Background Noise. Background noise is the total system noise independent of whether or not a signal is present. The signal is not to be included as part of the noise.

4.025 Bilateral-area Track. A bilateral-area track is a sound track having the two edges of the central area modulated according to the signal.

4.030 Binder. A binder is a resinous material which causes the various materials of a record compound to adhere to one another.

Biscuit—see Preform (Biscuit).

4.035 Burnishing Surface. A burnishing surface, in mechanical recording, is the portion of the cutting stylus directly behind the cutting edge which smooths the groove.

Cathode Sputtering—see Sputtering.
Cellulose Nitrate Disks—see Lacquer Disks.

4.040 Chip. The chip, in mechanical recording, is the material removed from the recording medium by the recording stylus while cutting the groove.

Christmas Tree Pattern—see Optical Pattern.
Coated Tape—see Magnetic Powder-coated Tape.
Concentric Groove—see Groove, Locked.

4.041 Compression Molding. Compression molding is molding a record or transcription by means of compressing a preform of plastic.

4.042 Cold Cutting Stylus. A cold cutting stylus is a stylus having its cutting edge burnished at a plane substantially different from the cutting face for the purpose of cutting and polishing the groove in an acetate disk at normal room temperature.

4.045 Constant-amplitude Recording. Constant-amplitude recording indicates a mechanical recording characteristic wherein, for a fixed amplitude of a sinusoidal signal, the resulting recorded amplitude is independent of frequency.

4.050 Constant-velocity Recording. Constant-velocity recording indicates a mechanical recording characteristic wherein, for a fixed amplitude of a sinusoidal signal, the resulting recorded amplitude is inversely proportional to the frequency.

4.052 Constant Velocity Recorder or Reproducer. Consists of a recording or reproducing machine designed so that the turntable rotates in such a manner that constant velocity is effected at the recording stylus or reproducer stylus irrespective of diameter.

4.055 Control Track. A control track is a supplementary sound track, usually placed on the same film with the sound track carrying the program material. Its purpose is to control, in some respect, the reproduction of the sound track. Ordinarily, it contains one or more tones, each of which may be modulated either as to amplitude or frequency.

4.060 Core. A core, in mechanical recording, is the center layer or basic support of certain types of laminated media.

Crossover Frequency—see Transition Frequency.
Crosstalk—see Magnetic Printing.

4.065 Crystal Cutter. A crystal cutter is a cutter in which the mechanical displacements of the recording stylus are derived from the deformations of a crystal having piezoelectric properties.

4.070 Cutter (Mechanical Recording Head). A cutter is an electromechanical transducer which transforms an electric input into a mechanical output, typified by mechanical motions which may be inscribed into a recording medium by a cutting stylus.

De-emphasis—see Postemphasis.

4.075 Densitometer. A densitometer is an instrument for the measurement of optical density (photographic transmission, photographic reflection, visual transmission, etc.) of a material.

4.080 Disk Recorder. A disk recorder is a mechanical recorder in which the recording medium has the geometry of a disk.

Drift—see Flutter.

4.085 Drive Pin. A drive pin, in disk recording, is a pin similar to the center pin, but located to one side thereof, which is used to prevent a disk record from slipping on the turntable.

4.090 Drive-pin Hole. A drive-pin hole, in disk recording, is a hole in a disk recording which accommodates the turntable drive pin.

4.095 Dubbing. Dubbing is a term used to describe the combining of two or more sources of sound into a complete recording, at least one of the sources being a recording. (See Re-recording)

Dynamic Reproducer—see Pickup, Moving Coil.
Eccentric Circle—see Groove, Eccentric.

4.100 Eccentricity. Eccentricity, in disk recording, is the displacement of the center of the recording groove spiral, with respect to the record center hole.

4.105 Equalization (Corrective Equalization). Equalization is the effect of all corrective means employed in the recording and reproducing process to obtain a desired over-all frequency response.

4.106 Equalization (Diameter). Diameter equalization is the increasing of the high frequency response with respect to decreasing diameter of the recording.

4.110 Erasing Head. An erasing head is a device for obliterating any previous recordings. It may be used for preconditioning the magnetic media for recording purposes.

4.115 Erasing Head, A-C. An a-c erasing head is a magnetic head which uses alternating current to produce the magnetic field necessary for erasing.

NOTE: A-c erasing is achieved by subjecting the medium to a number of cycles of a magnetic field of a decreasing magnitude. The medium is, therefore, essentially magnetically neutralized.

4.120 Erasing Head, D-C. A d-c erasing head is a magnetic head which utilizes direct current to produce the magnetic field necessary for erasing.

NOTE: D-c erasing is achieved by subjecting the medium to a unidirectional field. Such a medium is, therefore, in a different magnetic state than one erased by a-c.

4.125 Erasing Head, P-M. A p-m erasing head uses the fields of one or more permanent magnets for erasing.

4.130 Fast Groove (Fast Spiral). A fast groove, in disk recording, is an unmodulated spiral groove having a pitch that is much greater than that of the recorded grooves.

4.132 Feed Back Cutter. A feed back cutter is an electromechanical transducer which performs the same as a "cutter" except that it is equipped with an auxiliary feed back coil in the magnetic field. Signals exciting the "cutter" are induced into the feed back coil which in turn is fed back to the input of the cutter amplifier resulting in a substantially uniform frequency response.

4.135 Filler. Filler, in mechanical recording, is the insert material of a record compound as distinguished from the binder.

4.140 Film Reproducer. A film reproducer is an instrument in which film is the medium from which a recording is reproduced.

NOTE: In many cases, the term "film reproducer" is erroneously used synonymously with optical sound reproducer.

4.145 Film Sound Recorder. A film sound recorder is equipment which uses film as the recording medium.

NOTE: In many cases, the term "film sound recorder" is erroneously used synonymously with optical sound recorder.

4.147 Flash. Flash is the excess material generated at the edge of a record or transcription after the molding is completed.

4.150 Flutter (WOW) (Drift). In recording and reproducing, flutter is the deviation of frequency which results in general from irregular motion during recording, duplication, or reproduction.

NOTE: The term "flutter" usually refers to cyclic deviations occurring at a relatively high rate, as for example, 10 cycles per second. The term "wow" usually refers to cyclic deviations occurring at a relatively low rate, as for example, a once-per-revolution speed variation of a phonograph turntable. The term "drift" usually refers to a random rate close to zero cycles per second.

4.155 Flutter Rate. Flutter rate is the number of cyclical variations per second of the flutter.

Frequency—Crossover-Transition-Turnover—see Transition, Frequency.

4.157 Forty-five Record. A "45 RPM" record is a record recorded and reproduced at 45 revolutions per minute having a center hole of 1.5 inches.

4.160 Frequency Record. A frequency record is a recording of various known frequencies at known amplitudes, usually for the purposes of testing or measuring.

4.165 Galvanometer Recorder (for Photographic Recording). A galvanometer recorder for photographic recording is a combination of mirror and coil suspended in a magnetic field. The application of a signal voltage to the coil causes a reflected light beam from the mirror to pass across a slit in front of a moving photographic film, thus providing a photographic record of the signal.

4.170 Gamma. The gamma of a photographic material is the slope of the straight line portion of the H and D curve. It represents the rate of change of photographic density with the logarithm of exposure. Gamma is a measure of the contrast properties of the film. Both gamma and density specifications are commonly used as controls in the processing of photographic film.

4.175 Gap Length. In longitudinal magnetic recording, the gap length is the physical distance between adjacent surfaces of the poles of a magnetic head. (See Magnetic Head.)

NOTE: The effective gap length is usually greater than the physical length and can be experimentally determined in some cases.

4.180 Grain. A grain of photographic material is a small particle of metallic silver remaining in a photographic emulsion after development and fixing. In the agglomerate, these grains form the dark area of a photographic image.

4.185 Graininess. Graininess of a photographic material is the visible coarseness under specified conditions due to silver grains in a developed photographic film.

4.190 Groove. A groove, in mechanical recording, is the track inscribed in the record by the cutting or embossing stylus, including undulations or modulations caused by the vibration of the stylus.

4.195 Groove Angle. Groove angle, in disk recording, is the angle between the two walls of an unmodulated groove in a radial plane perpendicular to the surface of the recording medium.

4.200 Groove, Eccentric (Eccentric Circle). An eccentric groove, in disk recording, is an unmodulated locked groove whose center is other than that of the disk record (generally used in connection with mechanical control of phonographs).

4.205 Groove, Fast (Fast Spiral). A fast groove, in disk recording, is an unmodulated spiral groove having a pitch that is much greater than that of the recorded grooves.

4.210 Groove, Lead-in (Lead-in Spiral). A lead-in groove, in disk recording, is a blank spiral groove at the beginning of a record generally having a pitch that is much greater than that of the recorded grooves.

4.215 Groove, Lead-over, Crossover Spiral). A lead-over groove, in disk recording, is a groove cut between recordings of small durations which enables the pickup stylus to travel from one cut to the next.

4.220 Groove, Lead-out (Throw-out Spiral). A lead-out groove, in disk recording, is a blank spiral groove at the end of a recording generally of a pitch that is much greater than that of the recorded grooves and which is connected to either the locked or eccentric groove.

4.225 Groove, Locked (Concentric Groove). A locked groove, in disk recording, is a blank and continuous groove at the end of modulated grooves whose function is to prevent further travel of the pickup.

4.230 Groove Shape. Groove shape, in disk recording, is the contour of the groove in a radial plane perpendicular to the surface of the recording medium.

4.235 Groove Speed. Groove speed, in disk recording, is the linear speed of the groove with respect to the stylus.

4.240 Groove, Unmodulated. An unmodulated groove, in mechanical recording, is a groove made in the medium with no signal applied to the cutter.

4.245 Ground Noise. Ground noise is the residual system noise in the absence of the signal. It is usually caused by inhomogeneity in the recording and reproducing media, but may also include amplifier noise such as tube noise or noise generated in resistive elements in the input of the reproducer amplifier system.

4.250 Grouping. Grouping is nonuniform spacing between the grooves of a disk recording.

4.255 Guard Circle. A guard circle is an inner concentric groove inscribed, on disk records, to prevent the pickup from being damaged by being thrown to the center of the record.

4.260 H and D Curve (Hurter and Driffield Curve). An H and D Curve is a characteristic curve of a photographic emulsion which is a plot of density against the logarithm of exposure. It is used for the control of photographic processing, and for defining the response characteristics to light of photographic emulsions.

Impregnated Tape—see Magnetic Powder-Impregnated Tape.

4.262 Injection Molding. Injection molding is the process of molding a record or transcription by means of injecting into a die cavity a plastic liquified by heat.

4.265 Instantaneous Recording. An instantaneous recording is a recording which is intended for direct reproduction without further processing.

4.270 Lacquer Disks (Cellulose Nitrate Disks). Lacquer disks are mechanical recording disks usually made of metal, glass, or paper, and coated with a lacquer compound (often containing cellulose nitrate).

4.275 Lacquer Original (Lacquer Master °). A lacquer original is an original recording on a lacquer surface for the purpose of making a master.

4.280 Lacquer Recording. A lacquer recording is any recording made on a lacquer recording medium.

4.285 Laminated Record. A laminated record is a mechanical recording medium composed of several layers of material. Normally, it is made with a thin face of surface material on each side of a core.

4.290 Land. The land is the record surface between two adjacent grooves of a mechanical recording.

4.295 Lateral Recording. A lateral recording is a mechanical recording in which the groove modulation is perpendicular to the motion of the recording medium and parallel to the surface of the recording medium.

4.300 Light Modulator. A light modulator is the combination of a source of light, an appropriate optical system, and a means for varying the resulting light beam, so that a sound track may be produced (such as a galvanometer or light valve).

4.305 Light Valve. A light valve is a device in which the light passes through one or more slits, the width of which changes in accordance with the signal supplied.

° Deprecated.

4.307 Long-playing. Long-playing refers to a transcription or record having substantially longer playing time by reason of more lines per inch.

4.310 Magnetic Biasing. Magnetic biasing is the simultaneous conditioning of the magnetic recording medium during recording by superposing an additional magnetic field upon the signal magnetic field.

NOTE: In general, magnetic biasing is used to obtain a substantially linear relationship between the amplitude of the signal and the remanent flux density in the recording medium.

4.315 Magnetic Biasing, A-C. A-c magnetic biasing is magnetic biasing accomplished by the use of an alternating current, usually well above the signal frequency range.

4.320 Magnetic Biasing, D-C. D-c magnetic biasing is magnetic biasing accomplished by the use of direct current.

4.325 Magnetic Cutter. A magnetic cutter is a cutter in which the mechanical displacements of the recording stylus are produced by the action of magnetic fields.

4.330 Magnetic Head. In magnetic recording, a magnetic head is a transducer for converting electric variations into magnetic variations for storage on magnetic media, for reconverting energy so stored into electric energy, or for erasing such stored energy.

4.335 Magnetic Head, Double Pole-piece. A double pole-piece magnetic head is a magnetic head having two separate pole pieces in which pole faces of opposite polarity contact the medium on opposite sides. Either both or only one of these pole pieces may be provided with an energizing winding.

4.340 Magnetic Head, Single Pole-piece. A single pole-piece magnetic head is a magnetic head having a single pole piece which contacts the recording medium on oue side.

4.345 Magnetic Plated Wire. Magnetic plated wire is a magnetic wire having a core of nonmagnetic material and a plated surface of ferromagnetic material.

4.350 Magnetic Powder-coated Tape (Coated Tape). Magnetic powder-coated tape is a tape consisting of a coating of uniformly dispersed, powdered ferromagnetic material on a nonmagnetic hase.

4.355 Magnetic Powder-impregnated Tape (Impregnated Tape) (Dispersed Magnetic Powder Tape). Magnetic powder-impregnated tape is a magnetic tape which consists of magnetic particles uniformly dispersed in a nonmagnetic material.

4.360 Magnetic Printing (Crosstalk °). Magnetic printing is the permanent transfer of a recorded signal from a section of a magnetic recording medium to another section of the same or a different medium when these sections are brought in proximity.

4.365 Magnetic Recorder. A magnetic recorder is equipment incorporating an electromagnetic transducer and means for moving a ferromagnetic recording medium relative to the transducer for recording electric signals as magnetic variations in the medium.

NOTE: The generic term "magnetic recorder" can also be applied to an instrument which has not only facilities for recording electric signals as magnetic variations, but also for converting such magnetic variations back into electric variations.

4.370 Magnetic Recording Head. In magnetic recording, a magnetic recording head is a magnetic head for transforming electric variations into magnetic variations for storage on magnetic media.

4.375 Magnetic Recording Medium. A magnetic recording medium is a magnetizable material used in a magnetic recorder for retaining the magnetic variations imparted during the recording process. It may have the form of a wire, tape, cylinder, disk, etc.

4.380 Magnetic Recording Reproducer. A magnetic recording reproducer is equipment for converting magnetic variations on magnetic recording media into electric variations.

° Deprecated.

4.385 Magnetic Reproducing Head. In magnetic recording, a magnetic reproducing head is a magnetic head for converting magnetic variations on magnetic media into electric variations.

4.390 Magnetic Tape. Magnetic tape is a magnetic recording medium having a width greater than approximately 10 times the thickness. This tape may be homogeneous or coated.

4.395 Magnetic Wire. Magnetic wire is a magnetic recording medium, approximately circular in cross section.

4.400 Magnetization, Longitudinal. Longitudinal magnetization in magnetic recording is magnetization of the recording medium in a direction essentially parallel to the line of travel.

4.405 Magnetization, Perpendicular. Perpendicular magnetization in magnetic recording is magnetization of the recording medium in a direction perpendicular to the line of travel, and parallel to the smallest cross-sectional dimension of the medium.

