

# Frequency Allocations Under The Havana Treaty

(Text of FCC Rules Governing Assignments of Channels)

31.5A—The frequencies in the following tabulation are designated as clear channels and are assigned for use by the classes of stations as given:

(1) For Class I-A stations and Class II stations operating limited time or daytime only, 640, 650, 660, 670, 700, 720, 760, 780, 770, 780, 820, 830, 840, 850, 870, 880, 890, 1020, 1030, 1040, 1100, 1120, 1160, 1180, and 1210 kilocycles.

(2) For Class I-B and Class II stations, 680, 710, 810, 940, 1000, 1060, 1070, 1080, 1090, 1110, 1130, 1140, 1170, 1190, 1200, 1600, 1610, 1520, 1530, 1650, and 1660 kilocycles.

(3) For Class II stations located not less than 650 miles from the nearest Canadian Border and which will not deliver over 5 microvolts per meter ground wave or 25 microvolts per meter 10 per cent time sky wave at any point on said border, 690, 740, 860, 990, 1010\* and 1580 kilocycles.

(\*A station on 1010 kilocycles shall also protect a Class I-B station at Havana, Cuba.)

(4) For Class II stations located not less than 660 miles from the nearest Mexican Border and which will not deliver over 5 microvolts per meter ground wave or 26 microvolts per meter 10 per cent time sky wave at any point on said border, 730, 800, 900, 1050, 1220, and 1670 kilocycles.

(6) For Class II stations located not less than 650 miles from the nearest Cuban Border and which will not deliver over 5 microvolts per meter ground wave or 26 microvolts per meter 10 per cent time sky wave at any point on said border, 1540 kilocycles.

31.6A—The following frequencies are designated as regional channels and are assigned for use by Class III-A and Class III-B stations.\*

(\*See Rule 31.9 in regard to assigning Class IV stations to regional channels.)

650, 660\*, 670\*, 680, 690\*, 600, 610, 620, 630\*, 790, 910, 920, 930, 960, 960, 970, 980, 1160, 1260, 1260, 1270\*, 1280, 1290, 1300, 1310, 1320, 1330, 1350, 1360, 1370, 1380, 1390, 1410, 1420, 1430, 1440, 1460, 1470, 1480, 1690, and 1600 kilocycles.

(\*See North American Regional Broadcasting Agreement for special provision concerning the assigning of Class II stations in other countries of North America to these regional channels. Such stations shall be protected from interference in accordance with Appendix II, Table I, of said Agreement.)

31.7A—The following frequencies are designated as local channels and are assigned for use by Class IV stations:

## Change of Channel Assignments Under the Havana Treaty

A broadcast station assigned to a channel in Column 1 will be changed to the channel on the same horizontal line in Column 2 to comply with North American Regional Broadcasting Agreement (see note). Figures indicate kilocycles.

Col. 1	Col. 2	Col. 1	Col. 2	Col. 1	Col. 2
550	550	910	*	1260	1290
660	660	920	960	1270	1300
670	670	930	960	1280	1310
680	680	940	970	1290	1320
690	690	960	980	1300	1330
600	600	960	*	1310	1340
610	610	970	1000	1320	1360
620	620	980	1020	1330	1360
630	630	990	1030	1340	1370
640	640	1000	1040	1360	1380
650	650	1010	690, 740,	1360	1390
660	660		990 or 1050	1370	1400
670	670	1020	1060	1380	1410
680	680	1030	*	1390	1420
690	*	1040	1080	1400	1430
700	700	1060	1070	1410	1440
710	710	1060	1090	1420	1450
720	720	1070	1100	1430	1460
730	*	1080	1110	1440	1470
740	750	1090	1120	1450	1480
760	760	1100	1130	1460	1500
760	770	1110	1140	1470	1510
770	780 or 1110	1120	1160	1480	1520
780	790	1130	1160	1490	1530
790	810	1140	1070 or 1170	1500	1490
800	820	1160	1180	1510	*
810	830	1160	1170 or 1190	1520	*
820	840	1170	1200	1530	1690
830	860	1180	1170 or 1200	1540	*
840	*	1190	1210	1660	1600
850	870	1200	1230	1660	*
860	880	1210	1240	1670	*
870	890	1220	1250	1680	*
880	910	1230	1260	1590	*
890	920	1240	1270	1600	*
900	930	1250	1280		

\*Not assigned in U. S.  
Some changes in individual cases not in accordance with the above change of channels may be necessary to avoid interference on adjacent channels or other considerations.

1230, 1240, 1340, 1400, 1460, and 1490 kilocycles.

31.8A—(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 standards of good engineering practice prescribed and published from time to time by the Commission for the respective classes of stations involved. (For determin-

ing objectionable interference see "Engineering Standards of Allocation" and "Field Intensity Measurements in Allocation", Section C.)

(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.

31.9A—On condition that interference will not be caused to any Class III station, and that the channel is used fully for Class III stations and subject to such interference as may be received from Class III stations, Class IV stations may be assigned to regional channels.

### License Periods

31.14A—All standard broadcast station licenses will be issued so as to expire at the hour of 3 a. m. (EST) and will be issued for a normal license period of six months, expiring as follows:

(1) For stations operating on the channels 640, 650, 660, 670, 680, 690, 700, 710, 720, 730, 740, 760, 760, 770, 780, 800, 810, 820, 830, 840, 860, 860, 870, 880, 890, 900, 940, 990, 1,000, 1,010, 1,020, 1,030, 1,040, 1,060, 1,060, 1,070, 1,080, 1,090, 1,100, 1,110, 1,120, 1,130, 1,140, 1,160, 1,170, 1,180, 1,190, 1,200, 1,210, 1,220, 1,500, 1,610, 1,620, 1,630, 1,540, 1,660, 1,560, 1,570, and 1,580 kilocycles Aug. 1 and Feb. 1.

(2) For stations operating on the channels 660, 560, 670, 680, 590, 600, 610, 620, 630, 790, 910, 920, 930, and 960 kilocycles Sept. 1 and March 1.

(3) For stations operating on the channels 960, 970, 980, 1,160, 1,260, 1,260, 1,270, 1,280, 1,290, 1,300, 1,310, and 1,320 kilocycles Oct. 1 and April 1.

(4) For stations operating on the channels 1,330, 1,360, 1,360, 1,370, 1,380, 1,390, 1,410, 1,420, 1,430, 1,440, 1,460, 1,470, 1,480, 1,690, and 1,600 kilocycles Nov. 1 and May 1.

(6) For stations operating on the channels 1,230, 1,240, and 1,340 kilocycles Dec. 1 and June 1.

(6) For stations operating on the channels 1,400, 1,450, and 1,490 kilocycles Jan. 1 and July 1.



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# Full Text of North American Regional Broadcasting Agreement

(Allocations Treaty Adopted at Havana, December 13, 1937)

Governments Participating—Canada, Cuba, Dominican Republic, Haiti, Mexico and United States

## I

### Purpose and Scope of This Agreement

**1. Purpose of Agreement**—The purpose of this Agreement is to regulate and establish principles covering the use of the standard broadcast band in the North American Region so that each country may make the most effective use thereof with the minimum technical interference between broadcast stations.

**2. North American Region**—The North American Region (hereinafter referred to as "Region") for the purpose of this Agreement shall be deemed to include and to consist of the following countries: Canada, Cuba, Dominican Republic, Haiti, Mexico, Newfoundland, and United States of America.

**3. Standard broadcast band**—The standard broadcast band shall be deemed to be the band of frequencies extending from 550 to 1600 kc, both inclusive, both 550 kc and 1600 kc, being the carrier frequencies of broadcasting channels as hereinafter defined. The Governments agree, subject to the provisions of Article 7 of the General Radio Regulations annexed to the International Telecommunications Convention Madrid, 1932, that this band of frequencies shall be allocated exclusively to broadcasting in the Region.

**4. Sovereign right to use channels**—The sovereign right of all countries, parties to this Agreement, to the use of every channel in the standard broadcast band is recognized. The Governments recognize, however, that until technical developments reach a state permitting the elimination of radio interference of international character, a regional arrangement between them is necessary in order to promote standardization and to minimize interference.

**5. Regional character of Agreement**—The Governments recognize that this Agreement, and each provision thereof, is a regional arrangement within the meaning of, and authorized by the International Telecommunications Convention and the General Radio Regulations annexed thereto.

