(t) The groundwave service of two stations operating with synchronized carriers and broadcasting identical programs will be subject to some distortion in areas where the signals from the two stations are of comparable strength. For the purpose of estimating coverage of such stations, areas in which the signal ratio is between 1:2 and 2:1 will not be considered as receiving satisfactory service.

NOTE: Two stations are considered to be operated synchronously when the carriers are maintained within 0.2 Hz of each other and they transmit identical program s.

[56 FR 64862, Dec. 12, 1991; 57 FR 43290, Sept. 18, 1992, as amended at 58 FR 27950, May 12, 1993]

§ 73.183 Groundwave signals.

(a) Interference that may be caused by a proposed assignment or an existing assignment during daytime hours should be determined, when possible, by measurements on the frequency involved or on another frequency over the same terrain and by means for the curves in § 73.184 entitled ''Ground Wave Field Strength versus Distance.''

NOTE: Groundwave field strength measurements will not be accepted or considered for the purpose of establishing that interference to a station in a foreign country other than Canada, or that the field strength at the border thereof, would be less than indicated by the use of the ground conductivity maps and engineering standards contained in this part and applicable international agreements. Satisfactory groundwave measurements offered for the purpose of demonstrating values of conductivity other than those shown by Figure M3 in problems involving protection of Canadian stations will be considered only if, after review thereof, the appropriate agency of the Canadian government notifies the Commission that they are acceptable for such purpose.

(b)(1) In all cases where measurements taken in accordance with the requirements are not available, the groundwave strength must be determined by means of the pertinent map of ground conductivity and the groundwave curves of field strength versus distance. The conductivity of a given terrain may be determined by measurements of any broadcast signal traversing the terrain involved. Figure M3 (See Note 1) shows 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 § 73.190, may be used. It is a replica of Figure M3, and is contained in these standards. 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.

(2) For determinations of interference and service requiring a knowledge of ground conductivities in other countries, the ground conductivity maps comprising Appendix 1 to Annex 2 of each of the following international agreements may be used:

(i) For Canada, the U.S.-Canada AM Agreement, 1984;

(ii) For Mexico, the U.S.-Mexico AM Agreement, 1986; and

(iii) For other Western Hemisphere countries, the Regional Agreement for the Medium Frequency Broadcasting Service in Region 2.

Where different conductivities appear in the maps of two countries on opposite sides of the border, such differences are to be considered as real, even if they are not explained by geophysical cleavages.

(c) Example of determining interference by the graphs in § 73.184:

It is desired to determine whether objectionable interference exists between a proposed 5 kW Class B station on 990 kHz and an existing 1 kW Class B station on first adjacent channel, 1000 kHz. The distance between the two stations is 260 kilometers and both stations operate nondirectionally with antenna systems that produce a horizontal effective field of 282 in mV/m at one kilometer. (See § 73.185 regarding use of directional antennas.) The ground conductivity at the site of each station and along the intervening terrain is 6 mS/m. The protection to Class B stations during daytime is to the 500 μV/m (0.5 Vm) contour using a 6 dB protection factor. The distance to the 500 μV/m groundwave contour of the 1 kW station is determined by the use of the appropriate curve in § 73.184. Since the curve is plotted for 100 mV/m at a 1 kilometer, to find the distance of the 0.5 mV/m contour of the 1 kw station, it is necessary to determine the distance to the 0.1773 m/Vm contour.

$(100 \times 0.5 / 282 = 0.1773)$

Using the 6 mS/m curve, the estimated radius of the 0.5 mV/m contour is 62.5 kilometers. Subtracting this distance from the distance between the two stations leaves 197.5 kilometers. Using the same propagation curve, the signal from the 5 kW station at this distance is seen to be 0.059 mV/m. Since a protection ratio of 6 dB, desired to undesired signal, applies to stations separated by 10 kHz, the undesired signal could have had a value of up to 0.25 mV/m without causing objectionable interference. For co-channel studies, a desired to undesired signal ratio of no less than 20:1 (26 dB) is required to avoid causing objectionable interference.

(d) Where a signal traverses a path over which different conductivities exist, the distance to a particular groundwave field strength contour shall be determined by the use of the equivalent distance method. Reasonably accurate results may be expected in determining field strengths 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 strength 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 strength 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 § 73.186.

(e) Example of the use of the equivalent distance method;

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 kHz with an inverse distance field of 100 mV/m at one kilometer being radiated over a path having a conductivity of 10 mS/m for a distance of 20 kilometers, 5 mS/m for the next 30 kilometers and 15 mS/m thereafter. Using the appropriate curve in § 73.184, Graph 12, at a distance of 20 kilometers on the curve for 10 mS/m, the field strength is found to be 2.84 mV/m. On the 5mS/m curve, the equivalent distance to this field strength is 14.92 kilometers, which is 5.08 (20 − 14.92 kilometers nearer to the transmitter. Continuing on the propagation curve, the distance to a field strength of 0.5 mV/m is found to be 36.11 kilometers.

The actual length of the path travelled, however, is 41.19 (36.11+5.08) kilometers. Continuing on this propagation curve to the conductivity change at 44.92 (50.00 − 5.08) kilometers, the field strength is found to be 0.304 mV/m. On the 15 mS/m propagation curve, the equivalent distance to this field strength is 82.94 kilometers, which changes the effective path length by 38.02 (82.94 − 44.92) kilometers. Continuing on this propagation curve, the distance to a field strength of 0.025 mV/m is seen to be 224.4 kilometers. The actual length of the path travelled, however, is 191.46 (224.4+5.08 − 38.02) kilometers.

[28 FR 13574, Dec. 14, 1963, as amended at 44 FR 36037, June 20, 1979; 48 FR 9011, Mar. 3, 1983; 50 FR 18822, May 2, 1985; 50 FR 24522, June 11, 1985; 51 FR 9965, Mar. 24, 1986; 54 FR 39736, Sept. 28, 1989; 56 FR 64866, Dec. 12, 1991; 57 FR 43290, Sept. 18, 1992]

§ 73.184 Groundwave field strength graphs.

(a) Graphs 1 to 20 show, for each of 20 frequencies, the computed values of groundwave field strength as a function of groundwave conductivity and distance from the source of radiation. The groundwave field strength is considered to be that part of the vertical component of the electric field which has not been reflected from the ionosphere nor from the troposphere. These 20 families of curves are plotted on log-log graph paper and each is to be used for the range of frequencies shown thereon. Computations are based on a dielectric constant of the ground (referred to air as unity) equal to 15 for land and 80 for sea water and for the ground conductivities (expressed in mS/m) given on the curves. The curves show the variation of the groundwave field strength with distance to be expected for transmission from a vertical