NOTE: In this type of magnetization, either single pole-piece or double pole-piece magnetic heads may be used.

4.410 Magnetization, Transverse. Transverse magnetization in magnetic recording is magnetization of the recording medium in a direction perpendicular to the line of travel and parallel to the greatest cross-sectional dimension.

4.415 Master. A master is a metal part, normally derived from a disk recording by electroforming, which is a negative of the recording, i.e., a master which has ridges instead of grooves and thus cannot be played with a pointed stylus.

Master, Lacquer—see Lacquer Original.
Master, Metal—see Master, Original.

4.420 Master No. 2, No. 3, Etc. A No. 2, No. 3 master, etc. is a master produced by electroforming from a No. 1, No. 2, etc. mold.

4.425 Master, Original (Metal Master) (Metal Negative) (No. 1 Master). An original master, in disk recording, is the master produced by electroforming from the face of a wax or lacquer recording.

4.430 Mechanical Recorder. A mechanical recorder is an equipment for transforming electric or acoustical signals into mechanical motion of approximately like form and inscribing such motion in an appropriate medium by cutting or embossing.

Mechanical Recording Head—see Cutter.
Mechanical Reproducer—see Pickup.
Metal Master; Metal Negative—see Master, Original.
Metal Positive—see Mold, No. 1.

4.432 Micro-groove. Micro-groove refers to a transcription or record having substantially longer playing time by reason of more lines per inch.

4.433 Mini-groove. Mini-groove is a recording having more lines per inch than the average 78 RPM phonograph record and yet not enough lines per inch to be called "Extended play," "Long playing" or "Micro-groove."

4.435 Mixer. A mixer, in a sound recording or reproducing system, is a device having two or more inputs, usually adjustable, and a common output, which operates to combine linearly the separate input signals to produce an output signal.

NOTE: The term is also sometimes applied to the operator of the above device.

4.440 Modulation Noise. (Noise behind the Signal.) The modulation noise is the noise caused by the signal. The signal is not to be included as part of the noise.

NOTE: The term is used where the noise level is a function of the strength of the signal.

4.445 Mold. In disk recording, a mold is a metal part derived from a master by electroforming which is a positive of the recording, i.e., it has grooves similar to a recording and thus can be played in a manner similar to a record.

4.450 Mold, No. 1 (Mother) (Metal Positive). A No. 1 mold is a mold derived by electroforming from the original master.

4.455 Mold, No. 2, No. 3, Etc. A No. 2, No. 3, etc. mold is a mold derived by electroforming from a No. 2, No. 3, etc. master.

Mother—see Mold, No. 1.

4.460 Multitrack Magnetic Recording System. A multitrack magnetic recording system is a recording system which provides; on a medium such as magnetic tape, two or more recording paths which are parallel to each other, and which may carry either related or unrelated program material in common time relationship.

Needle Drag—see Stylus Drag.
Needle Force—see Stylus Force.
Noise behind the Signal—see Modulation Noise.

4.465 Noise Reduction. Noise reduction is a process whereby the average transmission of the sound track of the print (averaged across the track) is decreased for signals of low level and increased for signals of high level.

NOTE: Since the background noise introduced by the sound track is less at low transmission, this process reduces film noise during soft passages. The effect is normally accomplished automatically.

4.470 Offset Angle. In lateral disk recording reproduction, the offset angle is the smaller of the two angles between the projections into the plane of the disk of the vibration axis of the pickup stylus and the line connecting the vertical pivot (assuming a horizontal disk) of the pickup arm with the stylus point.

4.475 Opacity. Opacity of an optical path is the reciprocal of transmission. (See Transmission.)

Optical Density—see Transmission Density.

4.480 Optical Pattern (Christmas Tree Pattern). In mechanical recording, an optical pattern is a pattern which is observed when the surface of a record is illuminated by a light beam.

4.485 Optical Sound Recorder (Photographic Sound Recorder). An optical sound recorder is equipment incorporating a light modulator and means for moving a light-sensitive medium relative to the modulator for recording electric signals derived from sound signals.

4.490 Optical Sound Reproducer. An optical sound reproducer is a combination of light source, optical system, photoelectrical cell, and a mechanism for moving a photoelectric medium (usually film), by means of which recorded variations on a sound track may be converted into electric signals of approximately like form.

4.495 Overcutting. In disk recording, overcutting is the effect of excessive level characterized by one groove cutting through into an adjacent one.

4.500 Photographic Emulsion. Photographic emulsion is the light-sensitive coating on photographic film consisting usually of a gelatine containing silver halide.

4.505 Pickup, Acoustical. An acoustical pickup is a device which transforms groove modulation directly into acoustical radiation.

4.510 Pickup Arm (Tone Arm). A pickup arm is a pivoted arm arranged to hold a pickup.

4.515 Pickup, Capacitor. A capacitor pickup is a reproducer which depends for its operation upon the variation of its electrical capacitance.

4.520 Pickup Cartridge. A pickup cartridge is the removable portion of a pickup containing the electromechanical translating elements and the reproducing stylus.

4.525 Pickup, Crystal. A crystal pickup is a reproducer which depends for its operation on the piezoelectric effect of crystals.

4.530 Pickup, Light-beam. A light-beam pickup is a reproducer in which a light beam is a coupling element of the transducer.

4.535 Pickup, Magnetic (Variable-reluctance Pickup). A magnetic pickup is a reproducer which depends for its operation on the variations in the reluctance of a magnetic circuit.

4.540 Pickup (Mechanical Reproducer). A pickup is a mechanoelectrical transducer which is actuated by modulations present in the groove of the recording medium and which transforms this mechanical input into an electric output.

4.545 Pickup, Moving-coil (Dynamic Reproducer). A moving-coil pickup is a reproducer, the electric output of which results from the motion of a coil in a magnetic field.

4.550 Pick-up, Variable-inductance. A variable-inductance pickup is a reproducer which depends for its operation on the variation of its inductance.

4.555 Pickup, Variable-resistance. A variable-resistance pickup is a reproducer which depends for its operation upon the variation of a resistance.

4.560 Pinch Effect. In disk recording, the pinch effect is a pinching of the reproducing stylus tip twice each cycle in the reproduction of lateral recordings, due to a decrease of the groove angle cut by the recording stylus when it is moving across the record as it swings from a negative to a positive peak.

4.565 Playback. A playback is an expression used to denote reproduction of a recording.

Playback Loss—see Translation Loss.

4.570 Poid. A poid is the curve traced by the center of a sphere when it rolls or slides over a surface having a sinusoidal profile.

4.575 Post-emphasis (De-emphasis) (Post Equalization). Post-emphasis is usually a form of equalization complementary to pre-emphasis.

4.580 Pre-emphasis (Pre-equalization). In recording, pre-emphasis is an arbitrary change in the frequency response of a recording system from its basic response (such as constant velocity or amplitude) for the purpose of improvement in signal-to-noise ratio, or the reduction of distortion.

4.585 Preform (Biscuit *). In disk recording, a preform is a small slab of record stock material as it is prepared for use in the record presses.

4.590 Pressing. In disk recording, a pressing is a record produced in a record-molding press from a master or stamper.

4.595 Recording Channel. The term "recording channel" refers to one of a number of independent recorders in a recording system or to independent recording tracks on a recording medium.

NOTE: One or more channels may be used at the same time for covering different ranges of the transmitted frequency band, for multichannel recording, or for control purposes.

4.600 Recording Loss. Recording loss, mechanical recording, is the loss in recording level whereby the amplitude of the wave in the recorded medium differs from the amplitude executed by the recording stylus.

4.605 Re-recording. Re-recording is the process of making a recording by reproducing a recorded sound source and recording this reproduction. (See Dubbing.)

4.610 Re-recording System. A re-recording system is an association of reproducers, mixers, amplifiers, and recorders capable of being used for combining or modifying various sound recordings to provide a final sound record. Recording of speech, music, and sound effects may be so combined.

4.615 Ring Head. A ring head is a magnetic head in which the magnetic material forms an enclosure with one or more air gaps. The magnetic recording medium bridges one of these gaps and is contacted by the pole pieces on one side only.

4.620 Rumble (Turntable Rumble). Rumble is low-frequency vibration mechanically transmitted to the recording or reproducing turntable and super-imposed on the reproduction.

4.625 Scoring System. A scoring system for motion picture production is a recording system used for recording music to be reproduced in timed relationship with a motion picture.

4.630 Sensitometry. Sensitometry is the measurement of the light response characteristics of photographic film under specified conditions of exposure and development.

* Deprecated.

4.635 Shaving. In mechanical recording, shaving is the process of removing material from the surface of a recording medium for the purpose of obtaining a new recording surface.

4.640 Side Thrust. Side thrust, in disk recording, is the radial component of force on a pickup arm caused by the stylus drag.

4.645 Single Track (Standard Track). A single track is a variable-density or variable-area sound track in which both positive and negative halves of the signal are linearly recorded.

4.650 Sound Recording System. A sound recording system is a combination of transducing devices and associated equipment suitable for storing sound in a form capable of subsequent reproduction.

4.655 Sound Reproducing System. A sound reproducing system is a combination of transducing devices and associated equipment for reproducing recorded sound.

4.660 Sound Track. A sound track is a narrow band, usually along the margin of a sound film, which carries the sound record. In some cases, a plurality of such bands may be used.

4.665 Sound Track, Multiple. A multiple sound track consists of a group of sound tracks, printed adjacently on a common base, independent in character but in a common time relationship, e.g., two or more have been used for stereophonic sound recording.

4.670 Sound Track, Push-Pull, Class-A. A class-A push-pull sound track consists of two single tracks, side by side, the transmission of one being 180 degrees out of phase with the transmission of the other. Both positive and negative halves of the sound wave are linearly recorded on each of the two tracks.

4.675 Sound Track, Push-Pull, Class-B. A class-B push-pull sound track consists of two tracks, side by side, one of which carries the positive half of the signal only, and the other the negative half. During the inoperative half-cycle each track transmits little or no light.

Spiral, Crossover—see Groove, Leadover.
Spiral, Fast—see Groove, Fast.
Spiral, Lead-in—see Groove, Lead-in.
Spiral, Throw-out—see Groove, Thow-out.

4.677 Silvering. Silvering is a process wherein the surface of the original recorded master is metallized by precipitating on to this surface, the metallic silver in ammoniated silver nitrate.

4.678 Silver Spraying. Silver spraying is metallizing the surface of the original recorded master using a dual spray nozzle wherein the ammoniated silver nitrate and reducer are combined in anatomized spray to precipitate the metallic silver.

4.680 Sputtering (Cathode Sputtering). Sputtering is a process sometimes used in the production of the metal master wherein the original is coated with an electric conducting layer by means of an electric discharge in a vacuum.

NOTE: This is done prior to electroplating a heavier deposit.

4.685 Squeeze Track. A squeeze track is a variable-density sound track wherein, by means of adjustable masking, the width is varied by the recording operator, thus providing an overriding control on the amplitude of the reproduced signal.

4.690 Stamper. A stamper is a negative (generally made of metal by electroforming) from which finished pressings are molded.

4.695 Stamper, Backed. A backed stamper is a thin metal stamper which is attached to a backing material, generally a metal disk of desired thickness.

Standard Track—see Single Track.

4.700 Stylus, Cutting. A cutting stylus is a recording stylus with a sharpened tip which, by removing material, cuts a groove into the recording medium.

4.705 Stylus Drag (Needle Drag). Stylus drag is an expression used to denote the force resulting from friction between the surface of the recording medium and the reproducing stylus.

4.710 Stylus, Embossing. An embossing stylus is a recording stylus with a rounded tip which displaces the material in the recording medium to form a groove.

4.715 Stylus Force (Static Stylus Force) (Vertical Stylus Force) (Needle Force) (Stylus Pressure °). The stylus force is the vertical force exerted on a stationary recording medium by the stylus when in its operating position.

4.720 Stylus, Recording. A recording stylus is a tool which inscribes the grooves into the recording medium. There is the unmounted type used by cementing to the mounting; mounted, affixed to a metal shank and held in place by a set screw; morse taper which is held in place by friction. The latter two methods are necessary for "hot stylus" technique.

4.725 Stylus, Reproducing. A reproducing stylus is a mechanical element adapted to following the modulations of a record groove and transmitting the mechanical motion thus derived to the pickup mechanism.

NOTE: Stylus is a term defining a pickup needle or a holder furnished with a jewel or other abrasive-resistant tip. A stylus may or may not be arranged for convenient replacement.

4.730 Surface Noise. In mechanical recording surface noise is the noise component in the electric output of a pickup due to irregularities in the contact surface of groove. (See Ground Noise.)

Throw-out Spiral—see Groove, Lead-out.

4.735 Toe and Shoulder (of an H and D Curve). Toe and shoulder are the terms applied to the nonlinear portions of the H and D curve which lie respectively below and above the straight portion of this curve.

Tone Arm—see Pickup Arm.

4.740 Tracing Distortion. Tracing distortion is the nonlinear distortion introduced in the reproduction of mechanical recording because the curve traced by the motion of the reproducing stylus is not an exact replica of the modulated groove. For example, in the case of a sine-wave modulation in vertical recording the curve traced by the center of the tip of a stylus is a poid.

4.745 Tracking Error. Tracking error, in lateral mechanical recording, is the angle between the vibration axis of the mechanical system of the pickup and a plane containing the tangent to the unmodulated record groove and being perpendicular to the surface of the recording medium at the point of needle contact.

4.750 Transition Frequency (Crossover Frequency) (Turnover Frequency). The transition frequency, of a disk recording system, is the frequency corresponding to the point of intersection of the asymptotes to the constant amplitude and the constant velocity portions of its frequency response curve. This curve is plotted with output voltage ratio in decibels as the ordinate and the logarithm of the frequency as the abscissa.

4.755 Translation Loss (Playback Loss). Translation loss is the loss in the reproduction of a mechanical recording whereby the amplitude of motion of the reproducing stylus differs from the recorded amplitude in the medium.

4.760 Transmission. Transmission, as applied to optical recording, is the ratio of the light flux transmitted by a medium to the light flux incident upon it. Transmission may be either diffuse or specular.

4.765 Transmission Density, Diffuse.° Diffuse transmission density is the value of the photographic transmission density obtained when the light flux impinges normally on the sample and all the transmitted flux is collected and measured.

4.770 Transmission Density, Photographic † (Optical Density). Photographic transmission density is the common logarithm of opacity. Hence, film transmitting

° Deprecated.

† For details of measurement and specifications see American Standard Diffuse Transmission Density, Z38.2.5–1946, or the latest edition thereof approved by the American Standards Association.

100 percent of the light has a density of zero; transmitting 10 percent a density of 1, etc. Density may be diffused, specular, or intermediate. Conditions must be specified.

4.775 Transmission Density, Specular. Specular transmission density is the value of the photographic density obtained when the light flux impinges normally on the sample and only the normal component of the transmitted flux is collected and measured.

Turnover Frequency—see Transition Frequency.

4.780 Unilateral-area Track. A unilateral-area track is a sound track in which one edge only of the opaque area is modulated in accordance with the recorded signal. There may, however, be a second edge modulated by a noise reduction device.

4.782 Vacuum Chuck. A vacuum chuck is a chuck constructed with vacuum seals in such a manner that stampers may be held by vacuum for the purpose of machining.

4.785 Variable-area Track. A variable-area track is a sound track divided laterally into opaque and transparent areas, a sharp line of demarcation between these areas forming an oscillographic trace of the wave shape of the recorded signal.

4.790 Variable-density Track. A variable-density track is a sound track of constant width and of uniform light transmission on any instantaneous transverse axis and of which the average light transmission varies along the longitudinal axis in proportion to some characteristic of the applied signal.

