$$x \cong \frac{\pi}{p} \cdot \left(\frac{R}{\lambda}\right)_1 \cdot \cos b \qquad \text{(Eq. 1)}$$

$(R/\lambda)_1$ = Number of wavelengths in 1 kilometer,

* * * * *

f_{MHz}=frequency expressed in megahertz,

$$\varepsilon \cong \chi \tan b - 1 \qquad \text{(Eq. 3)}$$

ε = dielectric constant on the ground referred to air as unity.

First solve for χ by substituting the known values of p_1, $(R/\lambda)_1$, and cos *b* in equation (1). Equation (2) may then be solved for δ and equation (3) for ε. At distances greater than 80/f⅓ MHz kilometers the curves of Graph 21 do not give the correct relative values of field strength 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.

NOTE: For other values of dielectric constant, use can be made of the computer program which was employed by the FCC in generating the curves in Graphs 1 to 20. For information on obtaining a printout of this program, call or write the Consumer Affairs Office, Federal Communications Commission, Washington, DC 200554, (202) 632–7000.

(d) At sufficiently short distances (less than 55 kilometers at AM broadcast frequencies), such that the curvature of the earth does not introduce an additional attenuation of the waves, the curves of Graph 21 may be used to determine the groundwave field strength of transmitting and receiving antennas at the surface of the earth for any radiated power, frequency, or set of ground constants. First, trace the straight inverse distance line corresponding to the power radiated on transparent log-log graph paper similar to that of Graph 21, labelling the ordinates of the chart in terms of field strength, and the abscissae in terms of distance. Next, using the formulas given on Graph 21, calculate the value of the numerical distance, *p*, at 1 kilometer, and the value of *b*. Then superimpose the log-log graph paper over Graph 21, shifting it vertically until both inverse distance lines coincide and shifting it horizontally until the numerical distance at 1 kilometer on Graph 21 coincides with 1 kilometer on the log-log graph paper. The curve of Graph 21 corresponding to the calculated value of *b* is then traced on the log-log graph paper giving the field strength versus distance in kilometers.

(e) This paragraph consists of the following Graphs 1 to 20 and 21.

NOTE: The referenced graphs are not published in the CFR, nor will they be included in the Commission's automated rules system. For information on obtaining copies of the graphs call or write the Consumer Affairs Office, Federal Communications Commission, Washington, DC 20554, Telephone: (202) 632–7000.

[28 FR 13574, Dec. 14, 1963, as amended at 50 FR 18823, May 2, 1985; 51 FR 45891, Dec. 23, 1986; 52 FR 36878, Oct. 1, 1987; 56 FR 64866, Dec. 12, 1991; 57 FR 43290, Sept. 18, 1992]

§ 73.185 Computation of interfering signal.

(a) Measured values of radiation are not to be used in calculating overlap, interference, and coverage.

(1) In the case of an antenna which is intended to be non-directional in the horizontal plane, an ideal non-directional radiation pattern shall be used in determining interference, overlap, and coverage, even if the antenna is not actually non-directional.

(2) In the case of an antenna which is directional in the horizontal plane, the radiation which shall be used in determining interference, overlap, and coverage is that calculated pursuant to § 73.150 or § 73.152, depending on whether the station has a standard or modified standard pattern.

(3) In the case of calculation of interference or overlap to (not from) a foreign station, the notified radiation shall be used, even if the notified radiation differs from that in paragraphs (a) (1) or (2) of this section.

(b) For skywave signals from stations operating on all channels, interference shall be determined from the appropriate formulas and Figure 6a contained in § 73.190.

(c) The formulas in § 73.190(d) depicted in Figure 6a of § 73.190, entitled ''Angles of Departure versus Transmission Range'' are 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. To provide for variation in the pertinent vertical angle due to variations of ionosphere height and ionosphere scattering, the curves 2 and 3 indicate the upper and lower angles within which the radiated field is to be considered. The maximum value of field strength occurring between these angles shall be used to determine the multiplying factor to apply to the 10 percent skywave field intensity value determined from Formula 2 in § 73.190. The multiplying factor is found by dividing the maximum radiation between the pertinent angles by 100 mV/m.

(d) Example of the use of skywave curves and formulas: Assume a proposed new Class B station from which interference may be expected is located at a distance of 724 kilometers from a licensed Class B station. The proposed station specifies geographic coordinates of 40°00′00″ N and 100°00′00″ W and the station to be protected is located at an azimuth of 45° true at geographic coordinates of 44°26′05″ N and 93°32′54″ W. The critical angles of radiation as determined from Figure 6a of § 73.190 for use with Class B stations are 9.6° and 16.6°. If the vertical pattern of the antenna of the proposed station in the direction of the existing station is such that, between the angles of 9.6° and 16.6° above the horizon the maximum radiation is 260 mV/m at one kilometer, the value of the 50% field, as derived from Formula 1 of § 73.190, is 0.06217 mV/m at the location of the existing station. To obtain the value of the 10% field, the 50% value must be adjusted by a factor derived from Formula 2 of § 73.190. The value in this case is 8.42 dB. Thus, the 10% field is 0.1616 mV/m. Using this in conjunction with the co-channel protection ratio of 26 dB, the resultant nighttime limit from the proposed station to the licensed station is 3.232 mV/m.