## II

### Technical

#### A. Definitions

**1. Broadcast station**—A station the emissions of which are primarily intended to be received by the general public.

**2. Broadcast channels—550 to 1600 kc.**—A broadcast channel is a band of frequencies ten (10) kc. in width, with the carrier frequency at the center. Channels shall be designated by their assigned carrier frequencies. Carrier frequencies assigned to broadcast stations shall begin at 550 kc. and be in successive steps of 10 kc. No intermediate frequency shall be assigned as the carrier frequency of any broadcast station.

**3. Service areas:**  
**(a) Primary service area**—The primary service area of a broadcast station is the area in which the ground wave is not subject to objectionable interference or objectionable fading.

**(b) Secondary service area**—The secondary service area of a broadcast station is the area served by the sky wave and not subject to objectionable interference. The signal is subject to intermittent variations in intensity.

**4. Dominant stations**—A "dominant" station is a Class I station, as hereinafter defined, operating on a clear channel.

**5. Secondary station**—A "secondary" station is any station except a Class I station operating on a clear channel.

**6. Objectionable interference**—Objectionable interference is the degree of interference produced when, at a specified boundary or field intensity contour with respect to the desired

*Following is the complete text of the treaty on distribution of the 106 channels in the broadcast band, ranging from 550 to 1600 kc., reached at the Inter-American Radio Conference in Havana, Nov. 1 to Dec. 13, 1937. The treaty does not become operative until three of the four principal nations (United States, Canada, Mexico, and Cuba) have ratified it, and the fourth signifies its intention of doing so. Then the treaty becomes effective one year after ratification and remains in force for five years. Cuba ratified Dec. 22, 1937; the United States ratified June 15, 1938; Canada ratified Nov. 29, 1938; the Mexican Senate on Oct. 26, 1938, declined to ratify but Negotiations for an administrative agreement with that Government are in progress.*

station, the field intensity of an undesired station (or the root-mean-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 hereinafter set forth in this Agreement.

**7. Power**—The power of a radio transmitter is the power supplied to the antenna. The power in the antenna of a modulated-wave transmitter shall be expressed in two numbers, one indicating the power of the carrier frequency supplied to the antenna, and the other the actual maximum percentage of modulation.

**8. Spurious radiation**—A spurious radiation from a transmitter is any radiation outside the frequency band of emission normal for the type of transmission employed, including any harmonic modulation products, key clicks, parasitic oscillations and other transient effects.

**9. English, French and Spanish equivalents**—It is agreed that, as used in this Agreement, the French and Spanish words below set forth are respectively the equivalent of, and mean the same as, the English terms opposite which they appear:

English	French	Spanish
Clear channel	Frequence libre	Canal despejado
Objectionable interference	Brouillage nuisible	Interferencia objetable

#### Classes of Channels and Allocation Thereof

**1. Three classes**—The 106 channels in the standard broadcast band are divided into three principal classes—clear, regional and local.

**2. 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.

**3. Regional channel**—A regional channel is one on which several stations may operate with powers not in excess of 5 kw. 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.

**4. Local channel**—A local channel is one on which several stations may operate with powers not in excess of 250 watts. 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.

**5. Number of channels of each class**—The number of channels of each class shall be as follows:

Clear channels	59
Regional channels	41
Local channels	6

106

**6. Allocation of specific channels to each class**—The channels are allocated to the several classes as follows:

**Clear channels.** The following channels are designated as clear channels: 640 650 660 670 680 690 700 710 720 730 740 750 760 770 780 800 810 820 830 840 850 860 870 880 890 900 910 920 930 940 950 960 970 980 990 1000 1010 1020 1030 1040 1050 1060 1070 1080 1090 1100 1110 1120 1130 1140 1160 1170 1180 1190 1200 1210 1220 1500 1510 1520 1530 1540 1550 1560 1570 and 1580.

**Regional channels.** The following channels are designated as regional channels: 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 1600.

**Local channels.** The following channels are designated as local channels: 1230 1240 1340 1400 1450 and 1490 kc.

**7. Use of regional and local channels by countries**—All countries may use all regional and all local channels, subject to the power limitations and standards for prevention of objectionable interference set forth in this Agreement.

**8. Priority of use of clear channels by countries**—

(a) The clear channels are assigned for priority of use by Class I and II stations in the several countries in accordance with the table set forth in Appendix I.

(b) Each such channel shall be used in a manner conforming to the best engineering practice with due regard to the service to be rendered by the dominant stations operating thereon, as set forth elsewhere in this Agreement. If, for one year within the term of this Agreement, a country fails to make any use of a clear channel thus assigned to it, the channel shall be considered open for use by the other countries, parties to this Agreement, pursuant to such arrangement as may be agreed upon by their respective administrations and without any necessity for revision of this Agreement.

(c) No country to which a clear channel has been thus assigned shall permit, or agree to permit, any other country to use such channel in a manner not in conformity with this Agreement without first giving 60 days (calendar days) advance notice of its intention so to do to all other countries, parties to this Agreement. If during this period of 60 days (calendar days) any other country shall present objections to such proposed use of the channel, the country to which the clear channel has been assigned shall not permit, or agree to permit, such proposed use until the difference presented by the objection has been amicably resolved.

(d) If within the period of this Agreement the country to which a clear channel has been assigned shall have made use of the channel not in the manner above prescribed or not to the extent required by the provisions of this Agreement, such country shall be considered as having relinquished that portion of the rights which it has not used and at the expiration of this Agreement the other countries party thereto shall have the right, if they see fit, to withdraw the unused privileges from such country and to reassign them to any or all of the other interested countries.

#### C—Classes of Stations and Use of

##### The Several Classes of Channels

**1. Classes of stations**—Broadcast stations are divided into four principal classes, to be designated Class I, Class II, Class III, and Class IV, respectively.

**2. Definitions of classes**—The four classes of broadcast stations are defined as follows:

**Class I:** 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. Class I stations are subdivided into two classes:

**Class I-A:** A Class I station which operates with power of 50 kw or more and which has its primary service area, within the limits of the country in which the station is located, free from objectionable interference from other stations on the same and adjacent channels, and its secondary service area, within the same limits, free from objectionable interference

from stations on the same channel, in accordance with the engineering standards hereinafter set forth.

**Class I-B:** A Class I station which operates with power of not less than 10 kw or more than 50 kw and which has its primary service area free from objectionable interference from other stations on the same and adjacent channels and its secondary service area free from objectionable interference from stations on the same channel, in accordance with the engineering standards hereinafter set forth.

(a) When two Class I-B stations on the same channel are separated by a distance of 2800 miles or more, neither station shall be required to install a directional antenna.

(b) When two Class I-B stations on the same channel are separated by a distance of more than 1800 miles and less than 2800 miles, it will, in the absence of proof to the contrary, be assumed that each station is free of objectionable interference caused by the other and neither shall be required to install directional antennae or take other precautions to avoid such interference. In case the existence of objectionable interference is proved, the governments concerned will consult with each other regarding the desirability and practicality of installation of directional antennae or the taking of other precautions to eliminate the interference and will determine by special arrangement the measures, if any, to be taken.

(c) When two Class I-B stations on the same channel are separated by a distance less than 1800 miles, it will, in the absence of proof to the contrary, be assumed that the installation of directional antennae or the taking of other precautions to avoid interference is necessary, and the governments concerned will consult with each other and will take such measures as may be agreed upon between them to the end that the objectionable interference may be reduced or eliminated.

**Class II:** A "secondary" station which operates on a clear channel and is designed to render service over a primary service area which, depending on geographical location and power used, may be relatively large, but 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 of not less than 0.25 kw, or more than 50 kw. Whenever necessary a Class II station shall use a directional antenna or other means to avoid interference, in accordance with the engineering standards hereinafter set forth, with Class I stations and with other Class II stations.

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

**Class III-A:** A Class III station which operates with power not less than one kilowatt or more than five kilowatts and the service area of which is subject to interference in accordance with the engineering standards hereinafter set forth.

**Class III-B:** A Class III station which operates with a power not less than 0.5 kw or more than 1 kw night and 5 kw daytime and the service area of which is subject to interference in accord with the engineering standards hereinafter set forth:

**Class IV:** A station using 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 kw or more than 0.25 kw and its service area is subject to interference

(Continued on page 312)

# Full Text of North American Regional Broadcasting Agreement

(Continued from page 311)

in accord with the engineering standards hereinafter set forth.