4.795 Vertical Recording (Hill and Dale Recording). A vertical recording is a mechanical recording in which the groove modulation is in a direction perpendicular to the surface of the recording medium.

4.800 Wax. In mechanical recording, wax refers to a blend of waxes with metallic soaps. (See also Wax, Cake.)

4.805 Wax, Cake. Cake wax is a thick disk of wax upon which an original mechanical disk recording may be inscribed.

4.810 Wax, Flowed. Flowed wax is a mechanical recording medium, in disk form, prepared by melting and flowing wax onto a metal base.

4.815 Wax Original (Wax Master [*]). A wax original is an original recording on a wax surface for the purpose of making a master.

Wow—see Flutter.

C.C.I.R. STANDARDS OF SOUND RECORDING FOR THE INTERNATIONAL EXCHANGE OF PROGRAMS

Foreword

The International Radio Consultative Committee is a technical body functioning under the auspices of the United Nations. Its broad responsibilities are to make technical recommendations to the International Telecommunications Union (ITU) to facilitate and modernize the art of radio communication throughout the world. The C.C.I.R. has a permanent staff in Geneva, Switzerland, with a Director and a Vice-Director.

The work of the C.C.I.R. is divided among 14 Study Groups. One of these Groups is Study Group X, Broadcasting. Its terms of reference were defined at the VIIIth Plenary Assembly in Warsaw, Poland, 1956, and further amended at the IXth Plenary in Los Angeles, 1959, to include the study of the technical aspects of transmission and reception in the sound broadcasting service (except for tropical broadcasting), including standards of sound recording and sound reproduction to facilitate the international exchange of programmes, as well as standards for video tape.

The following Standards and Recommendations of the C.C.I.R. are included in

[*] Deprecated.

Volume I of the Documents of the VIIIth Plenary Assembly of the C.C.I.R., held in Warsaw, Poland, 1956, and will be included in the IXth Plenary documents when published. This volume may be purchased in its entirety from the International Telecommunications Union, Geneva, Switzerland. The entire volume contains Recommendations, Reports, Resolutions, Questions, and Study Programmes of all the 14 Study Groups of C.C.I.R.

Recommendation No. 207 *

Standards of Sound Recording for the International Exchange of Programmes

(Questions Nos. 42 and 63)
(Geneva, 1951–London, 1953–Warsaw, 1956)

The C.C.I.R. recommends that the international exchange of recorded sound programmes between broadcasting organisations should be by means of lateral-cut recording on disc and single-track magnetic recording on tape, conforming to the technical standards given in

Recommendation No. 208 for disc,
Recommendation No. 209 for tape.

Recommendation No. 208 †

Standards of Sound Recording for the International Exchange of Programmes

Lateral-cut Recording on Discs

(Questions Nos. 42 and 63–Recommendation No. 207)
(London, 1953–Warsaw, 1956)

The C.C.I.R. recommends that lateral-cut recording on disc should be in accordance with the following technical standards:

1. *Type of groove:*
   (*a*) Coarse groove
   –Minimum top width: 0.004″ (0.1 mm),
   –Maximum bottom radius: 0.0015″ (0.038 mm),
   –Included angle: 80° to 90°;
   (*b*) Fine groove
   –Minimum top width: 0.002″ (0.05 mm),
   –Maximum bottom radius: 0.0003″ (0.0076 mm),
   –Included angle: 80° to 90°.
2. *Speed of rotation:*
   33⅓ r.p.m. ± 0.5%,
   78 r.p.m. ± 0.7%.
3. *Direction of rotation:*
   Clockwise.
4. *Direction of cut:*
   Outside to inside.
5. *Type of disc:*
   Lacquer coated or processed.
6. *Maximum diameter of disc:*
   –for 33⅓ r.p.m. 16$\frac{1}{16}$″ (408 mm),
   –for 78 r.p.m. 12$\frac{1}{32}$″ (306 mm).
7. *Centre hole diameter:*

$$0.285'' \begin{cases} +0.002'' \\ -0'' \end{cases} \left(7.24 \text{ mm} \begin{cases} +0.05 \text{ mm} \\ -0 \text{ mm} \end{cases} \right)$$

* This Recommendation replaces Recommendation No. 133.
† This Recommendation replaces Recommendation No. 134.

8. *Minimum diameter of recorded surface:*
   —For 33⅓ r.p.m. coarse groove: 7½″ (190 mm),
   fine groove: 4¾″ (120 mm),
   —For 78 r.p.m. 3¾″ (95 mm).
9. *Number of plain grooves:*
   At start: minimum 2, maximum 4,
   At finish: minimum 2, maximum 4.
10. *Minimum information to be stated on label:*
   —Broadcasting organisation,
   —Programme title,
   —Side number,
   —Total number of sides,
   —Reference number,
   —Total playing time of programme,
   —Speed of rotation in r.p.m.
   —Type of groove.
   (The last two items should be marked as prominently as possible.)
11. *Recording characteristic* (fine and coarse groove discs):
   (*a*) Nominal characteristic
   With constant voltage applied to that point in the recording chain where the normal signal has the frequency characteristic that it is desired subsequently to reproduce, the curve of recorded velocity ° versus frequency shall be that which results from the combination of three curves as follows:
   —One rising with frequency in conformity with the admittance of a parallel combination of a capacitance and a resistance having a time constant of t_1;
   —One rising with frequency in conformity with the admittance of a series combination of a capacitance and a resistance having a time constant of t_2;
   —One falling with rise of frequency in conformity with the impedance of a series combination of a capacitance and a resistance having a time constant of t_3.
   The combined curve is defined by:

$$N\ (\text{db}) = 10 \log (1 + 4\pi^2 f^2 t_1^2) - 10 \log \left(1 + \frac{1}{4\pi^2 f^2 t_2^2}\right) + 10 \log \left(1 + \frac{1}{4\pi^2 f^2 t_3^2}\right)$$

where f = frequency in c/s
$t_1 = 50 \times 10^{-6}$ seconds
$t_2 = 318 \times 10^{-6}$ seconds
$t_3 = 3180 \times 10^{-6}$ seconds

This curve is shown in the figure.

NOTE: This paragraph defines the relative velocities to be recorded on a disc; but to ensure that the proper response is obtained on reproduction it is necessary to use a pickup with a suitable stylus and with working pressures low enough to avoid any appreciable deformation of the disc material.

   (*b*) Tolerance
   Discs for international interchange of programmes should be recorded within ±2 db of the nominal characteristic, taking as reference point the value at 1000 c/s.
   Any variation, for example that which results from the application of radius compensation, should be within the stated tolerance.

NOTE ON USE OF RECORDING CHARACTERISTIC: Within the U.S.A. a different characteristic will be used for the interchange of programmes between broadcasting organisations

° "Recorded velocity" is here defined as that determined by the Buchmann-Meyer light-band method.

but the C.C.I.R. characteristic will be used by the broadcasting companies of the U.S.A. for international exchange.

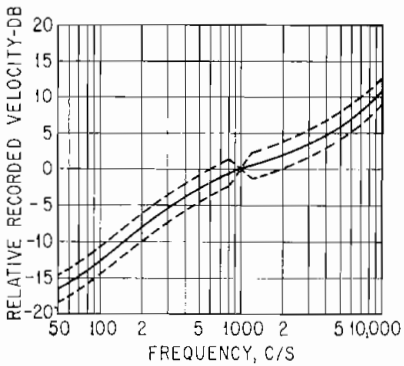


FIGURE 1. I.E.C. nominal recording characteristic for lateral-cut discs of fine groove and the tolerance within which discs should be recorded.

Recommendation No. 209 *

Standards of Sound Recording for the International Exchange of Programmes

Single Track Recording on Magnetic Tape

(Questions Nos. 42 and 63–Recommendation No. 133)
(London, 1953–Warsaw, 1956)

The C.C.I.R. unanimously recommends that single track recording on magnetic tape should be in accordance with the following technical standards:

1. *Speed of tape*

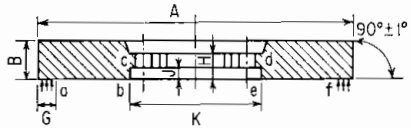
Primary speed:	15 inches/s ± 0.5%	(38.1	cm/s ± 0.5%),
Secondary speeds: †	30 inches/s ± 0.5%	(76.2	cm/s ± 0.5%),
	7½ inches/s ± 0.5%	(19.05	cm/s ± 0.5%).

2. *Width of tape*

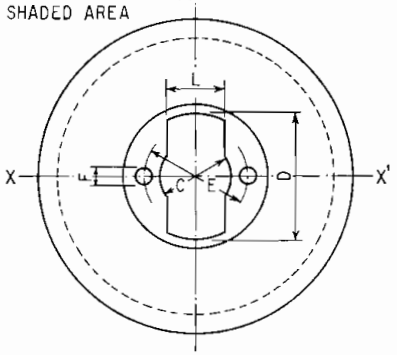
$$0.250 \text{ inches} \begin{cases} +0 \\ -0.006 \text{ inches} \end{cases} \left(6.35 \text{ mm} \begin{cases} +0 \\ -0.15 \text{ mm} \end{cases} \right)$$

3. *Strength of tape*
   The tape should be suitable for use on a machine exerting a maximum (transient) stress of 2.2 pounds (1 kg).
4. *Direction of winding*
   The tape should be wound in such a way that it may be unwound in an anti-clockwise direction during playing.
5. *Tape spools*
   Two types of hub are accepted for international programme exchange:
   Figure 1 gives the principal dimensions of the type more generally used in Europe;
   Figure 2 gives the dimensions of the hub more generally used in the United States and of the accompanying flange;
   Figure 3 gives the main dimensions of a typical machine fitting to receive the hub of Figure 1.
   Figure 4 gives the main dimensions of an adapter to enable the machine fitting of Figure 3 to receive the hub of Figure 2.

* This Recommendation replaces Recommendation No. 135.
† The secondary speeds should only be used by prior agreement.



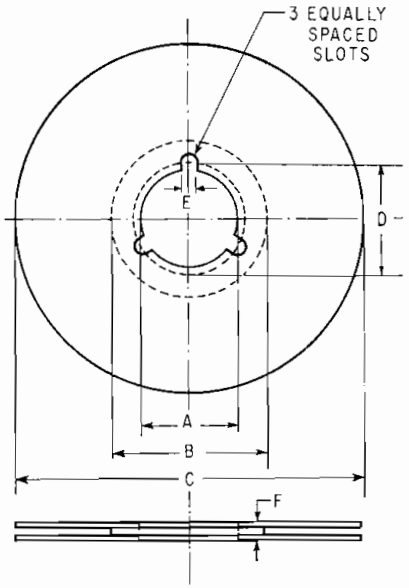
NOTE: THE CROSS-SECTION OF THE INNER SURFACE abcdef MUST FALL WITHIN THE SHADED AREA



THE HUB MAY CARRY A LABEL AND A FIXING DEVICE FOR THE TAPE, WHICH ARE NOT SHOWN

DIMENSIONS	MILLIMETERS	INCHES
A	58 a 100	2.28 to 3.95
B	11 $^{+0}_{-0.2}$	0.433 $^{+0}_{-0.008}$
C	20.1 $^{+0.1}_{-0}$	0.791 $^{+0.004}_{-0}$
D	35 $^{+0.2}_{-0}$	1.378 $^{+0.008}_{-0}$
E	28 $^{+0.2}_{-0}$	1.102 $^{+0.008}_{-0}$
F	5 $^{+0.2}_{-0}$	0.197 $^{+0.008}_{-0}$
G	4	0.157
H	7 $^{+0}_{-0}$	0.275 $^{+0}_{-0.04}$
J	3.5 MIN	0.138 MIN
K	36 MIN	1.417 MIN
L	16 $^{+0.2}_{-0}$	0.63 $^{+0.008}_{-0}$

FIGURE 1. European standards—spool hub for magnetic tape recording.



DIMENSION	INCHES		MILLIMETRES	
	MIN	MAX	MIN	MAX
A	3.000	3.004	76.20	76.30
B	4.490	4.510	114.05	114.55
C	10.50	10.52	267.0	267.5
D	3.248	3.252	82.45	82.55
E	0.219	0.225	5.60	5.75
F	0.447	0.457	11.35	11.60

FIGURE 2. U.S.A. type of spool for magnetic tape recording.

Whenever the exchange of recorded programmes has to be effected with cine-type flanged spools, the spools must conform to the standards established by the International Electrotechnical Commission.

6. *Maximum outside diameter of the reel of tape*
   For hub of Fig. 1: 11.4 inches (290 mm),
   For hub of Fig. 2: 10.5 inches (267 mm).
7. *Tape leader*
   A non-magnetic identification strip at least one meter long should be placed at the beginning of the tape giving at least the number of the spool and the reference number (see § 8 below). This information should be given on the side of the leader continuous with the unrecorded side of the tape.

NOTE: It is recommended that whenever possible the unrecorded side of the tape should be identified by some form of marking continuous throughout the length of the tape.

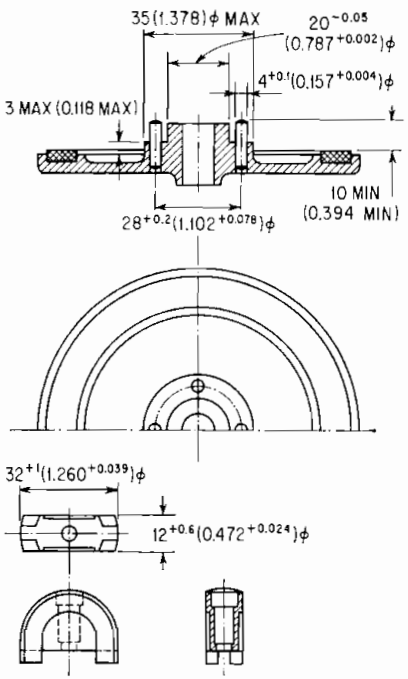


FIGURE 3. European standards—machine fitting to receive spool hub. NOTE: Unless otherwise indicated, all dimensions are in millimetres, with corresponding figures in inches in parenthesis.

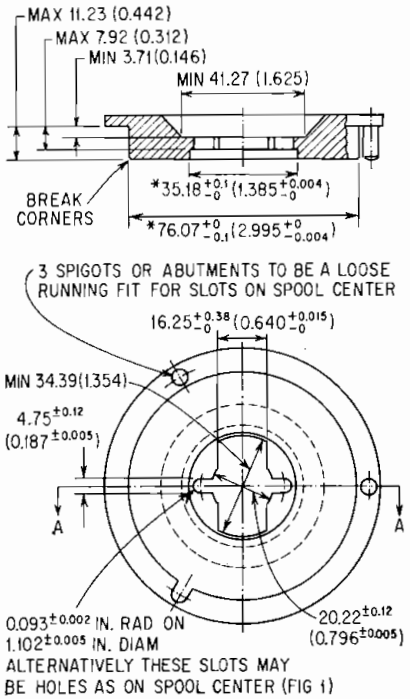


FIGURE 4. Typical adaptor to enable the European type of machine fitting to receive hub of Fig. 2. NOTE: Diameters marked thus * to be concentric within 0.003". Unless otherwise indicated, all dimensions are in millimetres, with corresponding figures in inches in parenthesis.

8. *Programme identification*

A label giving the following information should accompany each reel:
- —Broadcasting organisation,
- —Programme title,
- —Reel number,
- —Total number of reels,
- —Reference number,
- —Total playing time of programme,
- —Speed of tape (marked as prominently as possible).

