Changes in the sensitivity of the earphones cannot, of course, be detected by this method.

H. PSYCHOPHYSICAL METHODS OF CALIBRATION

A useful method for the calibration of the entire audiometer involves the measurement of the hearing of a number of individuals who have no history of noise exposure or other hearing difficulties (see Section III.O). The average audiogram of this group will usually give a reliable indication of the calibration of the audiometer.

The audiometric procedure for the test group should be the same as the standard procedure adopted for all tests (see, for instance, Hirsh[17]). About 10 young people should be tested in both ears. This number of audiograms appears to be sufficiently large to give a reliable average at the important audiometric frequencies, 500, 1000, 2000, and 4000 c.p.s. If measurements at either higher or lower frequencies are contemplated, it may be necessary to test a larger group of people. If the average of the audiograms at the important frequencies is within 5 db of the zero setting, it may be assumed that the audiometer is calibrated correctly. If larger deviations are observed and it is reasonably certain that the group used in the test is normal, the instrument should be returned to the manufacturer or his representative for repair and recalibration. If the normalcy of the test group is subject to question, comparison measurements can be made on another audiometer.

A simpler psychophysical procedure may be used to detect changes in the calibration of the audiometer. A small group of practiced listeners (perhaps 4 or 5) should be tested regularly. Any systematic change in their thresholds is usually an indication of a change in the calibration. Of course, the operator should be suspicious of individual threshold shifts. They may be caused by wax in the ear canal or a mild respiratory infection. Since this procedure does not attempt to give an absolute calibration of the instrument, the listeners need not be young nor have normal hearing provided that their hearing loss is relatively stable. Because this procedure is quite simple to carry out, it is recommended that it be repeated with the same listeners at least once for each full week of operation of the audiometer.

I. MASKING

Acuity of hearing is influenced strongly by the ambient noise in the testing room. If this ambient or background noise is excessive, the quiet tones cannot be heard and the individual will show an apparent hearing loss. This apparent hearing loss is the result of an auditory phenomenon called masking. We are familiar with other aspects of this phenomenon, such as the difficulty in hearing our automobile radios as a result of road or wind noise. Masking means the inability to hear a desired signal in the presence of an undesired sound or background noise. In the measurement of hearing, background noise will reduce the ability of the subject to hear the test signal and, therefore, produce an apparent hearing loss.

[17] I. J. Hirsh, *The Measurement of Hearing*. McGraw-Hill, New York, 1953, p. 364.

J. HOW QUIET MUST IT BE TO MEASURE NORMAL HEARING?

In order to design satisfactory yet practical rooms for the pure-tone testing of hearing we should know the allowable background noise level for each of the audiometric test tones. The noise at frequencies near that of a test tone is most effective in masking that tone and, therefore, the criteria for the background noise in an audiometer room will depend directly on the test frequencies that are to be used in the hearing measurements. For example, only the criterion shown in Table 6 for the 300 to 600 c.p.s. octave band need be observed if correct audiometric measurements are to be made at 500 c.p.s. The appropriate octave band criteria for other audiometric test frequencies are also listed in Table 6. If the octave band levels of the background noise in the test room exceed any of these criteria, masking of the corresponding test tones is likely for a 0 db setting of the hearing loss dial. This condition would cause some listeners to have an apparent hearing loss that would disappear were the measurement made in a room with background noise less than that specified in Table 6.

TABLE 6

Maximum Allowable Sound Pressure Levels for No Masking at Zero Hearing Loss on Standard Audiometers

Audiometric test frequency (c.p.s.)	Important octave band (c.p.s.)	Sound pressure level in the octave band (db)
500	300–600	40
1000	600–1200	40
2000	1200–2400	47
4000	2400–4800	57

It should be clearly understood that there is no relation whatsoever between an audiogram measured in the presence of excessive background noise and the true audiogram measured in quiet. It is *not* possible to apply a correction to measurements made in the presence of excessive noise. If useful audiometric records are to be kept, it is mandatory that the measurements be made in a sufficiently quiet environment.

K. GENERAL PRINCIPLES OF AUDIOMETER ROOM DESIGN

The background noise in an audiometer room is usually most intense at low frequencies. The control of low frequency noise is particularly difficult. Small leaks around doors and windows and the openings of ventilating systems provide excellent paths for the transmission of these sounds. Vibrations travelling through a