3. *Change of class*—If a station or stations in Class III-B located in any country can, through the use of directional antennae or otherwise, so reduce the interference caused or received by such station or stations to the field contour to which interference to stations in Class III-A is allowed, such station or stations shall automatically be classified and included in Class III-A and shall thereafter be so recognized and treated by the Administrations of all countries within the Region.

4. *Use of clear channels:*

(a) In principle and subject only to the exception hereinafter set forth, Class I stations shall be assigned only to clear channels.

(b) Class II stations may be assigned to clear channels only on condition that objectionable interference will not be caused to any Class I stations. Where any country has priority of use of a clear channel for any class I-A station, no other country shall assign any Class II station to that channel for nighttime operation (from sunset to sunrise at the location of the Class II station) unless such Class II station is located not less than 650 miles from the nearest border of the country in which the Class I-A station is located; provided, however, that where an assignment for a Class II station is specifically stated in Appendix I, such assignment shall be deemed as authorized under the limitations therein set forth.

5. *Use of regional channels:*

(a) In general only Class III-A and Class III-B stations shall be assigned to regional channels.

(b) On condition that interference be not caused to any Class III-A or Class III-B station, and subject to

such interference as may be received from Class III-A or Class III-B stations, Class IV stations may be assigned to regional channels.

(c) Because of their geographical location with respect to the North American continent, special consideration will be given to the use by Cuba, the Dominican Republic, Haiti and Newfoundland of stations of Classes I and II assigned to certain regional channels under certain conditions, with respect to power and precautions to avoid objectionable interference as set forth in Appendix VII.

6. *Use of local channels*—Only Class IV stations shall be assigned to local channels.

D. *Service and Interference*

1. *Satisfactory signal*—It is recognized that, in the absence of interference from other stations and in regions where the natural electrical noise level is not abnormally high, a signal of 100 microvolts per meter constitutes a usable signal in rural and sparsely settled areas but that, because of the higher electrical noise levels in more thickly populated communities, greater field intensities (ranging as high as 25 millivolts or more in cities) are necessary to render satisfactory service. It is further recognized that it is not possible to accord protection to stations from objectionable interference over the entire areas over which their signals are or may be above the electrical noise level, particularly at night, and that it is necessary to specify boundaries or contours at or within which stations are protected from objectionable interference from other stations.

2. *Areas protected from objectionable interference*—The boundaries or contours at and within which the several classes of stations shall be pro-

ected from objectionable interference are as set forth in Appendix II. No station, however, need be protected from objectionable interference at any point outside the boundaries of the country in which such station is located.

With respect to the root-mean-square values of interfering field intensities referred to herein, it shall be understood to apply in determining the interference between existing stations and no station thereafter assigned the channel shall increase the root-mean-square value of the interfering field intensity above the maximum specified in the attached tables.

3. *Objectionable interference on the same channel*—Objectionable interference shall be deemed to exist to a station when, at the boundary or field intensity contour specified in Appendix II with respect to the class to which the station belongs, the field intensity of an interfering station (or the root-mean-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 Appendix II.

4. *Interference to dominant clear channel stations*—A station shall be considered as not capable of causing objectionable interference to a Class I clear channel station on the same frequency when it is separated from the dominant clear channel station by a difference of 70 degrees or more of longitude.

5. *Objectionable interference on adjacent channels*—It is recognized, in principle, that objectionable interference may be caused to a desired station when, at or within the specified contours of a desired station, the field intensity of the ground wave of an undesired station operating on an adjacent channel (or the root-mean-square value of the field intensities of two or more such undesired stations operating on the same adjacent channel) exceeds a value determined by the following ratio:

Separation between channels	Minimum permissible ratio of desired to undesired signals
10 ke.	1 to 0.5
20 ke.	1 to 10
30 ke.	1 to 50

For convenient reference, the maximum permissible values of interfering signals on such adjacent channels at specified contours are set forth in Appendix III, Table I.

6. *Application of standards to existing stations:*

(a) For the purpose of estimating objectionable interference, all stations (other than those of Class II) shall be assumed to use the maximum power permitted to their respective classes. In this connection, the power of Class I-A stations shall be considered to be 50 kw. or the actual power, if higher.

(b) After this agreement has been placed in operation a station thereafter assigned a channel already assigned to other stations shall not be considered as preventing existing stations from increasing their power to the maximum allowed their class, even though such power increase may limit the newly assigned station to a field intensity contour of higher value than that permitted its class.

7. *Frequency stability*—The operating frequency of each broadcast station shall be maintained to within 50 cycles of the assigned frequency until January 1, 1939, and thereafter the frequency of each new station or each station where a new transmitter is installed shall be maintained within 20 cycles of the assigned frequency, and after January 1, 1942, the frequency of all stations shall be maintained within 20 cycles of the assigned frequency.

8. *Spurious radiation*—The governments shall endeavor to reduce and, if possible, eliminate spurious radiations from broadcast stations. Such radiations shall be reduced in all cases until they are not of sufficient intensity to cause interference outside the frequency band required for the type of emission employed. With respect to type A-3 emissions (radio-telephony) the transmitter should not be modulated in excess of its modulation capability to the extent that interfering spurious radiations occur, and, with respect to amplitude modulation, the operating percentage of modulation should not be less than seventy-five (75) percent on peaks of frequent recurrence. Means should be employed to insure that the transmitter is not modulated in excess of its modulation capability.

E. *Determination of Presence of Objectionable Interference*

1. *Antenna performance*—For the purpose of calculating the presence and the degree of objectionable interference, stations of the several classes shall be assumed to produce effective field, corrected for absorption, for one kilowatt of input power to the antenna, as follows:

Class of Station	At One Mile	At One Kilometer
I	225 mv/m	362 mv/m
II and III	175 mv/m	282 mv/m
IV	150 mv/m	241 mv/m

In case a directional antenna is employed, the interfering signal of a broadcasting station will vary in different directions. To determine the interference in any direction, in the absence of actual interference measurements, the horizontal and vertical field intensity patterns of the directional antenna must be calculated and by comparing the appropriate vectors in the horizontal or vertical pattern with that of a nondirectional with the same effective field, the interfering signal toward any other station can be expressed in terms of kilowatts. This rating in kilowatts shall be applied in the use of mileage separation tables or in computing distances from the propagation curves or tables.

2. *Power*—The power of a station shall, for the purposes of notifications required by this Agreement, be determined in one of the following manners:

(a) By taking the product of the square of the antenna current and the antenna resistance (antenna input power).

(b) By determination of the station's effective field intensity, corrected for absorption, by making sufficient field intensity measurements on at least eight radials as nearly equally spaced as practicable and by relating the field intensity thus determined to the effective field intensity of a station having the antenna efficiency stipulated above for its class.

3. *Methods of determining the presence of objectionable interference*—The existence or absence of objectionable interference from stations on the same or adjacent channels shall be determined by one of the following methods:

(a) By actual measurements contained in the method hereinafter prescribed; or, with the mutual consent of the countries concerned:

(b) By reference to the propagation curves in Appendices IV and V, or

(c) By reference to the distance tables set forth in Appendix VI.

4. *Actual proof of existence or absence of objectionable interference*—The existence or absence of objectionable interference may be proved by field intensity measurements or recordings made with suitable apparatus, duly calibrated, by Government

(Continued on page 314)

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# TRANSMISSION LINE NEWS

## GAS-FILLED ALUMINUM COAXIAL CONDUCTOR

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Light weight and low cost feature this radically new development in transmission line design, while life factor and electrical properties are comparable to those of copper. Solderless connectors make gas-tight joints of high tensile strength by a simple process of tightening bolts. Iso-Q\* low-loss ceramic insulators, shaped to conform with the electrical field, and shielded to eliminate air gap stresses, provide the ultimate in safety and efficiency.

The differential expansion or contraction between the inner and outer tubes is halved by locking the two tubes securely with respect to each other at the middle of the line, so that expansion takes place in both directions from the center point.