9. *Reproducing characteristics*

A Standard Replay Chain is specified and recordings for programme interchange should give a response within the tolerances stated below when reproduced on this Standard Replay Chain:

(*a*) Nominal characteristic

The Standard Replay Chain is defined as one having the same response as that of an "ideal" reproducing head, the open-circuit voltage of which is amplified in an amplifier with a response curve as specified below:

For tape speeds of 15 in/s (38.1 cm/s) and 30 in/s (76.2 cm/s), the specified frequency response curve falls with increasing frequency in conformity

with the impedance of a series combination of a capacitance and a resistance having a time constant of 35 μs. This curve is shown in Figure 5;
For a tape speed of 7½ in/s (19.05 cm/s) the specified frequency response curve falls with increasing frequency in conformity with the impedance of a series combination of a capacitance and a resistance having a time constant of 100 μs. This curve is shown in Figure 6.

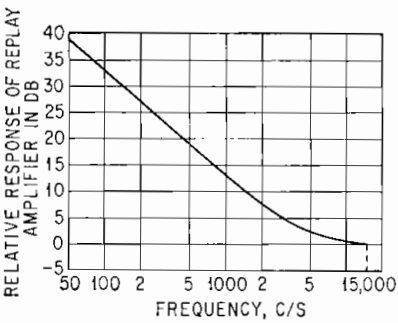


FIGURE 5. Nominal reproducing characteristic for magnetic tape at 15 in/s and 30 in/s.

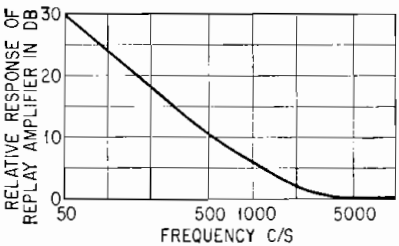


FIGURE 6. Nominal reproducing characteristic for magnetic tape at 7½ in/s.

(*b*) Tolerances

Tapes for international programme interchange should be recorded so that, when reproduced on a Standard Replay Chain the response falls between upper and lower limits defined as follows for tape speeds of 15 in/s (38.1 cm/s) and 30 in/s (76.2 cm/s):

Upper limit
—From 50 c/s to 100 c/s falling regularly by 1 db,
—From 100 c/s to 5 000 c/s flat,
—From 5 000 c/s to 10 000 c/s rising regularly by 1 db,
—From 10 000 c/s to 15 000 c/s flat;

Lower limit
—From 50 c/s to 100 c/s rising regularly by 3 db,
—From 100 c/s to 7 500 c/s flat,
—From 7 500 c/s to 15 000 c/s falling regularly by 3 db.

From 100 to 5 000 c/s the flat portions of the upper and lower limits are 2 db apart. These limits are shown in Figure 7;
For a tape speed of 7½ in/s (19.05 cm/s), the response should fall within limits defined as follows:

Upper limit
—From 50 c/s to 10 000 c/s flat;

Lower limit
—From 50 c/s to 100 c/s rising regularly by 3 db,
—From 100 c/s to 5 000 c/s flat,
—From 5 000 c/s to 10 000 c/s falling regularly by 3 db;

From 100 to 5 000 c/s the flat portions of the upper and lower limits are 2 db apart. These limits are shown in Figure 8.

NOTES:

1. An "ideal" reproducing head is defined as a ferromagnetic reproducing head, the losses of which are negligible. Normally this means that the gap is short, that the arc of contact with the tape is long compared with the relevant wavelengths on the tape and that the losses in the material of the head are small. With the reproducing heads used in practice, compensation for the head losses must be added to the replay amplifier. With good replay heads a mean value of this equalisation may be used for the two higher speeds and even for the three speeds.

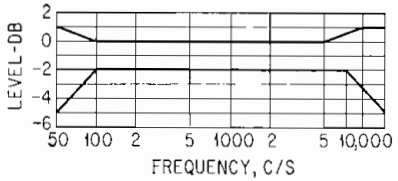


FIGURE 7. Recording tolerance for the speed of 15 and 30 in/s. Limits within which the response should lie when reproduction is carried out on the Standard Replay Chain.

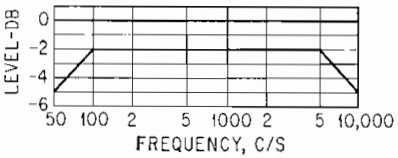


FIGURE 8. Recording tolerance for the speed of 7½ in/s. Limits which the response should lie when reproduction is carried out on the Standard Replay Chain.

2. The open circuit voltage developed in a ferromagnetic reproducing head depends on the surface induction * on the tape while it is in contact with the head. It has been found that, provided a coated high-coercivity tape is used, the surface induction in free space will be altered, when the tape is placed in contact with the head, by an approximately constant factor over the whole range of wavelengths. Under these circumstances the relative surface inductions at different frequencies can be measured by at least three methods that are described in the Annex. From such measurements the departure of the response of a reproducing head from the "ideal" can be defined, and consequently a Standard Replay Chain can be established as a primary standard. Test tapes can then be made which can serve as secondary standards for use in normal operation.

NOTE ON USE OF REPRODUCING CHARACTERISTICS: A different Standard Replay Chain has been adopted in the U.S.A. for 15 in/s (38.1 cm/s). The difference between the nominal characteristics of the Standard Replay Chain of the U.S.A. and that of the C.C.I.R. is less than the tolerance in § 9. Furthermore a different characteristic is used in France for 30 in/s (76.2 cm/s).

Annex

Methods of Measuring the Magnetisation of a Tape

There are two general ways in which the surface induction/frequency characteristic of a tape may be determined:

1. By means which do not affect the surface induction. This implies the use of a non-magnetic reproducing device. For example, reproduction by means of a simple non-magnetic conductor placed in the field at the surface of the moving tape is practicable as a laboratory method and may therefore be used to establish a primary standard. This can be used to determine the relative change of surface induction with wavelength created by the presence of a magnetic head;
2. By means of a magnetic reproducing device, which necessarily affects the surface induction of the tape in a manner dependent on recorded wavelength. In this category there are two ways in which conventional magnetic heads have been used, one method involving heads with a short gap, the other involving heads with a long gap. In both cases the gap in the reproducing head must be sufficiently accurate, magnetically, to give well-defined minima of reproduced level, one in the short gap method or several in the long gap method. In order to ensure that the same results will be obtained with both magnetic and non-magnetic reproducing devices, a coated high-coercivity tape must be used.

Steps must be taken to ensure that the arc of the tape in contact with the head is long enough in relation to the longest wavelengths recorded. If this is not so, it may be found that output level at the lower frequencies is slightly higher than that given by an ideal head and that the deviation increases as the frequency decreases while remaining as a general rule within the tolerances defined above. The

* In this Recommendation and in the Annex the term surface induction means the normal surface induction, that is to say, the flux density at right angles to the surface of the tape.

error may be reduced by using bigger reproducing heads for the very low frequencies.*

(a) **The "Short Gap" Method.** The longest wavelength at which a minimum of reproduced level occurs is called the effective gap length: d. The necessary correction for the gap length is calculated on the assumption that output is proportional to

$$\frac{\sin \frac{\pi d}{\lambda}}{\frac{\pi d}{\lambda}}$$

This correction must not exceed 5 db at the shortest wavelength considered. Any necessary correction for eddy current losses must also be determined, for example, by comparing outputs at various tape speeds or by the use of an inducing loop. Once these corrections are known and applied, the head may be used as an "ideal" head to measure relative surface inductions on the tape over the wavelength range considered.

(b) **The "Long Gap" Method.** In this method a head is used with a gap some 50 times longer than that of the normal reproducing head. In practice an erase head can usually be adapted for the purpose. The response of such a head should show a series of well defined maxima and minima as shown in Figure 9.

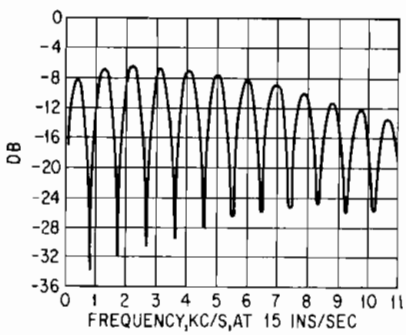


FIGURE 9. Typical response curve of a "long gap" reproducing head.

A curve through the successive maxima is a measure of the relative surface induction on the tape, when the necessary correction for the eddy current losses of the head has been made. This curve falls approximately 4 db/octave compared with the curve of surface induction/frequency in air as determined by a non-magnetic reproducing device, or by a "short gap" head. This correction must therefore be applied.

The precise steps by which the procedures of 2(a) and (b) may be applied in practice are outlined in the following.

Standardisation by the Short Gap Magnetic Head

Using the short gap method a recording equipment is set to the standard condition in the following way:

1. A "gliding tone" is recorded on a tape and reproduced by means of the head to be used for the measurements. The longest wavelength at which the output disappears is noted. This wavelength will be equal to the effective gap length, from which the gap correction may be deduced. If this correction exceeds 5 db the head is unsuitable for this measurement.

Since the measurement must take place at a very short recorded wavelength, a high-coercivity tape should be used, and a certain amount of pre-emphasis will be found useful. In order to avoid making the measurements at an unnecessarily high frequency the lowest tape speed available should be used.

* See Report No. 79.

2. The tape with the gliding tone is reproduced at two different speeds and the output curves are compared. If the curves can be brought to coincidence by displacing one frequency scale so that equal wavelengths coincide, it may be assumed that frequency-dependent losses are negligible. If not, these losses may be deduced from the two curves mentioned or, alternatively, from a measurement with an inducing loop.

3. The frequency response of the reproducing chain is now adjusted to be that specified in § 9(*a*) of this Recommendation together with the gap correction noted in 1. above and the compensation for frequency dependent losses noted in 2. above.

4. The recording equalisation is then adjusted so that a flat overall response is obtained.

Standardisation by the Long Gap Magnetic Head

Using the long gap method a recording equipment is set to the standard condition in the following way:

1. The reproducing head used has a well-defined gap long enough to give successive maxima of response at intervals of 1 kc/s, or less, in the audio-frequency range (with a tape speed of 30 in/sec (76.2 cms/sec) the gap length required would be about 800 microns). If the successive minima in the response curve are not equally well defined the head is not suitable for this measurement. A short preliminary experiment is carried out to determine the exact frequencies at which successive maxima occur at the relevant tape speed.

2. A "gliding tone" test tape of the audio frequencies of maximum level is then recorded with constant voltage input to the recording chain and the tape is reproduced using the long gap head. The open circuit voltage of the head around these frequencies is then plotted against frequency, and a smooth curve is drawn through the successive maxima.

3. The tape with the gliding tone is reproduced at two different speeds using the long gap head and the output curves are compared. If the curves can be brought to coincidence by displacing one frequency scale so that equal wavelengths coincide it may be assumed that frequency-dependent losses are negligible. If not, these losses may be deduced from the two curves mentioned or, alternatively, from a measurement with an inducing loop.

4. When the curve drawn in § 2 has been corrected by a 6 db/octave rise with increasing frequency together with the correction for frequency-dependent losses and a correction of 2 db/octave falling with increase of frequency, the result defines the relative surface inductions on the tape.

5. The equalisation of the recording amplifier is now altered to obtain a characteristic of surface induction/frequency that is the inverse of the equalisation specified for the reproducing chain (without allowance for the replay head losses).

6. The reproducing amplifier equalisation is then adjusted so that a flat overall response is obtained when using a normal reproducing head.

Recommendation No. 210

Measurement of Wow and Flutter in Equipment for Sound Recording and Reproduction

(Study Programme No. 74 (X))
(Warsaw, 1956)

The C.C.I.R. unanimously recommends:

1. That the tone to be recorded for the measurement of wow and flutter measurement should preferably be 3000 c/s;

2. That the equipment used should measure wow and flutter within a minimum frequency range of 0–200 c/s.

Recommendation No. 211

Sound Recording on Film for the International Exchange of Television Programmes

(Question No. 100)
(Warsaw, 1956)

The C.C.I.R. unanimously recommends that in the exchange of television programmes on film the recording of the sound should be carried out:

1. By conventional optical means on 35 mm perforated film with dimensions according to the ASA specifications:

PH 22.36 PH 22.58
PH 22.59 PH 22.40

2. By conventional optical means on 16 mm perforated film with dimensions according to the ASA specifications:

PH 22.12 Z 22.8
Z 22.7 Z 22.41

3. By conventional magnetic means on 16 mm perforated film with a single perforation and with the magnetic sound stripe towards the edge of the film remote from the perforations, and conforming to the following standards:

3.1 The dimension and position of the magnetic stripe should be as given in Figure 1;

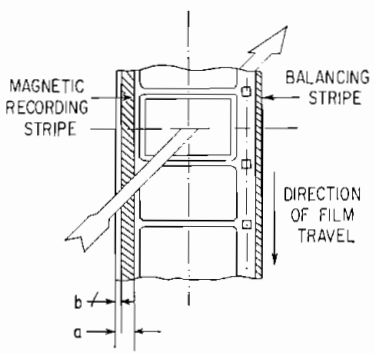


FIGURE 1. Sound recording on film Type 16 COMMAG.

SIZE OF MAGNETIC RECORDING STRIPE

(a) $2.5\ ^{+0.1}_{-0}$ MM ($0.1\ ^{+0.004}_{-0}$ IN.)
(b) $0.125\ ^{+0}_{-0.125}$ MM ($0.005\ ^{+0}_{-0.005}$ IN.)

3.2 Safety film should be used ;
3.3 The film should normally be photographic positive;
3.4 The film should be on reels as specified in ASA standard PH 22.11;*
3.5 Splicing of the film should be carried out according to the ASA standard PH 22.24;
3.6 The picture frequency should be either 25 frames or 24 frames (perforations) per second and should always be indicated;
3.7 The sound record should be in advance of the picture by 28 ± 0.5 frames;

NOTE: The figure of 26 ± 0.5 frames has been previously proposed by certain organisations. This figure is the same as that used in optical sound recording. At a meeting in Stockholm of an I.S.O. commission, the delegates agreed on a spacing of 28 ± 0.5 frames

* A different hub is used in France.

between picture and magnetic sound record. To facilitate the construction of machines with reproducing heads for both types of sound, the spacing between the picture and the magnetic and the optical sound recording should be different for the two systems. A difference of the order of 2 frames is considered desirable.

3.8 The magnetic stripe should be on the side of the film that faces the light source of a projector arranged for direct projection on a reflecting type screen;
3.9 The maximum additional thickness due to the magnetic stripe should be 0.0008 inch (20 microns);
3.10 If a balancing magnetic stripe is used outside the sprocket holes it should have the same composition and thickness as the main magnetic strip;
3.11 The recording characteristic should be that defined in Recommendation No. 209, § 9 for a tape speed of 7½ inches (19.05 cm) per second;
4. In certain cases by conventional magnetic means on 16 mm perforated film separate from the picture film, carrying magnetic sound stripes only and running at the same mean speed as the picture film.
Until standards for the second film can be agreed, reference should be made to Report No. 81.

STANDARDS OF THE AMERICAN STANDARDS ASSOCIATION

Because of the large number of standards available from the ASA, it is suggested that those who are interested request a list directly from the American Standards Association, Inc., 70 East 45th Street, New York 17, N.Y. ASA standards are divided into the following principal categories:

Automotive	D
Chemical	K
Civil Engineering and Construction	A
Commercial	DS
Drawings, Symbols, and Abbreviations	Y
Electrical Engineering	C
Ferrous Materials and Metallurgy	G
Mechanical Engineering	B
Mining	M
Miscellaneous	Z
Nonferrous Materials	H
Nuclear	N
Office Equipment and Supplies	X
Photography and Motion Pictures	PH
Pulp and Paper	P
Rubber	J
Textile	L
Wood	O

INSTITUTE OF RADIO ENGINEERS CURRENT STANDARDIZATION REPORTS

The following standards pertain and are of interest to the broadcast industry. For additional standards and information please contact IRE, 1 East 79th Street, New York 21, N.Y.:

48 IRE 2., 11., 15.S1	Standards on Antennas, Modulation Systems, and Transmitters: Definitions of Terms, 1948.
53 IRE 2.S1	Standards on Antennas and Waveguides: Definitions of Terms, 1953. Adopted by ASA (ASA C16.21-1954).
55 IRE 2.S1	Standards on Antennas and Waveguides: Definitions for Waveguide Components, 1955.
48 IRE 2.S2	Standards on Antennas: Methods of Testing, 1948. Adopted by ASA (ASA C16.11-1949).

