

STANDARD FREQUENCY BROADCAST SERVICE  
OF NATIONAL BUREAU OF STANDARDS.

The National Bureau of Standards broadcasts standard frequencies and related services from its radio station WWV, at Beltsville, Md., near Washington D.C. The service has been improved and extended, a new transmitting station has been built, 10-kilowatt radio transmitters installed and additional frequencies and voice announcements added. The services include: (1) standard radio frequencies, (2) standard time intervals accurately synchronized with basic time signals, (3) standard audio frequencies (4) standard musical pitch, 440 cycles per second, corresponding to A above middle C.

The standard frequency broadcast service makes widely available the national standard of frequency, which is of value in scientific and other measurements requiring an accurate frequency. Any desired frequency may be measured in terms of any one of the standard frequencies either audio or radio. This may be done by the aid of harmonics and beats, with one or more auxiliary oscillators.

The service is continuous at all times day and night. The standard radio frequencies are:

- 5 megacycles ( $\approx$  5000 kilocycles  $\approx$  5,000,000 cycles) per second, broadcast continuously.
- 10 megacycles ( $\approx$  10,000 kilocycles  $\approx$  10,000,000 cycles) per second, broadcast continuously.
- 15 megacycles ( $\approx$  15,000 kilocycles  $\approx$  15,000,000 cycles) per second, broadcast continuously in the daytime only (i.e., day at Washington, D.C.).

All the radio frequencies carry two audio frequencies at the same time, 440 cycles per second and 4000 cycles per second; the former is the standard musical pitch and the latter is a useful standard audio frequency. In addition there is a pulse every second heard as a faint tick each second when listening to the broadcast. The pulses last 0.005 second; they may be used for accurate time signals and their one-second spacing provides an accurate time interval for purposes of physical measurements.

The audio frequencies are interrupted precisely on the hour and each five minutes thereafter; after an interval of precisely one minute

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they are resumed. This one-minute interval is provided in order to give the station announcement and to afford an interval for the checking of radio-frequency measurements free from the presence of the audio frequencies. The announcement is the station call letters (WWV) in telegraphic code (dots and dashes) except at the hour and half hour when the announcement is given by voice.

The accuracy of all the frequencies, radio and audio, as transmitted, is better than a part in 10,000,000. Transmission effects in the medium (Doppler effect, etc.) may result in slight fluctuations in the audio frequencies as received at a particular place; the average frequency received is however as accurate as that transmitted. The time interval marked by the pulse every second is accurate to 0.000 01 second. The 1-minute, 4-minute, and 5-minute intervals, synchronized with the seconds pulses and marked by the beginning and ending of the periods when the audio frequencies are off, are accurate to a part in 10,000,000. The beginnings of the periods when the audio frequencies are off are so synchronized with the basic time service of the U.S. Naval Observatory that they mark accurately the hour and the successive 5-minute periods.

Of the radio frequencies on the air at a given time, the lowest provides service to short distances, and the highest to great distances. For example, during a winter day good service is given on 5 megacycles at distances from 0 to about 1000 miles, 10 megacycles from about 600 to 3000 miles, and 15 megacycles from about 1000 to 6000 miles. Except for a certain period at night, within a few hundred miles of the station, reliable reception is in general possible at all times throughout the United States and the North Atlantic Ocean, and fair reception over most of the world.

Information on how to receive and utilize the service is given in the Bureau's Letter Circular, "Methods of using standard frequencies broadcast by radio", obtainable on request. The Bureau welcomes reports of difficulties, methods of use, or special applications of the service. Correspondence should be addressed National Bureau of Standards, Washington, D.C.