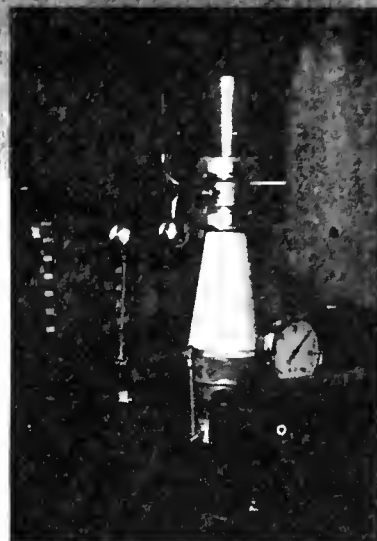
Every detail of this new aluminum line is engineered with the same skill that has made Isolantite copper transmission line the choice of more than 100 broadcasting stations throughout the country. Write for information on aluminum and copper transmission lines for broadcast, police radio, airway beacon, and communications equipment.

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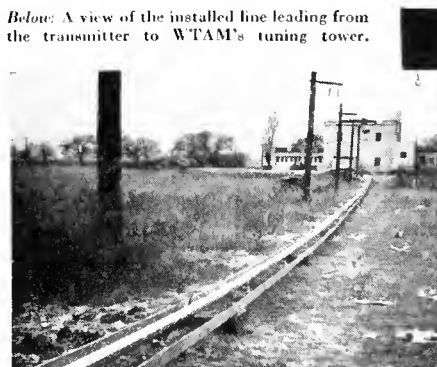


*Above:* Locking insulator located at center of line allows two-way expansion. Solderless connectors provide gas-tight joints.



*Right:* Fittings for the line include gas-tight Isolantite end seal equipped with lightning protection gaps and gage for checking gas pressure.

*Below, right:* A simple tightening operation with a wrench seals the joints in the line against leakage of gas.



*Below:* A view of the installed line leading from the transmitter to WTAM's tuning tower.



# ISOLANTITE INC.

## CERAMIC INSULATORS

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# Full Text of North American Regional Broadcasting Agreement

(Continued from page 312)

engineers or other engineers as may be mutually acceptable to the Governments concerned. Such field intensity measurements shall be made in the manner and for the periods of time mutually agreed upon by the Governments concerned.

The contracting Governments agree to facilitate the making of the measurements by requiring the stations involved to remain silent or operate in the manner deemed necessary, and at such times as not to interrupt regular schedules.

5. *Proof based on propagation curves and distance tables:*

(a) *Sky wave curves*—In computing the distance to the 50 per cent sky wave field intensity contour of a Class I station of a given power, and also in computing the 10 percent sky-wave field intensity of an alleged interfering station, of any class and given power, at a specified distance, use may be made of the appropriate graphs set forth in Appendix V, entitled "Average Sky Wave Field Intensity Corresponding to the Second Hour after Sunset in the Recording Station, 100 Millivolt per Meter at One Mile (161 at one kilometer)".

(b) *Ground wave curves*—The distance to any specified ground wave field intensity contour may be determined from appropriate ground wave curves plotted for the frequency under consideration and the conductivity and dielectric constant of the earth between the station and desired contour. The frequency and the conductivity of the earth must be considered in every case and where the distance is great due allowance must be made for loss due to curvature of the earth. A family of curves is necessary for this purpose. A graph for a conductivity of 10-13 is set forth in Appendix IV, entitled "Ground Wave

Field vs. Distance for One Kilowatt Radiated From Short Antenna". Three frequencies in the standard broadcast band are given. For other frequencies and soil conditions (conductivity and dielectric constant) other curves are required. A conductivity of 10-13 is considered average and is used throughout in determining the ground wave value for computing the mileage separation tables.

(c) *Distance tables*—Table I shows the required day separation in miles between broadcast stations on the same channel. Table II gives the required distance in miles from the boundary of a country in which a Class I-A station is located for the daytime operation of a Class II station on the same channel in another country. Table III gives the required separation in miles between broadcast stations on adjacent channels during both daytime and nighttime. Table IV gives the required night separation in miles between broadcast stations operating on the same channel. The assumed conditions of operation are given in Appendix VI.

The tables are based upon the use of nondirectional antennas but, in case a directional antenna is employed at a particular station, it will be necessary to consider the radiation distribution of the directional antenna involved and to modify the mileage separation tables accordingly. The night separation tables for stations on the same frequency are computed from the skywave curve given in Appendix V. These curves are based on extensive measurements of the skywave produced by broadcasting stations and shall be considered as accurate in all cases unless proof to the contrary is available as set out in Section E 4. The mileage separation tables for the same channel during daytime and for

adjacent channels day and night are computed from the groundwave curve in Appendix IV. Tables apply only in case the frequency is 1000 kc and the assumed soil conductivity and dielectric constant prevail. Since these values vary in every case the tables for daytime and adjacent channel separation cannot be used except as a general guide. In any case under consideration an estimate of the mileage separation required may be made from the operating frequency and known or assumed soil conditions. To determine the interference accurately, measurements must be made in accordance with Section E 4 on the frequency under consideration or on another frequency and from the curves the values may be determined for the desired frequency.

#### F. Miscellaneous

1. *Engineering standards*—The engineering standards set forth in this Agreement are subject to revision when justified by technical advances in the art, with the mutual consent of the governments parties to this Agreement.

*Attachments:*  
Appendix I—Priority of use of clear channels for Class I and II stations.

Appendix II—Protected service and interference.

Appendix III—Adjacent channel interference.

Appendix IV—Ground wave graphs.

Appendix V—Sky wave graphs.

Appendix VI—Mileage separation tables.

Appendix VII—Engineering requirements for use of regional channels by Class II stations.

#### III

#### Notification and Effect Thereof

1. *Initial notification*—Each Government shall, as soon as possible af-

ter ratification of this Agreement, and in any event not later than 180 days prior to the effective date thereof, transmit to the other Governments:

(a) A complete list of all broadcast stations actually in operation in its country in the standard broadcast band both as of the date of the signing of this Agreement and as of the date of transmitting said list, showing with respect to each station its call signal, location, frequency, power, and antenna characteristics together with all changes authorized to be made with respect to said stations on or before the effective date of this Agreement, and the classification claimed for each such station.

(b) A complete list of all changes authorized to be made with respect to said stations after the effective date of this Agreement, the dates on or before which such changes are to be consummated, and the classification claimed for each such station under this Agreement when the proposed change has been consummated.

(c) A complete list of all new broadcast stations authorized but not yet in operation, showing with respect to each such station its call signal, location, frequency, power and antenna characteristics, the date and or before which each such station shall commence operation, and the classification claimed for it under this Agreement.

(d) The Governments agree that prior to the effective date of this Agreement, they will, so far as possible, resolve all conflicts that may arise between them as a result of the foregoing initial listings, and that, notwithstanding some such conflicts may

(Continued on page 316)

## Engineering Services for Radio Stations

Allocation Engineering

Frequency Surveys

Equipment Studies

Engineering Advice

Antenna Designs  
of all Types

Field Intensity Measurements

Particular Consideration to Directional  
Characteristics

General Communication Problems

Counsel on Station Construction

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**Give you more performance - - at less cost!**

From station to station the word is going around about the new performance and efficiency records introduced by Lingo Radiators. IT'S THE BIG NEWS OF THE YEAR! More and more alert station owners, managers and engineers are realizing that actual results for commercial, police and government stations throughout the world have proven that Lingo "Tube" Radiators give maximum performance and economy.

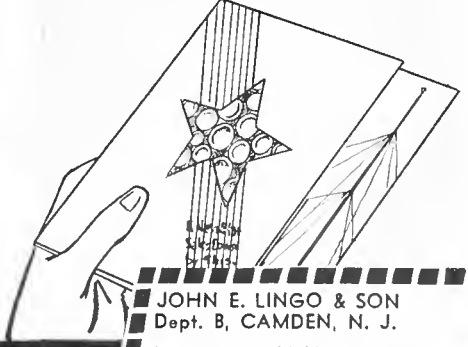
Radio station CFAC writes, "We are satisfied that a more efficient and economical Radiator could not be obtained." If you, like other aggressive radiomen, investigate the amazing results of LINGO efficiency and economy, you will realize that here, indeed, are NEW STANDARDS that vitally affect your future. You will want to do something about it. You will want to take advantage of this new high in efficiency and new low in cost.

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We have published this new 1939 brochure for you. Just off the press, it contains actual evidence and facts that will interest you, whether you are planning to install a new antenna system now, or in the future. If you want to know in advance, not only what you can expect . . . but what you CAN GET . . . then drop us a line. State frequency, location and power of station and we will give you complete costs and performance charts in advance . . . without obligation.