54 IRE 3.S1	Standards on Audio Techniques: Definitions of Terms, 1954.
56 IRE 3.S1	Standards on Audio Systems and Components: Methods of Measurement of Gain, Amplification, Loss, Attenuation, and Amplitude-frequency-response, 1956. Adopted by ASA (ASA C16.29-1957).
53 IRE 3.S2	Standards on American Recommended Practice for Volume Measurement of Electrical Speech and Program Waves, 1953. Adopted by ASA (ASA C16.5-1954).
53 IRE 7.S1	Standards on Electron Devices: Methods of Measuring Noise, 1953. Adopted by ASA (ASA C60.13-1954).
50 IRE 7.S2	Standards on Electron Tubes: Methods of Testing, 1950.
57 IRE 7.82	Standards on Electron Tubes: Definitions of Terms, 1957.
53 IRE 11.S1	Standards on Modulation Systems: Definitions of Terms, 1953.
49 IRE 14.S1	Standards on Piezoelectric Crystals, 1949. Adopted by ASA (ASA C83.3-1951, R 1954).
53 IRE 19.S1	Standards on Sound Recording and Reproducing: Methods of Measurement of Noise, 1953.
53 IRE 19.S2	Standards on Sound Recording and Reproducing: Methods for Determining Flutter Content, 1953. Adopted by ASA (ASA Z57.1-1954).
55 IRE 22.S1	Standards on Television: Definitions of Color Terms, 1955.
50 IRE 23.S1	Standards on Television: Methods of Measurement of Television Signal Levels, Resolution, and Timing of Video Switching Systems, 1950.
54 IRE 23.S1	Standards on Television: Methods of Measurement of Aspect Ratio and Geometric Distortion, 1954. Adopted by ASA (ASA C16.23-1954).
55 IRE 23.S1	Standards on Television: Definitions of Television Signal Measurement Terms, 1955.
50 IRE 23.S2	Standards on Television: Methods of Measurement of Time of Rise, Pulse Width, and Pulse Timing of Video Pulses in Television, 1950.
50 IRE 23.S3	Standards on Television: Methods of Measurement of Electronically Regulated Power Supplies, 1950.
45 IRE 24.S1	Standards on Radio Wave Propagation: Definition of Terms Relating to Guided Waves, 1945.
50 IRE 24.S1	Standards on Wave Propagation: Definitions of Terms, 1950.
56 IRE 27.S1	Standards on Methods of Measurement of the Conducted Interference Output of Broadcast and Television Receivers in the Range of 300 Kc to 25 Mc, 1956. Adopted by ASA (ASA C16.25a-1957).

STANDARDS OF THE NATIONAL ASSOCIATION OF BROADCASTERS

Additional copies of the NAB Recording and Reproducing Standards with a Glossary of Terms and Definitions may be obtained by addressing a request to the NAB; Department of Engineering. These standards are set forth in this section.

RECOMMENDED STANDARDS OF THE ELECTRONIC INDUSTRIES ASSOCIATION

EIA has available and for sale numerous recommended standards and engineering publications. Advance payment is required except when a company purchase order is furnished and all remittances and orders should be forwarded directly to EIA Engineering Office, Room 650, 11 West 42nd Street, New York 36, N.Y. The following standards pertain and are of interest to the broadcast industry. For additional standards and information, please contact EIA.

GEN-101-A	Color Codes
REC-108-A	Color Codes
REC-128	Standard Frequency Test Record
REC-134	Magnetic Recorders, Conditions for Measurement and Definitions

REC-138	Recording Tapes
REC-143	Standards for Universal Television Broadcasting
REC-146	Lateral Disc Recording Characteristics
TR-101-A	Electrical Performance Standards for Standard Broadcast Transmitters
TR-102-B	Power Transformers for Radio Transmitters
TR-103-A	Transmission lines for FM Broadcast Transmitters (88–108 Mc)
TR-104-B	Electrical Performance Standards for Monochrome Television Broadcast Transmitters Channels 2–13
TR-105-B	Audio Facilities for Radio Broadcast Systems
TR-106	Electrical Performance Standards for Television Relay Facilities
TR-107	Electrical Performance Standards for FM Broadcast Transmitters (88–108 Mc)
TR-108-A	Rectangular Wave Guides
TR-110-B	Power Filter Reactors for Radio Transmitters
TR-111-A	Socket and Accessories for Electron Tubes for Use in Transmitters
TR-112-A	Definitions and Dimensional Characteristics of Quartz Crystal Units
TR-114	Frequency Modulation Broadcast Transmission Pre-emphasis and Polarization
TR-115	Symbols and Designations for Single Line Diagrams for Audio Facilities
TR-116	Radio Transmitting Antennas and Supporting Towers for Radio Transmitting Antennas
TR-117	Antennas and Combinations of Antennas and Transmission Lines for FM Broadcast Stations
TR-118	Cable Connectors for Audio Facilities for Radio Broadcasting
TR-119-A	Minimum Standards for Land-mobile Communication FM Receivers
TR-135	Electrical Performance Standards—Television Studio Facilities
TR-136	Television Picture Area—35 mm Motion Picture Film
TR-137	Television Picture Area—16 mm Motion Picture Film
TR-138	Slides and Opaques for Television Film Camera Chains
TR-139	Audio Transmitter Input Impedances
TR-142	Microwave Housing Facilities
TR-144	Color Television Test Signal to Accompany Monochrome Transmission
RS-152	Land Mobile Transmitters, FM (25–470 Mc)

EIA Television Test Charts

Resolution Chart (18" x 24" Heavy Paper)

The Resolution Chart is used to help measure the resolving power of a television system or of a part of it, such as a television camera chain. The chart is televised by the studio facility, under test, and reproduced on a suitable picture monitor; 10 gray steps aid in setting monitor bias and gain. Horizontal and vertical resolution wedges cover the range from 200 to 600 lines.

Gray Scale Overlay Strips for Resolution Chart (10" x 1" Cardboard Strips—Set of 4)

The Gray Scale overlay strips are intended to be pasted over the corresponding sections of the Resolution Chart (18" x 24"). These highly accurate gray scales will then provide the correct logarithmic reflections relationship for the scales on the chart.

Linearity ("Ball") Chart (18" x 24" Heavy Paper)

The Linearity Chart is used to help test geometric distortion of a television camera chain. This is done by comparing on a suitable picture monitor two superimposed patterns; one generated by an electrical pattern generator, the other by television a chart with the equipment to be checked. The electrical pattern grating generator frequencies required to match the chart pattern are 315 kc for horizontal, 900 cycles for vertical linearity tests.

Color Registration Chart (18" x 24" Heavy Paper)

The Color Registration Chart is used to aid in the alignment and test of the accuracy of registration of triple-pickup color television cameras. The fine black horizontal and vertical lines on a white background permit accurate alignment of the optical and electrical systems of three-pickup cameras.

Linear Reflectance Chart (18" x 24" Cardboard Mounted)

The Linear Reflectance Chart is used in the alignment and measurement of the transfer characteristic of television camera systems. This is of particular importance in color television, where departures from the correct characteristics may result in color error.

Logarithmic Reflectance Chart (18" x 24" Cardboard Mounted)

This chart is similar to the Linear Reflectance Chart with the exception that the steps of reflectance difference follows a logarithmic, instead of a linear, relationship. This chart is also highly useful in the alignment and measurement of the transfer characteristic of television camera systems, particularly those for color.

Color Registration Slide Transparency (2" x 2")

Metal and glass mounted, highly accurate slide of Color Registration Chart (see above).

IRE Facsimile Test Chart (8½" x 11")

This chart was prepared as an engineering test to show limitations of facsimile equipment, transmission circuits, recording paper, and over-all systems. Sections of this chart are specifically intended for checking modulation characteristics, power-supply regulation, halftone characteristics, definition, index of cooperation, paper-feed error, readability, jitter, and other factors affecting facsimile reproduction.

STANDARDS OF THE SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS (SMPTE)

SMPTE has available numerous test films which are widely used by the television industry as yardsticks for setting performance objectives of new and operational equipment. The test films are planned by the technical committee of the Society after considerable research and consultation. When ordering test films, you must specify the name, the code number, and, where priced on a footage basis, the length of the film desired. All other films are supplied only in the lengths shown. When requested, pro forma invoices will be supplied in advance. All films are sold on a cash basis only and no discounts are given and facilities for extending credit are not available.

35-mm Television Test Film

Code No.: TV35. Length: 945 ft.

Alignment and Resolution Section: Code No.: TV35-AS. Length: 100 ft.

The Television Test Film is a print which indicates the operating condition of those portions of the television film reproducing system which depend upon the relation between the projector and the electrical equipment. Six test sections and several representative scenes make up the complete test reel. The film is silent, being used for picture tests only. The test sections are a series of geometric patterns that check the factors most likely to be degraded in television reproduction. Each target selects some particular failing of the average system and produces a signal intended to exaggerate and thus clearly define any deviation from normal.

The Alignment Section of the alignment and resolution target defines the portion of the projected film frame which is to be reproduced by the television system and permits accurate alignment of the motion picture projector with the television camera. Resolution patterns are of calibrated wedge design and range from 200 to 500 television lines.

The Low Frequency Response Section is made in two parts, each consisting of a half-black, half-white frame, with the dividing line horizontal. When viewed on the waveform monitor set for field rate deflection, serious tilting or bowing of a square wave indicates incorrect low-frequency phase and amplitude response. The section of the target which is black at the bottom also permits a check on the amount of flare encountered in iconoscope operation.

The Medium Frequency Response of the system is checked by a test target having horizontal bars equal in length to the distance of scanning beam travel at 2, 5, 12½, and 32 microseconds. These correspond to half-wave pulses covering an approximate fundamental frequency range from 15 to 250 kc.

The Storage Test Section provides an indication of the storage characteristics of pickup tubes. This chart is made up to vertical black and white stripes on a gray background and is viewed on the waveform monitor set at field rate.

The Transfer Characteristics target provides a measure of the television system's ability to reproduce shades of gray. The target consists of two strips of seven density tablets each. In the upper strip the shades are from white to black and in the lower they are reversed.

An Automatic Brightness Control test consists of a black frame in which a white disc enlarges slowly until the entire frame is white. The ability of the automatic brightness control to hold constant black level is clearly demonstrated.

To provide a qualitative check on the over-all results to be expected from good motion picture film, several scenes taken from pictures made specifically for television are included.

Separate lengths of the Alignment and Resolution Section of this film are required for extended testing during installation or servicing of television film projectors.

16-mm Television Test Film

Code No.: TV16. Length: 367 ft.

Alignment and Resolution Section: Code No.: TV16-AS. Length: 100 ft.

This print is a 16-mm version of the 25-mm Television Test Film. To assure the best possible test of picture resolution, the Alignment and Resolution Section is made on original camera film which is spliced into the reel and is also available as a separate section.

35-mm Color Television Test Film

Code No.: TV-35-Color. Length: 700 ft.

The Color Television Test Film includes prints which represent the quality of material obtainable from Ansco, Technicolor, and Eastman prints. Each color print material contains five scenes.

At the beginning of the first scene is a section including a gray scale which can be used in setup or for adjusting the signal-generating equipment so that the chrominance subcarrier vanishes on this setup.

All scenes were illuminated with a lighting ratio of approximately 2:1; that is, the key light was twice the fill light, as measured in foot-candles.

The film is silent, being used for picture tests only.

16-mm Color Television Test Film

Code No.: TV-16-Color. Length: 280 ft.

This print is a 16-mm version of the 35-mm Color Television Test Film.

Color Television Test Slides Size 2″ x 2″

Code No.: Slides TV Color. Set of 10.

The slides contain the same high-quality color picture material used in the television test films.

35-mm Television Leader

Code No.: L35. Length: 90 ft.

Leaders are produced as fine-grain master positive prints. The film is one strip of three complete leaders. The leader is intended for general release print use and is designed to have a main body pattern to be used in television to permit checking system operation before switching into the first picture frame. Footage and sound threading marks have been clearly indicated for easier reading.

16-mm Television Leader

Code No.: L16. Length: 25 ft.

Fine-grain master positive prints are a 16-mm version of the 35-mm leader. The film is one strip of three complete leaders.

35-mm Magnetic Four-track CinemaScope Test Films

NOTE: Items 3 and 4 are f.o.b. Hollywood.

1. Level Balance Test Film. Code No.: SL-1. Length: 50 ft. 1,000 cps; four tracks simultaneously; sound only.

2. Multifrequency Test Reel. Code No.: MF-1. Length: 425 ft. Various frequencies; four tracks simultaneously; sound only.

3. Loudspeaker Balance Reel. Code No.: LB-1. Length: 300 ft. Recording of identical speech and music on all four tracks, progressively in this order: 2, 1, 3, and 4.

4. Stereophonic Test Reel. Code No.: ST-1. Length: 330 ft. Picture with stereophonic sound and 12-kc control signal.

5. Flutter Test Film. Code No.: FL-1. Length: 50 ft. 3,000 cps; four tracks simultaneously; sound only.

6. Loudspeaker Phasing Test Film. Code No.: LP-1. Length: 50 ft. Warble frequency; tracks—1, 2, and 3 simultaneously; sound only; crossover 400 or 500 cps. Specify which frequency desired.

7. Constant Level Test Film. Code No.: AZ-1. Length: 50 ft. 8,000 cps; azimuth check; four tracks simultaneously; sound only.

8. Channel-Four Test Film. Code No.: CH-4. Length: 50 ft. 12,000 cycles/1,000 cycles; sound only.

9. Projector Alignment Chart. Code No.: PR-1. Length: 100 ft. Picture only. For aligning projectors using a four-track aperture 0.912 x 0.715 in., aspect ratio of 2.55 to 1.

10. Projector Alignment Chart (Optical Track) Standard Sprocket Holes. Code No.: CSOS. Length: 50 ft per min or multiples thereof. Picture only.

35-mm Visual Test Film

Code No.: VTF. Length: 450 ft.

Focus-and-alignment Section. Code No.: VTF-FAS. Length: 100 ft.

Travel-ghost Target Section. Code No.: VTF-TGS. Length 100 ft.

Jump-and-weave Target Section. Code No.: VTF-JWS. Length: 100 ft.

The Visual Test Film is a special type of print, picture only, containing four targets to check focus and alignment, travel ghost, jump and weave, and lens aberrations. This test film is used when installing new projectors and screens or performing maintenance operations on existing equipment.

The Focus-and-alignment target shows whether or not picture size and screen masking are correct and whether the projected picture is centered properly on the screen.

The Travel-ghost target shows improper timing of the shutter quite readily and gives a clear indication of the correct adjustment as the timing is being corrected.

The Jump-and-weave target gives an accurate indication of the unsteadiness of the projected picture. Picture jump is measured in per cent of picture height, and picture weave is measured in per cent of picture width.

The Lens-aberration target shows picture distortion and gives an indication of the lack of sharpness that will be present in pictures shown on any particular projector.

Explanatory titles precede each section and an instruction booklet is furnished giving complete details on its proper use.

Because some users prefer loops or continuous lengths of the separate target sections for adjusting machines, one at a time or in pairs, separate sections of the first three targets have been made available.