(e) In the case of an antenna which is non-directional in the horizontal plane, the vertical distribution of the relative fields should be computed pursuant to § 73.160. In the case of an antenna which is directional in the horizontal plane, the vertical pattern in the great circle direction toward the point of reception in question must first be calculated. In cases where the radiation in the vertical plane, at 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 just described; each such case will be considered on the basis of the best knowledge available.

(f) In performing calculations to determine permissible radiation from stations operating presunrise or postsunset in accordance with § 73.99, calculated diurnal factors will be multiplied by the values of skywave field strength for such stations obtained from Formula 1 or 2 of § 73.190.

(1) The diurnal factor is determined using the time of day at the mid-point of path between the site of the interfering station and the point at which interference is being calculated. Diurnal factors are computed using the formula $D_f=a+bF+cF^2+dF^3$ where:

D_f represents the diurnal factor,
F is the frequency in MHz,
a,b,c, and d are constants obtained from the tables in paragraph (k)(2)

A diurnal factor greater than one will not be used in calculations and interpolation is to be used between calculated values where necessary. For reference purposes, curves for presunrise and postsunset diurnal factors are contained in Figures 13 and 14 of § 73.190.

(2) Constants used in calculating diurnal factors for the presunrise and postsunset periods are contained in paragraphs (f)(2) (i) and (ii) of this section respectively. The columns labeled T_{mp} represent the number of hours before and after sunrise and sunset at the path midpoint.

(i) PRESUNRISE CONSTANTS

T_{mp}	a	b	c	d
−2	1.3084	.0083	−.0155	.0144
−1.75	1.3165	−.4919	.6011	−.1884
−1.5	1.0079	.0296	.1488	−.0452
−1.25	.7773	.3751	−.1911	.0736
−1	.6230	.1547	.2654	−.1006
−.75	.3718	.1178	.3632	−.1172
−.5	.2151	.0737	.4167	−.1413
−.25	.2027	−.2560	.7269	−.2577
SR	.1504	−.2325	.5374	−.1729
+.25	.1057	−.2092	.4148	−.1239
+5.	.0642	−.1295	.2583	−.0699
+.75	.0446	−.1002	.1754	−.0405
+1	.0148	.0135	.0462	.0010

(ii) POSTSUNSET CONSTANTS

T_{mp}	a	b	c	d
1.75	.9495	−.0187	.0720	−.0290
1.5	.7196	.3583	−.2280	.0611
1.25	.6756	.1518	.0279	−.0163
1.0	.5486	.1401	.0952	−.0288
.75	.3003	.4050	−.0961	.0256
.5	.1186	.4281	−.0799	.0197
.25	.0382	.3706	−.0673	.0171
SS	.0002	.3024	−.0540	.0086
−.25	.0278	.0458	.1473	−.0486
−.5	.0203	.0132	.1166	−.0340
−.75	.0152	−.0002	.0786	−.0185
−1.0	−.0043	.0452	−.0040	.0103
−1.25	.0010	.0135	.0103	.0047
−1.5	.0018	.0052	.0069	.0042
−1.75	−.0012	.0122	−.0076	.0076
−2.0	−.0024	.0141	−.0141	.0091

EDITORIAL NOTE: At 56 FR 64867, Dec. 12, 1991, §73.185 was amended by redesignating paragraphs (d), (e), (h), and (k) as (c), (d), (e), and (f), resulting in two consecutive paragraph (f)'s. These paragraphs will be correctly designated by a Federal Communication Commission document published in the FEDERAL REGISTER at a later date.

(f) For stations operating on regional and local channels, interfering skywave field intensities shall be determined in accordance with the procedure specified in (d) of this section and illustrated in (e) of this section, except that Figure 2 of §73.190 is used in place of Figure 1a and 1b and the formulas of §73.190. In using Figure 2 of §73.190, one additional parameter must be considered, *i.e.*, the variation of received field with the latitude of the path.

(g) Figure 2 of §73.190, ''10 percent Skywave Signal Range Chart,'' shows the signal as a function of the latitude of the transmission path, which is defined as the geographic latitude of the midpoint between the transmitter and receiver. When using Figure 2 of §73.190, latitude 35° should be used in case the mid-point of the path lies below 35° North and latitude 50° should be used in case the mid-point of the path lies above 50° North.

[30 FR 13783, Oct. 29, 1965, as amended at 33 FR 15420, Oct. 17, 1968; 46 FR 11995, Feb. 12, 1981; 48 FR 42958, Sept. 20, 1983; 50 FR 18843, May 2, 1985; 56 FR 64867, Dec. 12, 1991]

§ 73.186 Establishment of effective field at one kilometer.

(a) Section 73.189 provides that certain minimum field strengths are acceptable in lieu of the required minimum physical heights of the antennas proper. Also, in other situations, it may be necessary to determine the effective field. The following requirements shall govern the taking and submission of data on the field strength 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 is not 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 six or more radials, at intervals of approximately 0.2 kilometer up to 3 kilometers from the antenna, at intervals of approximately one kilometer from 3 kilometers to 5 kilometers from the antenna, at intervals of approximately 2 kilometers from 5 kilometers to 15 kilometers 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 at least 15 measurements on each radial. These shall include at least 7 measurements within 3 kilometers of the antenna. 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 3 kilometers of the antenna. In cases where it is not possible to obtain accurate measurements at the closer distances (even out to 8 or 10 kilometers due to the character of the intervening terrain), the measurements at greater distances should be made at closer intervals.

(2) The data required by paragraph (a)(1) of this section 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 strengths as ordinate and distance as abscissa.