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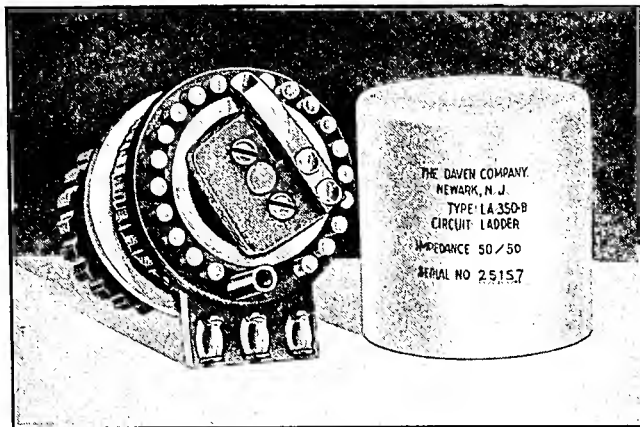
Station .....

City .....

# Best Results With DAVEN ATTENUATORS

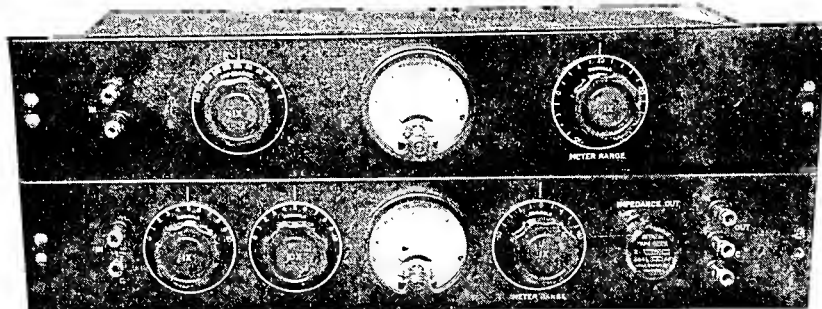
The inherent quality and dependability of DAVEN resistance units for attenuation is not affected by their low prices. The DAVEN attenuators are designed for commercial applications, and are guaranteed to give utmost satisfaction.

DAVEN products are demanded by leading broadcast stations, newsreel companies, recording studios, electrical and university laboratories and public address sound specialists for best results at lowest cost.



**TYPE LA-350** Circuit: Ladder network. Noise level: minus 137 db. Number of steps: 20. Minimum attenuation: 6 db. for 1:1 impedance, 2 db. for 1:2 impedance. Maximum attenuation: infinity. Attenuation on next to last step: 52 db. Attenuation per step: 2 db., tapered on last three steps to complete cut-off. Frequency error: None over the range 0 to 20,000 cycles. 100% wire wound. Knob, Alumilite dial and Shield supplied. Dimensions: 1 3/4 in. diameter, 1 3/4 in. depth. Mounting: single hole, 3/8-32 bushing. Terminal impedances: 30/30, 50/50, 200/200, 250/250, 500/500, 600/600, 30/60, 50/100, 250/500.

NET PRICE \$7.50



## TYPE 685 DAVEN UNIVERSAL GAIN SET

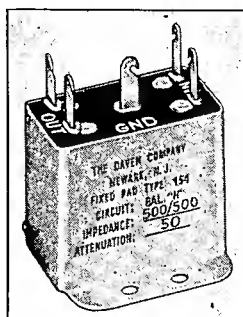
A universal gain measuring instrument for rapid and accurate measurement of overall gain, frequency response and power output of audio amplifiers. All networks, meters and associated apparatus shielded and carefully balanced, matched for uniform accuracy over a wide frequency range.

• ATTENUATION RANGE: plus 10 db. to minus 120 db. in 1 db. steps • POWER MEASURING RANGE: minus 20 db. to plus 36 db. • LOAD IMPEDANCE: Eleven values, ranging from 5 to 600 ohms, are available • OUTPUT IMPEDANCES: May be changed from "balanced" to "unbalanced" and to any loss and impedance required by means of plug-in type matching networks • FREQUENCY RANGE: 20 to 17,000 cycles • ACCURACY OF ATTENUATION CONTROLS: plus or minus 1% • PRICES ON REQUEST.

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Pads are fixed type attenuator networks for use where a definite and constant loss must be introduced without upsetting the impedance characteristics of the system. They are also used for changing from one impedance to another. Most popular terminal impedances and decibel loss available in stock for immediate delivery. Any terminal impedance or loss may be secured at no additional cost.

Balanced "H" network ..... \$4.00  
"TEE" network ..... \$3.00



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158-160 SUMMIT STREET NEWARK, NEW JERSEY

Page 316 • 1939 Yearbook Number

## Text of North American Agreement

(Continued from page 314)

remain unresolved, they will cooperate to the end that there be no delay in putting the provisions of this Agreement into full force and effect on that date.

(e) In resolving conflicts in the use of clear channels, and in the listing of Class I and Class II stations, the provisions of this Agreement and particularly of Appendix I shall be controlling. In resolving conflicts in the use of regional and local channels, and in the listing of Class III and Class IV stations, priority of use shall be recognized in each country with respect to stations which at the time of signing of this Agreement are in actual operation, which in substance conform to the definitions of said classes as set forth in this Agreement, and with respect to which no substantial change is made or proposed; a change of frequency in order to conform to the designation of channels in this Agreement shall not be deemed a substantial change.

2. *Subsequent notifications*—After the effective date of this Agreement and throughout the period during which it shall remain in effect, each Government shall promptly notify the other Governments by registered letter of all further changes in existing broadcast stations and of all further new broadcast stations, together with similar information with regard to each such change or new station, and the proposed date on which each such change is to go into effect and on which each such new station is to actually commence operation.

3. *Effect of notification*—Each government may, within 30 days of receiving notification of any proposed change in the assignment of an existing station or of the authorization of a new station in another country, notify the Government of the latter country of any objection it may have there to under the terms of this Agreement.

4. *Conflict between notifications*—To be valid, notifications of changes in the assignments of existing stations, or of authorizations of new stations must be such that the assignments proposed therein are in accordance with this Agreement and are such as not to involve objectionable interference to existing stations in other countries, assigned and operating in accordance with this Agreement. As between two or more notifications of changes or authorizations of new stations proceeding from different countries, after the effective date of this Agreement, priority in the date of mailing of notification shall govern.

5. *Cessation of effect*—(a) A notification of a proposed change in the assignment of an existing station or of an authorization of a new station shall cease to have any force and effect if, within one year of the date thereof such change shall not have been actually consummated or such new station shall not have actually commenced continuous operation.

(b) In special cases in which circumstances beyond the control of the Administration concerned have prevented the completion of the change or the construction of the new station, the term of the original notification may be extended for a period of six months.

6. *Berne Bureau*—The foregoing notifications shall be made independently of and in addition to those which, under current practice, are sent to the Bureau of the International Telecommunications Union.

### IV Arbitration

In case of disagreement between two or more contracting Governments concerning the execution of this Agreement the dispute, if it is not settled through diplomatic channels, shall be submitted to arbitration at the request of one of the Governments in disagreement. Unless the parties in disagreement agree to adopt a procedure already established by treaties concluded between them for the settle-

ment of international disputes, the procedure shall be that provided for in Article 15 of the International Telecommunications Convention of Madrid, 1932.

### V Ratification, Execution and Denunciation

1. *Ratification*—To be valid this Agreement must be ratified by Canada, Cuba, Mexico and the United States of America.

If and when three of said four countries shall have ratified and the fourth shall, through unavoidable circumstances, have been unable to ratify but shall have signified to those countries that have ratified its readiness, pending ratification and as an administrative measure, to put the provisions of this Agreement (including the contents of Appendix I) into effect in whole or in part, then such country, together with those countries which shall have ratified, may, by administrative agreement between them, fix a definite date on which they shall give effect to such provisions, which date shall preferably be one year from the date of such administrative agreement.

The ratification must be deposited, as soon as possible, through diplomatic channels, in the archives of the Government of Cuba. This same Government shall, through diplomatic channels, notify the other signatory Governments of the ratifications as soon as they are received.

2. *Effect of ratification*—This Agreement shall be valid only as between such countries as shall have ratified it.

3. *Execution*—The contracting Governments undertake to apply the provisions of this Agreement, and to take steps necessary to enforce said provisions upon the private operating agencies recognized or authorized by them to establish and operate broadcast stations within their respective countries.