16-mm Magnetic Azimuth Alignment Test Film

Code No.: MATF. Length: 100 ft.

A 200-mil sound recording of 7,000 cycles is placed on full-width coated 16-mm film. The sound record is in the same position as that shown on American Standard PH22.87 with the exception of the recorded width being 200 mils instead of the 100-mil width specified. Azimuth is correct to ±3 min of arc.

16-mm Magnetic Multifrequency Test Film

Code No.: M16MF. Length: 200 ft.

The Magnetic Multifrequency Test Film has a recorded track 200 mils wide, the edge of which is 5 mils in from the nonperforated side of the film.

The sequence of recorded material is as follows ±7,000 cycles—approx. 30 ft azimuth adjustment.

Each of the following frequencies is preceded by a spoken announcement:

1,000	300	3,000	7,000
50	500	4,000	1,000
100	1,000	5,000	
200	2,000	6,000	

16-mm Sound-service Test Film

Code No.: SPSA. Length: 320 ft.

The 16-mm Sound-service Test Film is a special type of print, both picture and sound, developed for users of 16-mm projectors and films, as well as for television stations and projector service shops. This film includes wide-frequency-range title music, followed by sections of buzz-track, which is a 14-ft section of original negative spliced in, sound-focusing test, constant frequencies from 50 to 6,000 cycles, dialogue, piano music, and orchestral music. The buzz, focus, and frequency sections will show whether mechanical or electrical adjustments are correct, while the one dialogue and three music sections, which were specially prepared for this film and are consistent with the best quality obtainable today, will indicate over-all reproducer sound quality.

Accompanying titles explain the purpose of each section, while the instruction book supplied with the film explains in detail why the various tests are made and how the results of those tests should be evaluated. This combination test film will show whether poor sound quality is the fault of the projector or of the print being projected. It will indicate when projector overhaul is necessary and the nature of the repairs required.

16-mm "Jiffy" Test Film

Code No.: Jiffy. Length: 135 ft.

A short, inexpensive test film for rapid checking and demonstrating of 16-mm projector system performance developed in collaboration with the U.S. Navy. This high-quality film will prove a boon to projector manufacturers, educational organizations, repair shops, and camera stores.

It requires no test instruments, yet provides checks for faithful reproduction of wide-range music, picture steadiness, uniform picture brightness, flutter, correct sound-track guide adjustment, normal volume, sound focusing in both standard and non-standard emulsion positions, frequency response from 50 to 5,000 cycles, and dialogue intelligibility.

16-mm 3,000-cycle Flutter Test Film

Code No.: PH22.43. Length: 380 ft.
Code No.: PH22.43. Length: 100 ft.

The 3,000-cycle Flutter Test Film is a direct-positive original recording and carries a 3,000-cycle tone having extremely low flutter content for use in measuring the flutter introduced by 16-mm sound reproducers. A flutter meter is required to make this measurement. The recorded frequency is within 25 cycles of the 3,000-cycle frequency, the output level is constant within 0.25 db, and the total flutter content of the film at the time of shipment is less than 0.1 per cent.

16-mm Multifrequency Test Film

Code No.: PH22.44. Length: 150 ft.

The Multifrequency Test Film is a direct-positive original recording and is used to obtain the electrical-frequency response at the output of the power amplifier. Each film is individually calibrated on equipment correct with ±0.5 db above 3,000 and through 7,000 cycles. The deviation from the intended flat-response characteristic (assuming negligible reproducing light-beam width) is stated as a correction for each frequency which will give the true level when it is added algebraically to the output-level measurement obtained when using the film.

This test film contains the following series of frequencies, each preceded by a spoken announcement:

400	300	2,000	5,000
50	500	3,000	6,000
100	1,000	4,000	7,000
			400

16-mm Scanning-beam Illumination Test Film

Laboratory Type: Code No.: PH22.80-L. Length: 102 ft.
Service Type: Code No.: PH22.81-S. Length: 100 ft.

The Scanning-beam Illumination Test Film is a print and carries a narrow sound track (0.005 in. wide) modulated at constant level by a 1,000-cycle tone. The location of this sound track changes at a uniform rate along the length of the film from a position just inside one edge of the scanned area to a position just inside the opposite edge of the scanned area. The narrow 1,000-cycle sound track sweeps across the scanning-light beam from one end to the other at a uniform rate, the position of the sound track relative to the ends of the light beam at any instant being shown by an animated diagram appearing in the picture area.

If the scanning-beam illumination were absolutely uniform across the width of the scanned area, the output level of the 1,000-cycle tone would be constant. In practice, however, some variation of an output-meter reading will always be observed. By running a loop of the film continuously and observing the indications of the

output meter while adjustments are made, it is usually possible to correct unevenness of illumination and bring the variation of output within a limit of ±1.5 db.

The Laboratory Type is shipped in one length of film to make three 34-ft loops and the Service Type in one length of twenty-four 3½-ft loops.

16-mm Buzz-track Test Film

Code No.: PH22.57. Length: 100 ft.

The Buzz-track Test Film is an original negative and is used for checking scanning-beam placement. The track consists of an 0.076-in. opaque center with a frequency of 300 cycles on the picture side and a frequency of 1,000 cycles on the side nearest the film edge. These tracks are accurately located on the film so that when the film is run on a projector in correct adjustment and free from weave, no sound should be heard or equal loudness of both buzz sounds.

16-mm Sound-focusing Test Film

Laboratory Type: Code No.: PH22.42-7000. Length 100 ft.

Service Type: Code No.: PH22.42-5000. Length: 100 ft.

The Sound-focusing Test Film is an original negative and carries a special "square-wave" track, chosen because its output changes more rapidly with changes in the focus of the sound optical system of the projector than the output from the usual "sine-wave" high-frequency track. The "square-wave" track also gives a more sensitive indication of the errors of the "azimuth" adjustment of the sound-reproducing light beam.

The Sound-focusing Test Film is made in two types: Laboratory Type, a 7,000-cycle record for manufacturing and precision adjustments of the focus and azimuth of the sound optical system, and Service Type, a 5,000-cycle record for quick service adjustment.

16-mm 400-cycle Signal-level Test Film

Code No.: PH22.45. Length: 100 ft.

The 400-cycle Signal-level Test Film is a direct-positive original recording designed to furnish as nearly as is practicable an absolute standard of recorded signal level for use in measuring the effective amplification and sound output of 16-mm sound motion picture projectors, taking into account the sound optical system and phototube, as well as the amplifier and loudspeaker.

A definite output level is determined by specifying the amplitude of the recorded signal, the density of the image, and the combined base and fog density of the clear part of the sound track within narrow limits. The specified level is approximately 2 db below the maximum level possible and is about equal to the highest level that is to be expected in most recording, since in commercial practice the image density is usually not so great and the fog density not so low as the values specified for this film.

16-mm Steadiness Test Film

Code No.: ST16. Length: 100 ft.

This film permits the unsteadiness of a projected film image to be measured. As a steadiness reference there are three round holes punched in the picture area. The center and lower holes are produced by a single punch stroke that is indexed from the adjacent standard film perforation, the one that locates that particular frame in the aperture on many projectors. The upper hole is produced by the succeeding stroke. Motion of the center hole can be measured by using the gauge supplied with the film. Residual unsteadiness of films approved for sale is no greater than 0.05 per cent of picture width.

16-mm Travel-ghost Test Film (Block Target)

Code No.: TG16. Length: 100 ft.

This print is a 16-mm version of the Travel-ghost Target Section of the 35-mm Visual Test Film. The target shows improper timing of the shutter quite readily and gives a clear indication of correct performance as the timing is being adjusted.

16-mm Projector Lens Resolution Target

Code No.: PH22.53.

This is a glass slide, approximately 1 x 2 in. with 19 resolution test patterns photographed within the standard 16-mm projector aperture area. This slide is intended for use in determining the resolving power of projector lenses in terms of the number of lines per millimeter which are resolved.

A special test projector designed to hold the glass test plate in proper relation to the lens axis, which may be very simply designed, is required as auxiliary equipment. This test is normally used by development laboratories and lens and projector manufacturers.

Part 8

NAB SAMPLE TRANSMITTER OPERATING LOGS AND PERTINENT FCC RULES AND REGULATIONS

INTRODUCTION

The Rules and Regulations of the Federal Communications Commission require that operating logs be maintained by all broadcasting stations. These requirements are set forth in Part 3 of the FCC Rules and Regulations and in some instances in the instrument of authorization, i.e., license, construction permit, temporary authorization, etc. The following article consolidates the FCC Rules, Regulations and Standards of Good Engineering Practice pertaining to AM, FM, and TV broadcast station logs, and, in addition, presents an up-to-date version of the NAB Sample Logs.

The material presented herewith is divided into two sections:

Part I contains pertinent facts about the format and use of transmitter operating logs and discusses each part of the log requirements. It also makes suggestions with respect to the NAB Sample Logs appearing in Part II.

Part II contains explanations and illustrations of Sample Logs.

Maintenance logs are not considered in this material, since the requirements for such logs are somewhat peculiar to each transmitter installation. In most instances, maintenance logs are found to be kept separately from the operating log. This procedure, while generally desirable, is not, however, mandatory. The logs may be combined. Also combination (basic) logs may be used in such instances where one operator is in charge of the actual operation of an AM transmitter and an FM transmitter.

The FCC does not place its official approval on any particular log as compared with another; its only interest is that the required entries be made in a neat and orderly fashion in accordance with the Rules and Regulations. The Sample Logs attached have been examined by Commission Engineering personnel and are believed to meet all their requirements.

We hereby acknowledge our thanks and appreciation to them for their help and criticism.

PART I

PERTINENT FACTS ABOUT THE FORMAT AND USE OF TRANSMITTER OPERATING LOGS

Sections 3.111(b) and (c), 3.281(b) and (c), 3.663(b) and (c), 17.37, and 17.38 set forth the basic requirements as to entries which must be made in the transmitter logs of AM, FM, and TV Stations.

To comply with paragraph (b)(1), the time (to the nearest minute) any amount of carrier is applied to the radiating systems [1] should be entered in Column 1 of the

[1] Includes video and audio transmitters of TV stations.

sample logs, with an appropriate phrase in the "Remarks" column such as "Carrier on." If the carrier is applied in steps, entries of voltage and currents may be made for each step or an entry in the "Remarks" column may be made as to the approximate power. The time the carrier is removed from the radiating system should be entered in Column 1 and in the "Remarks" column the words "Carrier off" may be inserted.

To comply with (b)(2) the time the program is applied to the carrier(s) [1] and the time the program is removed from the carrier(s) [1] should be entered in Column 1. Since the rule requires only two entries for each broadcast period appropriate entries may be made in the "Remarks" column such as "Program on" and "Program off" or "Program begins" and "Program ends." "Program on" and "Program off" times may be entered in the "Remarks" column if desired instead of in Column 1. This is often done when the time at half-hour intervals is printed on the log.

To comply with (b)(3) the time of each carrier interruption must be entered in Column 1, and a statement as to the cause and duration of the interruption must be placed on the log, preferably in the "Remarks" column. Upon resumption of transmission, the time the carrier is placed on the air and the time the program is resumed must be entered in Column 1 with appropriate remarks in the "Remarks" column.

This part (b)(4) requires that certain operating constants of the transmitter(s) [1] be entered in the log every 30 minutes during the time the carrier is on the air. The times that the readings are taken should be entered in Column 1 and the proper entries should be made in Columns 2-6 and 2-5 of the basic logs for either AM or FM or TV stations respectively (Figures 1, 4, and 5).

To comply with (b)(4)(i), enter in Column 2 of the sample log the total plate current of the final radio-frequency stage in the transmitter. In Column 3 should be entered the plate voltage applied to the final radio-frequency stage.

(NOTE: FOR AM STATIONS) Column 4 of the basic AM log is provided to comply with (b)(4)(ii) for the entry of the reading of the actual antenna current meter, remote antenna meter, or transmission line current meter, whichever method is elected by the station in accordance with Commission Rules. Column 4 may be labeled I_A for actual antenna current, I_R for remote antenna meter reading, or I_T for transmission line current. If remote reading meters are utilized, calibration must be checked against the actual antenna current meter at least once weekly for each authorized power.[1] The time of the calibration check should be entered in Column 1 and the check data in the "Remarks" column.

Under Section 3.51, the indirect method of determining power may be used under certain conditions on a temporary basis. When this method is used with a series feed antenna, the transmission line current may be logged in lieu of the antenna current, provided that the ratio between transmission line current and the antenna current is logged every 30 minutes. Further, the actual antenna current must be checked for each operating power at least once daily and logged by entering the time of the check in Column 1 and the check data in the "Remarks" column. In such instances, a column headed, for example, $I_T I_A$ should be used. Since the indirect measurement method can be used only on a temporary basis, a permanent column for this purpose is not necessary.

In the case of a shunt excited antenna the transmission line current meter at the transmitter may be considered as a remote antenna ammeter, provided that the antenna termination of the transmission line is made directly into a series circuit without parallel tuning components. The transmission feed line meter (meter in slant wire feed line or equivalent) may be logged for each authorized power. The time of this observation should be entered in Column 1 and appropriate remarks made in the "Remarks" column.

For installations using directional antenna systems, 3.111(b)(4)(ii), which states that merely "antenna current" should be logged, must be considered with an inter-

[1] Where convenient, it is often advisable to check the calibration daily so that in the event of failure time will permit repair or replacement.

pretation of requirements appearing in the instrument of authorization (DA Specs) to operate with a directional antenna system. Following are steps of consideration:

1. The antenna current meter reading at the common point of feed must be logged each half hour, since this is the point where power is determined. This may be identified as I_{cr}.

2. In reference to the ratio of antenna currents as determined from the indications of the phase monitor, these indications must be the current flowing in each phase monitor sampling loop circuit with no other shunt circuits of any nature employed. Although no specific rule states that current ratios must be logged, such ratios are included in the instrument of authorization and, for the protection of the licensee, logging of it appears advisable. If loop currents are logged, base currents must be read and logged once each day for each authorized power. The time of these observations should be entered in Column 1 and data in the "Remarks" column. In the event remote reading meters are used in a directional antenna system to read base currents, a calibration check between meters must be made at least once each week. It is, however, general practice at most stations to make this calibration check once daily.

3. If a phase monitor is employed, relative phase indications between the elements must be logged at least once each hour. This requirement appears only on certain instruments of authorization.

4. In the interest of consistency and to prevent confusion, it is suggested that each station select a definite system of identifying elements in a DA system such that each tower can be easily and readily associated with the element identification given in the instrument of authorization. In preparing the log format, this identification should appear at the top of the column used for that tower.

(NOTE: FOR FM AND TV STATIONS) On FM and TV installations (b)(4)(ii) requires that transmission line voltage or current be logged each half hour. Figure 5 (TV Log) indicates the use of "Reflectometer Unit" as found in one particular make of television transmitter. If transmission line voltmeters or ammeters are used, Columns 5-6 and 8-9 may be deleted and one column under both audio and video transmitters added for transmission line voltage or current.

In compliance with (b)(4)(iii), the frequency monitor reading should be entered in Column 5 of the AM and FM logs. Columns 4 and 7 of Figure 5 (TV Log) must be filled in with the frequency deviation in cps of the audio and video carriers respectively.

PART II

EXPLANATIONS AND ILLUSTRATIONS OF SAMPLE LOGS

Figure 1. Basic AM Log. The columns set forth in this form cover the basic AM requirements, the form being suitable for stations having no special log requirements occasioned by the use of directional antennas.

Figure 2. This figure consists of three sections to be added to the Basic AM Log if directional antennas are employed. The number of columns to be employed would be equal to the number of antennas used in the directional array.