4. *Denunciation*—Each contracting Government shall have the right to denounce this Agreement by a notification addressed, through diplomatic channels, to the Government of Cuba, and announced by that Government, through diplomatic channels, to all the other contracting Governments. This denunciation shall take effect at the expiration of the period of one year from the date on which the notification was received by the Government of Cuba. This effect shall apply only to the author of the denunciation. This Agreement shall remain in force for the other contracting Governments but only as between such Governments.

### VI Effective Date and Term of the Agreement

1. Except for the provisions of Section 1 of Part III, Section 1 of Part V, and paragraph 3 of Table VI of Appendix I annexed hereto (which provisions shall go into effect immediately upon this Agreement becoming valid), this Agreement shall become effective one year after the date it shall have been ratified by the fourth of those Governments whose ratification is requisite to the validity of this Agreement. The Governments will cooperate to the end that, wherever possible, the provisions of this Agreement shall be carried out in advance of said effective date.

2. This Agreement shall remain in effect for a period of five years after said effective date.

### VII Adherence

This Agreement shall be open to adherence in the name of Newfoundland.

In witness whereof the respective plenipotentiaries have signed the Agreement in triplicate, one copy in English, one in Spanish, and one copy in French, each of which shall remain deposited in the archives of the Government of Cuba and a copy of each of which shall be forwarded to each Government.

Done at Habana, Cuba, December 13, 1937.

BROADCASTING • Broadcast Advertising

# Appendices and Tables: Allocation Provisions of Havana Agreement

## APPENDIX I

Under the provisions of Section II of this Agreement each country may use all the 106 channels when technical conditions with respect to interference to established stations are such as to render such use practicable. However, priority of use on specified clear channels is recognized for the following number of Class I and II stations in each country.

TABLE I

Canada	14
Cuba	9*
Dominican Republic	1
Haiti	1
Mexico	15
Newfoundland	2*
United States	63

\*See Table V for special arrangements provided for Cuba and Newfoundland.

These stations and the conditions of their operation are as specified in Tables II, III, IV, V, VI, VII and VIII following herewith.

TABLE II  
Class I-A Stations  
(Canada, Cuba, and Mexico)

Frequency	Location of Stations
690	Quebec, Canada
730	Mexico, D. F.
740	Ontario, Canada
800	Sonora, Mexico
860	Ontario, Canada
900	Mexico, D. F.
990	Manitoba, Canada
1010	Alberta, Canada
1050	Nuevo Leon, Mexico
1220	Yucatan, Mexico
1540	Santa Clara, Cuba
1570	Nuevo Leon, Mexico
1580	Quebec, Canada

TABLE III  
Class I-B Stations

Frequency	Location of stations	Power Limitation (Kw.)	Requirements as to directional antennas
810	New York, U. S. A.	—	None
810	California, U. S. A.	—	To be determined
940	Quebec, Canada	5 kw. min. permissible	Determine from operation
940	Mexico, D. F.	—	Determine from operation
1000	Jalisco, Mexico	20	To be determined
1000	Washington, U. S. A.	—	To be determined
1000	Illinois, U. S. A.	—	To be determined
1010	Havana, Cuba	—	Determine from operation
1060	Mexico, D. F.	—	To be determined
1060	Pennsylvania, U. S. A.	—	To be determined
1070	Maritime Provinces, Canada	—	None
1070	California, U. S. A.	—	None
1080	Connecticut, U. S. A.	—	To be determined
1080	Texas, U. S. A.	—	To be determined
1090	Baja Calif., Mexico	—	To be determined
1090	Maryland, U. S. A.	—	To be determined
1090	Arkansas, U. S. A.	—	To be determined
1110	North Carolina, U. S. A.	—	To be determined
1110	Nebraska, U. S. A.	—	To be determined
1130	British Columbia, Canada	5 kw. min. permissible	None
1130	New York-New Jersey, U. S. A.	—	None
1140	Chihuahua, Mexico	—	To be determined
1140	Virginia, U. S. A.	—	To be determined
1170	Oregon, U. S. A.	—	To be determined
1170	Oklahoma, U. S. A.	—	To be determined
1170	West Virginia, U. S. A.	—	To be determined
1190	Sinaloa, Mexico	—	To be determined
1190	Indiana, U. S. A.	—	To be determined
1550	Ontario, Canada	—	Determine from operation
1550	Vera Cruz, Mexico	20	Determine from operation
1560	Havana, Cuba	—	.....

TABLE IV  
Class II Stations

Frequency	Location of stations	Power Limitation (Kw.)	Requirements as to directional antennas
640	Newfoundland	—	None
690	Kansas-Oklahoma, U. S. A.	—	To be determined <sup>a</sup>
740	Calif., U. S. A.	—	To be determined <sup>b</sup>
800	Ontario, Canada	5	To be determined
810	Tumapulipas (Tampico) Mexico	50	To be determined
900	Quebec, Canada	5	To be determined
990	Tennessee, U. S. A.	—	To be determined <sup>c</sup>
1000	Oriente, Cuba	10	To be determined
1050	New York, U. S. A.	—	To be determined
1060	Alberta, Canada	10	To be determined
1070	Alabama, U. S. A.	—	To be determined
1080	Manitoba, Canada	15	To be determined
1080	Haiti	10	To be determined
1110	Mexico, D. F.	20	To be determined
1130	Louisiana, U. S. A.	—	To be determined
1170	Dominican Republic	10	To be determined
1190	Havana, Cuba	15	To be determined

<sup>a</sup> Permissible to increase field intensity above 25 uv/m (10% skywave) west of Minnesota on Canadian border.

<sup>b</sup> Same as <sup>a</sup> except west of North Dakota.

<sup>c</sup> Same as <sup>a</sup> except east of Minnesota. Also 650 miles from border requirement waived.

TABLE V  
Class II Stations<sup>a</sup> on Regional Channels  
(Cuba and Newfoundland)

Frequency	Location of Stations	Maximum Power in kw.
560	Newfoundland	10
570	Santa Clara, Cuba	15
590	Havana, Cuba	25
630	Havana, Cuba	15
1270	Havana, Cuba	10

<sup>a</sup> These stations shall use directional antennas to prevent objectionable interference to the Class III stations on the channel in accordance with Appendix VII.

TABLE VI

### Special Conditions Affecting the United States

The 24 Class I and II stations in the United States which use clear channels with other countries party to this agreement are given in Tables III and IV. The remaining 39 Class I and II stations of the United States will be assigned the following clear channels:

640 650 660 670 680 700 710 720 750 760 770 780 820 830 840 850 870 880 890 1020 1030 1040 1100 1120 1160 1180 1200 1210 1500 1510 1520 1530

It is recognized that the United States must make extensive adjustments in the assignments of its existing stations in order to make possible the carrying out of this Agreement, that these adjustments will require approximately a year, and that it is not possible for the United States at this time to specify on which of the said 32 channels it will have priority of use for Class I-A stations, Class I-B stations and Class II stations respectively, nor the locations of such stations, power and other information with respect thereto. The United States may assign Class I-A stations to at least 25 of said channels. The United States agrees that ninety days before the effective date of this Agreement it will communicate this information to each of the other countries parties to this Agreement, and such information, when communicated, shall be considered part of this Agreement as if fully set forth herein.

Nothing stated in this Agreement shall be construed to preclude the United States of America from asserting, and enjoying recognition of, priority of use with reference to certain other Class II stations (not included in the 63 stations mentioned in Table I) which are now in actual operation in the band 640-1190 kcs. and which are known under the Regulations of the Federal Communications Commission as "limited time stations" and "daytime stations" (having hours of operation limited to sunset taken either at their respective locations or at the locations of the respective dominant stations on clear channels and in some cases including hours not actually used by said dominant stations) which stations may, so far as permitted by the terms of this Agreement and the engineering standards herein set forth, be given assignments substantially equivalent to those they now enjoy.

TABLE VII

### Special Conditions Regarding the Use of 1010 kc. by Cuba and Canada

With regard to the use of the clear channel of 1010 kc by a Class I-A station in Canada, and by a Class I-B station in Cuba, both countries mutually agree that the interfering signal shall not exceed for 10 per cent of the time or more the value of 50 microvolts per meter at the following points of measurement: in Cuba at any point east of the province of Camaguey, and in Canada at any point west of the province of Manitoba.

TABLE VIII

### Special Conditions Affecting Canada

Nothing stated in this Agreement shall be construed to preclude Canada from asserting priority of use with reference to certain Class III and IV stations now in operation in Canada on existing clear and regional channels which through this Agreement will become of a class of channel which may not permit their use by Class III and IV stations.

(Continued on page 318)

**PAUL F. GODLEY**

Consulting Radio Engineer

Phone: Montclair (N. J.) 2-7859



# Appendices and Tables: Allocation Provisions of Havana Agreement

(Continued from page 317)

## PROTECTED SERVICE CONTOURS AND PERMISSIBLE INTERFERENCE SIGNALS FOR BROADCAST STATIONS

### APPENDIX II

TABLE I

Class of station	Class of channel used	Permissible power	Boundary or signal intensity contour of area protected from objectionable interference a		Permissible interfering signal b	
			Day	Night	Day	Night c
I A	Clear	60 kw or more	Boundary of country in which station is located		5 uv/m	26 uv/m d
I B	Clear	10 kw to 50 kw	100 uv/m	500 uv/m (50% sky wave)	5 uv/m	26 uv/m
II	Clear d	0.26 kw to 60 kw	600 uv/m e	2600 uv/m e (Ground wave)	26 uv/m e	126 uv/m e
III A	Regional	1 kw to 5 kw	600 uv/m	2500 uv/m (Ground wave)	26 uv/m	126 uv/m
III B	Regional	0.6 kw to 1 kw night and 5 kw day	600 uv/m	4000 uv/m (Ground wave)	26 uv/m	200 uv/m
IV	Local	0.1 kw to 0.26 kw	600 uv/m	4000 uv/m (Ground wave)	26 uv/m	200 uv/m

a In accordance with other provisions in this Agreement this freedom of interference does not apply outside the boundaries of the country in which the station is located.

b From other stations on same channel only. For adjacent channels see Appendix III, Table I.

c Sky wave field intensity exceeded for 10% of the time.

d No Class II station shall be assigned to the same channel as a Class I-A station for nighttime operation (from sunset to sunrise) less than 660 miles of the nearest border of the country in which the Class I-A station is located.

e These values are with respect to interference from all stations except Class I, 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 stations will not exceed these values. If the Class II stations are limited by Class I stations to higher values, then such values shall be the standard established with respect to interference from all other classes of stations.

### APPENDIX III

TABLE I

#### ADJACENT CHANNEL INTERFERENCE

Channel separation between desired and undesired stations	Maximum ground wave field intensity of undesired station
10 kc	0.25 mv/m
20 kc	5.0 mv/m
30 kc	25.0 mv/m

The undesired ground wave signal shall be measured at or within the 0.5 mv/m ground wave contour of the desired station. These values apply to all classes of stations both day and night and are based on ground waves only. No adjacent channel interference is considered on the basis of an interfering sky wave.

### APPENDIX VI

#### Mileage Separation Tables

The required separations between broadcasting stations as tabulated below are based upon the following conditions:

1. The use of nondirectional antennas.
2. Antenna efficiencies (in mv/m at one mile for one kilowatt).  
Class I—225 mv/m  
Class II and III—175 mv/m  
Class IV—150 mv/m
3. Frequency, 1000 kc.
4. Soil conductivity,  $s = 10-13$ .
5. Soil dielectric constant,  $e = 15$ .
6. Groundwave transmission as shown on chart in Appendix IV.
7. Skywave transmission as shown on chart in Appendix V.
8. Protection to service areas as shown in Appendix II, Table I.
9. Ratio of desired to undesired signal:

Channel Separation	Ratio of Desired to Undesired
Same frequency	20:1
10 kc.	2:1
20 kc.	1:10
30 kc.	1:50

TABLE I  
REQUIRED DAY SEPARATION IN MILES BETWEEN BROADCAST STATIONS ON THE SAME CHANNEL

Class and Power	Class IV		Classes II and III							Class I					
	100 W.	250 W.	0.25 Kw.	0.5 Kw.	1 Kw.	5 Kw.	10 Kw.	25 Kw.	50 Kw.	10 Kw.	25 Kw.	50 Kw.	100 Kw.	250 Kw.	500 Kw.
Class IV															
100 W.	143	165	172	192	213	266	285	310	336	390	417	437	462	486	513
250 W.	165	173	180	200	221	273	293	318	343	415	442	462	487	611	638
Classes II and III															
0.25 Kw.	172	180	183	203	224	276	296	321	346	418	446	465	490	514	641
0.5 Kw.	192	200	203	210	231	283	303	328	363	446	473	493	618	542	669
1 Kw.	213	221	224	231	239	291	311	336	361	467	494	514	639	663	590
5 Kw.	265	273	276	283	291	313	333	368	383	620	647	667	692	616	643
10 Kw.	286	293	296	303	311	333	345	370	395	640	667	687	612	636	663
26 Kw.	310	318	321	328	336	368	370	389	414	665	692	612	637	661	688
50 Kw.	335	343	346	363	361	383	395	414	430	587	614	634	639	683	710
Class I															
10 Kw.	390	416	418	446	467	520	540	665	587	656	686	605	620	655	682
26 Kw.	417	442	446	473	494	647	667	692	614	686	612	632	657	692	709
60 Kw.	437	462	466	493	514	667	587	612	634	606	632	652	677	702	729
100 Kw.	462	487	490	618	639	692	612	637	669	628	657	677	697	727	754
260 Kw.	486	611	614	642	663	616	636	661	683	666	682	702	727	751	778
500 Kw.	513	538	641	669	690	643	663	688	710	682	709	729	764	778	806

TABLE II

#### REQUIRED DISTANCE IN MILES FROM THE BOUNDARY OF A COUNTRY IN WHICH A CLASS I-A STATION IS LOCATED FOR DAYTIME OPERATION OF A CLASS II ON THE SAME CHANNEL

Power of Station	Class II				
	0.25 Kw.	0.5 Kw.	1 Kw.	5 Kw.	10 Kw.
Miles from Boundary	237	261	282	336	356

(Continued on page 320)

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APACE WITH NEW ANTENNA REQUIREMENTS

# LEHIGH

## VERTICAL RADIATORS

Lehigh's experienced engineers are constantly improving their towers to meet the increasing demands of modern broadcasting systems. Stations obtain these benefits when they install Lehigh Vertical Radiators.

(Illustrated: Two Lehigh Insulated Towers 350 feet high at WGAN, Portland, Maine.)

RADIO DIVISION

# LEHIGH STRUCTURAL STEEL CO.

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PLANT AT ALLENTOWN, PA.

OFFICES IN PRINCIPAL CITIES

# Appendices and Tables: Allocation Provisions of Havana Agreement

(Continued from page 318)

**TABLE III**  
REQUIRED DAY AND NIGHT SEPARATION IN MILES BETWEEN BROADCAST STATIONS ON ADJACENT CHANNELS

Class & Power	Class IV						Classes II and III															
	0.1 Kw.			0.25 Kw.			0.25 Kw.			0.5 Kw.			1 Kw.			5 Kw.			10 Kw.			
	10 Kc.	20 Kc.	30 Kc.	10 Kc.	20 Kc.	30 Kc.	10 Kc.	20 Kc.	30 Kc.	10 Kc.	20 Kc.	30 Kc.	10 Kc.	20 Kc.	30 Kc.	10 Kc.	20 Kc.	30 Kc.	10 Kc.	20 Kc.	30 Kc.	
<b>Class IV</b>																						
0.1 Kw.	73	37	32	82	45	40	86	47	42	94	55	50	105	63	58	133	84	79	149	98	93	
0.25 Kw.	82	45	40	90	48	41	94	50	43	102	58	51	113	66	59	141	87	80	157	101	94	
<b>Classes II &amp; III</b>																						
0.25 Kw.	86	47	42	94	50	43	96	51	48	104	59	51	115	67	59	143	88	80	159	102	94	
0.5 Kw.	94	55	50	102	58	51	104	59	51	112	62	52	123	70	60	151	91	81	167	105	95	
1 Kw.	105	63	58	118	66	59	115	67	59	123	70	60	131	73	62	159	94	83	175	108	97	
5 Kw.	133	84	79	141	87	80	143	88	80	151	91	81	159	94	83	180	104	87	196	118	101	
10 Kw.	149	98	93	157	101	94	159	102	94	167	105	95	175	108	97	195	118	101	210	123	104	
25 Kw.	172	115	110	180	118	111	182	119	111	190	122	112	198	125	114	219	135	118	233	140	121	
50 Kw.	190	131	126	198	134	127	200	135	127	208	138	128	216	141	130	237	151	134	251	156	137	
<b>Class I</b>																						
10 Kw.	162	107	102	170	110	103	172	111	103	180	114	104	188	117	106	209	127	118	223	132	113	
25 Kw.	183	126	121	191	129	122	193	130	122	201	138	128	209	136	125	230	146	129	244	151	132	
50 Kw.	203	144	139	211	147	140	218	148	140	221	151	141	229	154	143	250	164	147	264	169	150	
500 Kw.	277	211	206	285	214	207	287	215	207	295	218	208	303	221	210	324	231	214	338	236	217	