(*1*) *Antenna Current.* This is as may be read on remote reading meters. If this method is elected by the station, calibration checks must be made at least once weekly. Most stations, however, provide this calibration check daily.

(*2*) *Current Ratios.* Ratios are not required to be logged. It is the usual practice to log only currents in the sampling loops, from which ratios may be determined when needed. However, if it appears desirable that operators compute ratios, this column may be used. If sampling loop currents are used, tower base currents must be read daily for each power used. The common point current must also be checked in the normal manner.

(*3*) *Phasing Relation.* This group of columns must be used if a phase monitor is employed. The readings should follow those values set forth in the instrument of authorization and should show degrees of lead or lag with respect to the reference tower.

AM STATION CALL LETTERS
TRANSMITTER OPERATING LOG
12 — KILOCYCLES: 5 KW — DAY 1 KW — NIGHT

DATE _____ 19__

CITY AND STATE

① TIME	② PLATE CURRENT FINAL STAGE	③ PLATE VOLTAGE FINAL STAGE	④ ANTENNA CURRENT AMPS	⑤ FREQUENCY DEVIATION ± CYCLES	REMARKS:

FIGURE 1. Basic AM log.

COLUMNS ① TO ⑤ OF BASIC AM LOG

	1				2			3			
	ANTENNA CURRENT					CURRENT RATIO			PHASING RELATION			REMARKS
	COMMON POINT	1	2	3	4	2/1	3/1	4/1	2/1	3/1	4/1	

FIGURE 2

If monitoring point readings are required, add additional columns. The "Remarks" column would follow the final column on the chart.

Figure 3. This is a sample log for a standard station using a three-element directive array at night and non-directional operation daytime.

Figure 4. Basic FM Log. The columns set forth in this sample log cover the basic FM requirements.

Figure 5. Basic TV Log. This is a sample log for a television station. Although the rules are somewhat ambiguous as to the frequency monitor reading, the frequency deviation of both carriers must be checked and logged every 30 minutes.

Important Points of Consideration in Designing an Operating Log Format

(Sample abbreviations shown in brackets)

1. Be sure the log is properly identified as to station location and frequency. It is sometimes convenient to print the transmitter latitude and longitude in the log.
2. Put the date in a convenient place in the event reference must be made to a specific day.
3. If abbreviations of any nature are used, be certain that each abbreviation is fully explained on the log and as a permanent part of the log. This is generally done at the bottom or on the back of each page when the logs are printed.
4. Where directive arrays are used, identify each tower in a manner consistent with the instrument of authorization.
5. Keep the log neat, precise, simple, and free of extraneous remarks.

TRANSMITTER OPERATION LOG
CALL LETTERS DATE _____ 19___
LOCATION
FREQUENCY – POWER – TIME OF OPERATION

TIME	E_p	I_p	F_d	ANTENNA CURRENTS				PHASE RELATION		REMARKS:
				I_{cp}	I_1	I_2	I_3	T_1/T_2	T_1/T_3	

ABBREVIATIONS:
E_p - FINAL STAGE PLATE VOLTAGE - KILOVOLTS
I_p - FINAL STAGE PLATE CURRENT - AMPERES
F_d - FREQUENCY DEVIATION - CYCLES PER SECOND
I_{cp} - COMMON POINT ANTENNA CURRENT - AMPS - REMOTE
I_1, I_2, I_3 - PHASE MONITOR SAMPLING LOOP CURRENTS. I_1 LOOP CURRENT USED IN LIEU OF ANTENNA CURRENT ON NON-DA OPERATION
T_1/T_2 - PHASE DIFFERENCE BETWEEN TOWER # 1 AND TOWER # 2
T_1/T_3 - PHASE DIFFERENCE BETWEEN TOWER # 1 AND TOWER # 3

FIGURE 3

FM STATION CALL LETTERS
TRANSMITTER OPERATING LOG
CHANNEL 269 — 101.7 MC — POWER 1KW

① TIME	② PLATE CURRENT FINAL STAGE	③ PLATE VOLTAGE FINAL STAGE	④ TRANSMISSION LINE * CURRENT	⑤ FREQUENCY DEVIATION ± CYCLES	REMARKS:

* OR VOLTAGE

FIGURE 4. Basic FM sample.

TV STATION CALL LETTERS
TRANSMITTER OPERATING LOG

CHANNEL _____ DATE _____
VIDEO FREQUENCY _____ CITY AND STATE _____
AUDIO FREQUENCY _____

TIME (1)	AUDIO TRANSMITTER (I)					VIDEO TRANSMITTER (II)			REMARKS
	I_p	E_p	F_d	REFLECTOMETER INCI.	REFL.	F_d	REFLECTOMETER INCI.	REFL.	
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	

ABBREVIATIONS
E_p – PLATE VOLTAGE FINAL STAGE
I_p – PLATE CURRENT FINAL STAGE
F_d – FREQUENCY DEVIATION IN CYCLES PER SECOND

(I) AUDIO: ___ MICROAMPERES INCIDENT IS EQUAL TO ___ WATTS.
(II) VIDEO: ___ MICROAMPERES INCIDENT IS EQUAL TO ___ WATTS.
(I) AND (II) CALIBRATED USING DUMMY LOAD BEYOND SIDE BAND FILTER.

FIGURE 5. Basic TV sample.

6. Provide sufficient room for a "Remarks" column, which may be used for the following:

a. Operator's signature (not initials) when going on and off duty, if not placed in separate box.
b. Notation "Carrier On" and "Carrier Off." [CON] [COF]
c. Notation "Program On" and "Program Off." [PON] [POF]
d. Remarks as to cause of carrier interruption.
e. Calibration checks on remote-reading meters, etc. [CRRM]
f. Observation of tower lights and remarks as to steps taken if tower lights fail.
g. Remarks as to any unusual occurrences affecting transmissions.
h. Notations and initialing in the case of corrections in log entries.
i. Time of power change if required.

7. Stations utilizing remote control should make provisions in the operating log for the weekly calibration of the remote control metering system. The Commission also requires that the indications at the transmitter, if remote control of a directional antenna is utilized, 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 2 hours after the commencement of operation of each pattern.

Part 9

NATIONAL BUREAU OF STANDARDS STANDARD FREQUENCY TRANSMISSIONS

STANDARD FREQUENCIES AND TIME SIGNALS WWV AND WWVH

The National Bureau of Standards' Radio Stations WWV (in operation since 1923) and WWVH (since 1949) broadcast six widely used technical services: 1. STANDARD RADIO FREQUENCIES, 2. STANDARD AUDIO FREQUENCIES, 3. STANDARD TIME INTERVALS, 4. STANDARD MUSICAL PITCH, 5. TIME SIGNALS, 6. RADIO PROPAGATION FORECASTS.

All inquiries concerning the technical radio broadcast services should be addressed to: National Bureau of Standards Boulder Laboratories, Boulder, Colorado.

The radio bands in which the foregoing services are broadcast are: 2500 ± 5 kc (2500 ± 2 kc in Region 1); 5000 ± 5 kc; 10,000 ± 5 kc; 15,000 ± 10 kc; 20,000 ± 10 kc; 25,000 ± kc. These bands were allotted by international agreement, in 1947, for exclusive standard-frequency-broadcast use.

The National Bureau of Standards' radio stations are located as follows: WWV, Beltsville, Maryland (Box 182, Route 2, Lanham, Maryland); WWVH, Maui, Hawaii (Box 901), Puunene, Maui, Hawaii). Coordinates of the stations are: WWV (lat. 38°59′33″ N., long. 76°50′52″ W.); WWVH (lat. 20°46′02″ N., long. 156°27′42″ W.).

The WWV-WWVH broadcasts are a convenient means of transferring the national standard of frequency and time interval and making it readily available throughout the United States and over much of the world. The broadcast program is shown schematically in Figure 1.

1. Standard Radio Frequencies

Station WWV broadcasts on standard radio frequencies of 2.5, 5, 10, 15, 20, and 25 Mc. The broadcasts are continuous, night and day, except WWV is off the air for approximately 4 minutes each hour. The silent period commences at 45 minutes, plus 0 to 15 seconds, after each hour.

Station WWVH broadcasts on standard radio frequencies of 5, 10, and 15 Mc. The WWVH broadcast is interrupted for 4 minutes following each hour and half hour and for periods of 34 minutes each day beginning at 1900 UT (Universal Time, UT is the same as GMT and GCT).

The standard radio frequencies are widely used, e.g., by the communications and electronics industry, research laboratories, and government. A local oscillator may be set versus the received frequency, and any desired radio frequency, including microwave frequencies, may be accurately measured in terms of the standard. The beat frequency method, or variations of it, is generally used. With a very narrow band receiver the standard radio frequency can be used when the received field strength is too low for audibility on ordinary radio receivers.

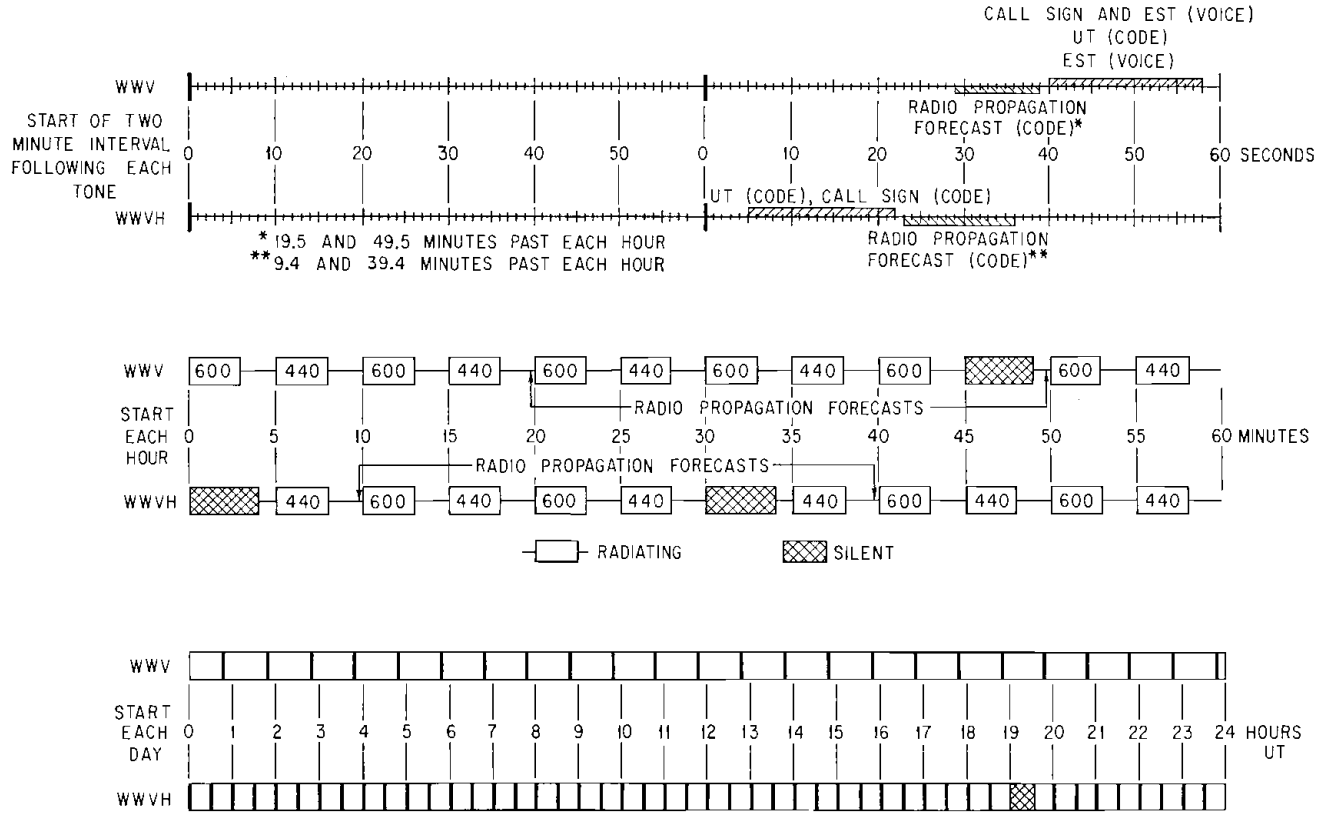

CALL SIGN AND EST (VOICE)
UT (CODE)
EST (VOICE)
WWV
START OF TWO MINUTE INTERVAL FOLLOWING EACH TONE
RADIO PROPAGATION FORECAST (CODE)*
0 10 20 30 40 50 0 10 20 30 40 50 60 SECONDS
UT (CODE), CALL SIGN (CODE)
WWVH
*19.5 AND 49.5 MINUTES PAST EACH HOUR
**9.4 AND 39.4 MINUTES PAST EACH HOUR
RADIO PROPAGATION FORECAST (CODE)**
WWV
600 440 600 440 600 440 600 440 600 440 600 440
START EACH HOUR
RADIO PROPAGATION FORECASTS
0 5 10 15 20 25 30 35 40 45 50 55 60 MINUTES
RADIO PROPAGATION FORECASTS
WWVH
440 600 440 600 440 440 440 600 440 600 440
RADIATING
SILENT
WWV
START EACH DAY
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 HOURS UT
WWVH

FIGURE 1

The accuracy of each of the radio frequencies as transmitted is better than 1 part in 100,000,000. The stability (quality of remaining fixed or unvarying) at the transmitter is normally within 1 part in 10^9 at WWV and 5 parts in 10^9 at WWVH. Deviations at WWV are about 2 in 10^{10} each day; frequency adjustments are made each day if necessary at 1900 UT. Deviations at WWVH are about 4 in 10^{10} each day; frequency adjustments are made each day if necessary during the interval 1900 to 1935 UT. If received accuracies better than 3 parts in 10^7 are desired it is necessary to make measurements over a long interval, e.g., 24 hours to obtain an accuracy of 1 part in 10^8. Such long-interval measurements should preferably be of the type that result in a strip chart record of frequency or phase changes (local oscillator vs WWV or WWVH) during the measurement interval. During intervals of about 10 hours or less, one may obtain highest accuracy when ionospheric conditions are normal and when measurements are made at the optimum time of day which is when sunrise or sunset does not occur over the radio propagation path.

Final corrections to the broadcast frequencies are available on a quarterly basis from the National Bureau of Standards Boulder Laboratories, Boulder, Colorado.

2. *Standard Audio Frequencies*

Two standard audio frequencies, 440 cycles per second and 600 cycles per second, are broadcast on each radio carrier frequency. The audio frequencies are given alternately starting with 600c on the hour for three minutes, interrupted two minutes, followed by 440c for three minutes and interrupted two minutes. Each 10-minute period is the same except for transmitter interruptions mentioned under 1 above.

The two standard audio frequencies are useful for accurate measurement or calibration of instruments operating in the audio or ultrasonic regions of the frequency spectrum. The frequencies broadcast were chosen because 440c is the standard musical pitch and 600c has the maximum number of integral multiples and submultiples; also, 600c is conveniently used with the standard power-frequency 60c.

Electronic circuits may be associated with radio receivers which automatically convert 600c to 1000c, 100c, etc.

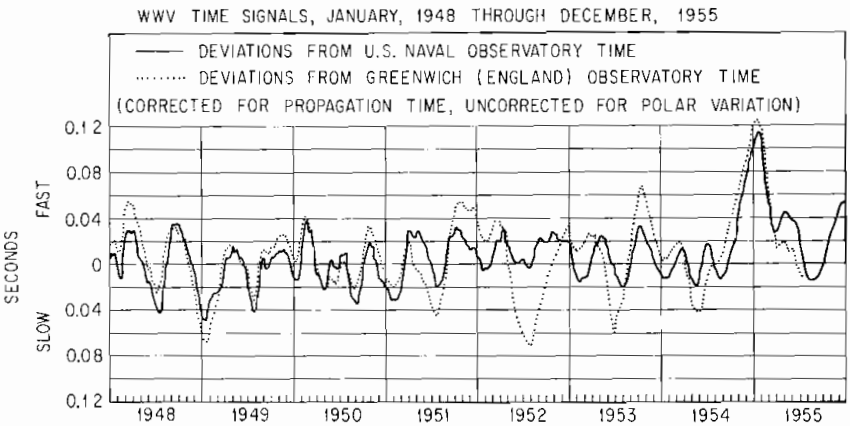
The accuracy of the audio frequencies, as transmitted is better than one part in 100,000,000. Changes in the transmitting medium (Doppler effect, etc.) result at times in fluctuations in the audio frequencies as received.

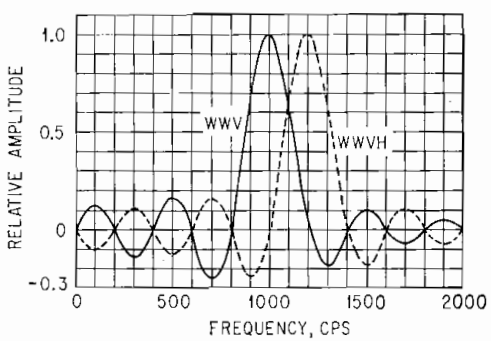
3. *Standard Time Intervals*

Seconds pulses at intervals of precisely one second are given as double sideband amplitude modulation on each radio carrier frequency. The pulse duration is 0.005 second. The pulse wave form is shown in Figure 2. At WWV each pulse consists of five cycles of a 1000c frequency. At WWVH each pulse consists of six cycles of a 1200c frequency. The pulse spectrum is composed of discrete frequency components at intervals of 1.0c. The components have maximum amplitudes at approximately 995c and 1194c for the WWV and WWVH pulses respectively.

The seconds pulses provide a useful standard time interval for quick and accurate measurement or calibration of time and frequency standards and timing devices. For example, a watch rate recorder may be checked by recording the seconds pulses. Intervals of one minute are marked by omitting the pulse at the beginning of the last second of every minute and by commencing each minute with two pulses spaced by 0.1 second. The two-minute, three-minute and five-minute intervals are synchronized with the seconds pulses and are marked by the beginning or ending of the periods when the audio frequencies are off.

A time interval as broadcast from WWV is accurate to 1 part in 10^8 plus or minus 1 microsecond. Received pulses have random phase shifts or jitter because of changes in the propagating medium. The magnitudes of these changes range from practically zero for the direct or ground wave to about 1000 microseconds when received via a changing ionosphere. Multiple pulses and echos are sometimes received because of propagation around the world and reflection from objects on the earth's





THE FREQUENCY SPECTRUM
OF THE
WWV AND WWVH SECONDS PULSES

THE SPECTRUM IS COMPOSED OF DISCRETE FREQUENCY COMPONENTS AT INTERVALS OF 1.0 CPS. THE COMPONENTS AT THE SPECTRAL MAXIMA HAVE AMPLITUDES OF 0.005 VOLT. FOR A PULSE AMPLITUDE OF 1.0 VOLT. THE WWV PULSE CONSISTS OF FIVE CYCLES OF 1000 CPS. THE WWVH PULSE CONSISTS OF SIX CYCLES OF 1200 CPS.

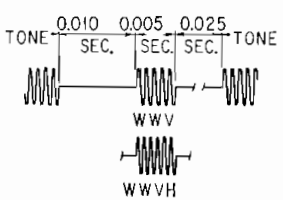


FIGURE 2

surface. The beginning of the first pulse received, i.e., the part having least delay, is most accurate and should be used. When ionospheric conditions are normal and the correct time of day is chosen, a frequency standard can be checked in a few hours versus WWV with a precision of about 1 part in 10^9; however, it is best to use intervals of 24 hours when comparing with this precision.

In using the time interval markers for high precision work it is necessary to remember that step adjustments of precisely ±20 milliseconds may be made at the transmitter on Wednesdays at 1900 UT; this is explained under paragraph 5, Time Signals.

The seconds pulses from WWVH are adjusted if necessary each day during the interval 1900 to 1935 UT so as to commence simultaneously with these from WWV, within plus or minus 500 microseconds.

4. Standard Musical Pitch

The frequency 440 cycles per second for note A above middle C has been the standard in the music industry in the United States since 1925. The radio broadcast of this standard was commenced by the National Bureau of Standards in 1937. It is now given six times per hour, 18 minutes per hour, from WWV and WWVH as shown in Figure 1. With this broadcast the standard pitch is maintained and musical instruments are manufactured and adjusted versus an unvarying standard. Listeners of music are benefited because there are fewer instruments not in tune and practically no instruments are manufactured which cannot be tuned to 440c.

A high frequency or short-wave radio receiver is the only equipment needed to effectively use the musical pitch standard.

5. Time Signals

The audio frequencies are interrupted at precisely two minutes before each hour. They are resumed precisely on the hour and each five minutes thereafter; they mark accurately the hour and the successive 5-minute periods (see Figure 1).

Time signals from WWV are maintained in close agreement with uniform time, called U. T. 2, determined by the U. S. Naval Observatory. This is done by occasional step adjustments in time, when necessary, of precisely plus or minus twenty milliseconds. These adjustments may be necessary several times per year. When required, they are made on Wednesdays at 1900 UT simultaneously at WWV and WWVH.

Universal Time is announced in telegraphic code each five minutes from WWV and WWVH. This provides a quick reference to correct time where a timepiece may be in error by a few minutes. The zero- to twenty-four-hour system is used starting with 0000 at midnight. The first two figures give the hour and the last two figures give the number of minutes past the hour when the tone returns. For example, at 1655 UT, or 11:55 a.m., Eastern Standard Time, four figures (1, 6, 5, and 5) are broadcast in code. The time announcement refers to the end of an announcement interval, i.e., when the audio frequencies are resumed.

At Station WWV a voice announcement of *Eastern* Standard Time is given before and after each telegraphic code announcement. For example, at 9:10 a.m., EST, the voice announcement in English is: "National Bureau of Standards, WWV; when the tone returns, Eastern Standard Time is 9:10 a.m."

Final corrections to the time signals, as broadcast, are determined and published, on a weekly basis, by the U.S. Naval Observatory, Washington 25, D.C.

6. Radio Propagation Forecasts

A forecast of radio propagation conditions is broadcast in telegraphic code on each of the standard radio carrier frequencies; from WWV at approximately 19.5 and 49.5 minutes past each hour, and from WWVH at approximately 9.4 and 39.4 minutes past each hour, as shown in Figure 1. Propagation notices were first broadcast from WWV in 1946; the present type of announcement has been broadcast from WWV since July 1952, and from WWVH since January 1954.

The forecast announcement tells users the condition of the ionosphere at the regular time the forecast is made and how good or bad communications conditions are expected to be in the succeeding 6 or more hours. The NBS forecasts are based on information obtained from a world-wide network of geophysical and solar observatories, including radio soundings of the upper atmosphere, short-wave reception data, and similar information. Trained forecasters digest the information and formulate the predictions.

From WWV the forecasts refer only to North Atlantic radio paths, such as Washington to London or New York to Berlin. The times of issue are 0500, 1200 (1100 in summer), 1700, 2300 UT. These are the short-term forecasts prepared by NBS-CRPL North Atlantic Radio Warning Service, Box 178, Ft. Belvoir, Virginia.

From *WWVH* the forecasts are for North Pacific radio paths, such as Seattle to Tokyo or Anchorage to San Francisco. The times of issue are 0200 and 1800 UT, with these forecasts first broadcast at 0239 and 1839 UT respectively. These are short-term forecasts prepared by NBS-CRPL North Pacific Radio Warning Service, Box 1119, Anchorage, Alaska. (Another short-term forecast at 0900 UT may be broadcast at a later date.)

The forecasters assume that the most suitable radio frequencies for communications are available and in use for the typical paths. Because of this assumption, their notices must be interpreted on a relative scale in terms of experience on each radio circuit in use. It is impossible to rate conditions on an absolute scale since the varied effects of transmitter power, type of communications traffic and procedure, antennas and receivers, prevent an evaluation which will be valid for all circuits. One purpose of broadcasting both a description and a forecast is to show more clearly whether propagation conditions are expected to deteriorate or improve in the coming period. The forecasts broadcast by WWV and WWVH apply only to short-wave radio transmissions over paths which are near the auroral zone for a considerable part of their length. In this zone the ionospheric layers are very likely to be disturbed, and because short-wave, long-range radio transmissions are dependent on the condition of the ionosphere, communications may be disrupted. Often the ionospheric disturbance accompanies intense magnetic field variations and a brilliant aurora. The resulting propagation effects range from severe fading to a complete break in the communications link.

The forecast is broadcast as a letter and a digit. The letter portion of the announcement identifies the radio quality at the time the forecast is made. The letters denoting qnality are "N," "U," and "W," signifying that radio propagation conditions are normal, unsettled, and disturbed. The digit portion is the forecast of the radio propagation quality on a typical North Atlantic (from WWV) or a typical North Pacific (from WWVH) transmission path during the 6 or more hours after the forecast is made. Quality is graded in steps ranging from 1 (useless) to 9 (excellent) as follows:

Disturbed Grades (W)	*Unsettled Grade (U)*	*Normal Grades (N)*
1–useless	5–fair	6–fair-to-good
2–very poor		7–good
3–poor		8–very good
4–poor-to-fair		9–excellent

If, for example, propagation conditions at the time the forecast is made are normal but are expected to be only "poor-to-fair" within the next 6 or more hours, the announcement would be broadcast as N4 in international Morse code.

7. *Radiated Power, Transmitting Antennas, Modulation*

Radiated power is shown in the table below:

Frequency, Mc	*Power, Kw WWV*	*Power, Kw WWVH*
2.5	1	
5	8	2
10	9	2
15	9	2
20	1	
25	0.1	

The broadcast on 2.5 Mc is from a vertical quarter-wave antenna. The broadcasts on all other frequencies are from vertical half-wave dipoles. The radiation is omnidirectional.

The percent amplitude modulation, double sideband, is:

Audio frequencies 440 or 600 c/s	75%
Voice and seconds pulses, peak	100%

At WWV, the tone frequency 440 or 600 c/s, except on 25 Mc, is experimentally operated as a single upper sideband with full carrier. Power output from the sideband transmitter is about one-third the carrier power. Single sideband tone on 25 Mc may be added at a later date. Other signals (announcements and seconds pulses) are double sideband, 100 percent amplitude modulation.

8. *Accuracy*

Frequencies from WWV and WWVH are accurate to within 1 part in 10^8 as broadcast; this is with reference to the U.S. Naval Observatory time and is limited by uncertainties in the immediate determination of astronomical time.

The radio frequencies may be consistently received with accuracies equal to those transmitted for several hours per day during total light or total darkness over the transmission path at locations in the service range. This was described under 1. Standard Radio Frequencies.

Large errors are caused by motion of the radio receiver relative to the transmitting stations or by motions of the reflecting ionospheric layers on which long-distance radio propagation depends. For example, on a vehicle moving 60 miles per hour relative to a fixed station, the received frequency would be in error by about 1 part in 10^7. Measurements made at NBS Boulder Laboratories and at WWVH have shown that during the course of the day errors in the received frequencies vary approximately -3 to $+3$ parts in 10^7.

Daily deviations in frequency and time of stations WWV and WWVH are tabulated on a quarterly basis. These data are available on request. In Figure 2 are plotted time signal deviations extending back 7 years. The deviations may be considerably less commencing in 1956.

9. *Distance Range of Reception*

Of the standard radio frequencies (2.5, 5, 10, 15, 20 and 25 Mc), the lowest provide service to short distances, and the highest to great distances. Reliable reception is in general possible throughout the United States and the North Atlantic and Pacific Oceans, and reception at times throughout the world. One should select the frequency that gives best reception at any particular place and time. This can be done by two methods:

a. By tuning to the different frequencies and selecting the one most suitable at that time.

b. By making use of techniques of prediction of usable frequencies. NBS publications useful for this purpose are the reports of the CRPL-D series, "Basic Radio Propagation Predictions," which are issued monthly, three months in advance of the month of prediction, and Circular 465 of the National Bureau of Standards, "Instructions for the Use of Basic Radio Propagation Predictions." These two publications may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., price in U.S. $1.00 per year (12 issues) and 30 cents per copy, respectively (foreign, $1.25, and 40 cents).

10. *Other Standard Frequency and Radio Time Signal Services*

The U.S. Naval Observatory, Department of the Navy, broadcasts time signals at regular intervals from NSS (Annapolis, Maryland), NPG (Mare Island, California), NPM (Pearl Harbor, Hawaii), NBA (Balboa, Canal Zone). Detailed information may be obtained from the U.S. Naval Observatory, Washington 25, D.C.

The Dominion Observatory, Ottawa, Canada, broadcasts time signals continuously over Station CHU on frequencies of 3330, 7335 and 14670 kc. Information may be obtained by writing the Dominion Observatory.

A comprehensive list of United States and foreign radio time signals is given in chapter 3 of "Radio Navigational Aids," Hydrographic Office publication No. 205,

for sale by the Hydrographic Office, Washington 25, D.C., price $2.00, U.S. or foreign.

Standard frequencies and time signals are broadcast by other stations as indicated in the following table.

Call Sign	*Location*	*Carrier Frequency Mc*	*Modulation c/s*	*Carrier Power Kw*
LOL	Buenos Aires, Argentina	2.5, 5, 10, 15, 20 and 25	1, 440, 1000	2
ZUO	Johannesburg, South Africa	5	I – –	0.1
ZLFS	Lower Hutt, New Zealand	2.5	– – –	0.035
–	Moscow, USSR	10 and 15	I – –	–
MSF	Rugby, England	2.5, 5 and 10	1, 1000 –	0.5
JJY	Tokyo, Japan	2.5, 5, 10 and 15	1, 1000 –	1
IBF	Torino, Italy	5	1, 440, 1000	0.3
–	Uccle, Belgium	2.5	– – –	0.02

FEDERAL COMMUNICATIONS COMMISSION 20103
Washington 25, D.C.

(Revised as of
May 17, 1955)

February 16, 1954

NOTICE TO ALL BROADCAST STATION LICENSEES:

SUBJECT: Rebroadcasts of Time Signals
(This supersedes all notices on this subject of earlier dates)

A. Naval Observatory Time Signals
Any broadcasting station desiring to rebroadcast Naval Observatory Time Signals is hereby authorized to do so, without further permission by the Commission, subject to the following conditions:
1) The time signal rebroadcast must be obtained by direct reception from a Naval radio station.
2) Announcement of the time signal must be made without reference to any commercial activity.
3) Identification of the Naval Observatory as the source of the time signal must be made by an announcement, substantially as follows: "With the signal, the time will be _____, courtesy of the United States Naval Observatory."
Schedules of time signal broadcasts may be obtained upon request from the superintendent, United States Naval Observatory, Washington 25, D.C.

B. Time Signals from National Bureau of Standards Stations
Any broadcasting station desiring to rebroadcast the time signals from stations WWV or WWVH is hereby authorized to do so, without further permission by the Commission, subject to the following conditions:
1) The use of receiving and rebroadcasting equipment which does not delay the signals by more than 0.05 second.
2) Voice of code announcements on WWV or WWVH are not to be rebroadcast.
3) Announcement that the signal is a rebroadcast of a continuous service given by the National Bureau of Standards.

A circular describing the Bureau's radio broadcast services is available on request from the National Bureau of Standards, Boulder, Colorado

Mary Jane Morris
Secretary