Class and Power	Class II						Class I											
	25 Kw.			50 Kw.			10 Kw.			25 Kw.			50 Kw.			500 Kw.		
	10 Kc.	20 Kc.	30 Kc.	10 Kc.	20 Kc.	30 Kc.	10 Kc.	20 Kc.	30 Kc.	10 Kc.	20 Kc.	30 Kc.	10 Kc.	20 Kc.	30 Kc.	10 Kc.	20 Kc.	30 Kc.
<b>Class IV</b>																		
0.1 Kw.	172	115	110	190	131	126	162	107	102	188	126	121	203	144	139	277	211	206
0.25 Kw.	180	118	111	198	134	127	170	110	108	191	129	122	211	147	140	285	214	207
<b>Classes II and III</b>																		
0.25 Kw.	182	119	111	200	135	127	172	111	103	193	130	122	213	148	140	287	215	207
0.5 Kw.	190	122	112	208	138	128	180	114	104	201	133	123	221	151	141	295	218	208
1 Kw.	198	125	114	216	141	130	188	117	106	209	136	125	229	154	143	303	221	210
5 Kw.	219	135	118	237	151	134	209	127	110	230	146	129	250	164	147	324	231	214
10 Kw.	233	140	121	251	156	137	223	132	113	244	151	132	264	169	150	338	236	217
25 Kw.	250	149	125	268	165	141	242	145	123	261	160	136	281	178	154	355	245	221
50 Kw.	268	165	141	284	172	145	260	161	139	279	163	144	297	185	158	371	252	225
<b>Class I</b>																		
10 Kw.	242	145	123	260	161	139	232	137	115	253	156	134	273	174	152	347	241	219
25 Kw.	261	160	136	279	168	144	253	156	134	272	163	139	292	181	157	366	248	224
50 Kw.	281	178	154	297	185	158	273	174	152	292	181	157	310	190	161	384	257	227
500 Kw.	356	245	221	371	252	225	347	241	219	366	248	224	384	257	227	451	291	247

**TABLE IV**  
Required Night Separation in Miles Between Broadcast Stations on the Same Channels

The following tables indicate the mileage protection each class must give all other classes.

Class I-A	Class I-A	Not required to protect Class II stations on same channel at night.
-----------	-----------	---

Class I-B	Class I-B			
	5 kw.	10 kw.	25 kw.	50 kw.
10 kw.		2665	3010	3280
25 kw.		3010	3243	3500
50 kw.		3280	3500	3660

**TABLE IV-C**  
CLASS III-Aa MUST PROTECT OTHER CLASSES AS SHOWN BELOW

Class III-A	Class III-B			
	1 Kw.	5 Kw.	.5 Kw.	1 Kw.
1 Kw.	739	1025	550	553
5 Kw.	1025	1039	847	851

<sup>a</sup>See Appendix VII for protection Class III stations should give Class II stations on regional channels.

**TABLE IV D**  
Class III B b Must protect other classes as shown below.

Class III B	Class III A		Class III B	
	1 kw.	5 kw.	.5 kw.	1 kw.
.5 kw.	735	1020	383	550
1. kw.	739	1025	550	553

**TABLE IV-B**  
CLASS II—MUST PROTECT OTHER CLASSES AS SHOWN BELOW

Class II	Class II Stations						Class I-B Stations			Class I-A Stations Distance from Nearest Border of Country in Which Class I-A Station is Located	
	.25 Kw.	.5 Kw.	1 Kw.	5 Kw.	10 Kw.	25 Kw.	50 Kw.	10 Kw.	25 Kw.		50 Kw.
.25 Kw.	451	602	732	1018	1136	1271	1529	1378	1610	1760	1038
.5 Kw.	602	606	736	1022	1140	1275	1533	1508	1785	1890	1180
1 Kw.	732	736	739	1025	1143	1280	1535	1658	1885	2080	1335
5 Kw.	1018	1022	1025	1039	1157	1292	1547	2165	2395	2550	1830
10 Kw.	1136	1140	1143	1157	1162	1298	1553	2450	2680	2830	2122
25 Kw.	1271	1275	1280	1292	1298	1298	1310	2880	3120	3260	2575
50 Kw.	1529	1533	1535	1547	1553	1560	1570	3090	3330	3480	2730

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**TABLE IV E**

Class IV—Must protect other classes as shown below.

Class IV	Class III A		Class III B	Class IV
	1 kw.	5 kw.	.5 kw. 1 kw.	
.1 kw.	300	300	Daytime separation determines	Daytime separation determines
.25 kw.	395	407		

See Note a, Table IV-c

**TABLE IV F**

Distance Class II Stations must be from Class I A and I B Stations to obtain recommended protection to Class II Station (2.5 mv/m ground wave contour).

Class II (a)	Class I A and I B Stations			
	10 kw.	25 kw.	50 kw.	500 kw.
.25 kw.	1248	1462	1520	2767
.5 kw.	1252	1470	1523	2771
1. kw.	1256	1473	1528	2775
5. kw.	1270	1484	1541	2789
10. kw.	1275	1490	1546	2793
25. kw.	1285	1498	1743	2803
50. kw.	1293	1510	1750	2812

Note (a): Must use directional antenna to protect dominant station or stations with these separations.

**TABLE IV G**

Distance Class IV Stations must be from Class III-A and III-B Station to obtain recommended protection to Class IV Station (4.0 mv/m ground wave contour).

Class IV Power	Class III-A or III-B		
	.5	1.0	5.0
.10	377	547	847
.25	381	551	851

**APPENDIX VII**

Engineering Requirements for the Use of Regional Channels by Class II Station under the Provisions of Section C 5 c.

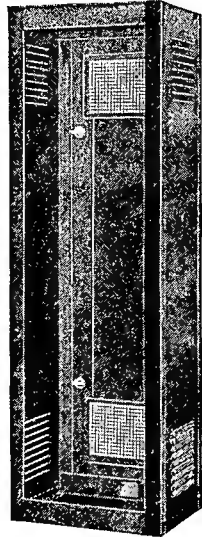
A Class II station assigned to a regional channel in accordance with Section C 5 c shall use a directional antenna or other means to limit the interfering signal within the protected service area of any Class II station on the channel to the value set forth in Appendix II, Table I. The interfering signal in case of projected operation shall be determined from the characteristics of the antenna and appropriate curve in Appendix V. In case of actual operation the interfering signal shall be determined by the method described in Section D 4.

Class III stations, operating on a channel to which a Class II station is assigned, should limit the interference to the Class II station in conformity with the provisions of Appendix II, Table I.

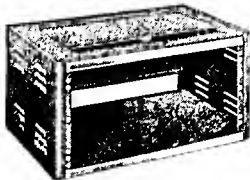
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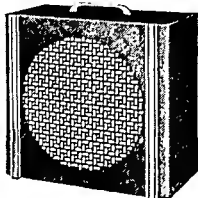
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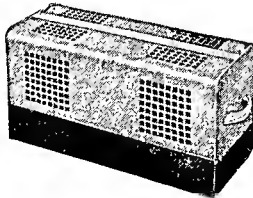
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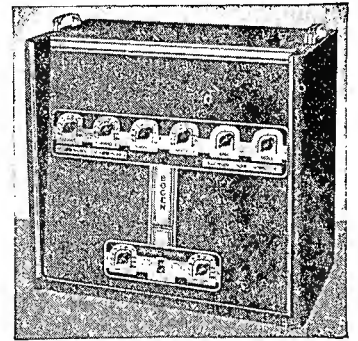
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