

NOISE ENGINEERING

NOISE IN TELEPHONE OPERATING ROOMS

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1. GENERAL

1.01 This practice is reissued to renumber it into the nine digit numbered Plant Series. In addition, references to related practices, also renumbered, have been changed, and obsolete references have been updated or deleted. Since this is an extensive revision, marginal arrows usually used to indicate changes have been omitted.

1.02 This section discusses the nature and effects of the noise in telephone operating rooms, the precautionary and remedial measures available to keep room noise at reasonable levels, and the benefits to be derived from the reduction of room noise in telephone operating rooms. While the discussion relates primarily to operating rooms, it also applies to test desk rooms and similar locations. Further, the general principles apply to other types of rooms such as business offices.

1.03 Room noise arises from many sources, some of which are classed as indoor, and include such items as central office equipment, bells, fans, speech, etc., and the noise from others is classed as street noise in that it arises from traffic. The room noise conditions in various operating rooms vary over a considerable range depending on the characteristics of the room, location of the room, type and size of equipment involved, exposure to street noise, etc. In a particular room the noise varies from minute to minute because of the various

frequencies of occurrence of the individual noise sources. There are also variations in the noise conditions from hour to hour, day to day, and season to season, because of variations in the volume of traffic handled, prevalence of open windows, etc. For engineering purposes in the consideration of room noise problems, there is usually employed the average noise level during the hours in which the activities in the particular location are normal or of major interest. In operating rooms, it is usual to consider the average noise level during the busy hour for both typical winter and summer conditions.

1.04 The types, numbers and importance of noise sources encountered in operating rooms and their frequencies of occurrence vary considerably. Of the individual sources some, such as fans, cause a fairly steady noise whereas others, such as bells, cause relatively high noise conditions only for short intervals. Other sources, such as doors slamming, introduce a single sharp noise peak each time they occur. The overall noise at any point in the room is the composite result of the noises from all the sources. Obviously, this noise may vary widely from instant to instant. Methods of measuring noise by means of a sound meter, which take into account this variability of the noise level, are discussed in Section 870-190-102.

1.05 The contribution of a given noise source to the overall noise at a particular location in the room depends on a number of factors, including the distance between the source and the listening point. The noise caused by a particular source decreases as the distance from the source increases. This distance loss is affected by the acoustics of the room, particularly the amount of absorption provided by the walls, ceiling, floors, and contents of the room. The sound waves arising from a given source may be considered to reach the listening point through two paths. Part of each sound wave travels directly from the source to the listening point, while other parts reach the latter point after being reflected from the walls, ceiling, etc. Increasing the amount of absorption

provided by the room surfaces and its contents decreases the amount of reflected sound reaching a given listening point from a particular source and so reduces the total noise from that source experienced at the listening point. This reduction in the total noise from the particular source depends on the relative importance of the direct and reflected sounds and, therefore, is greater at some distance than close to the source.

1.06 Experience indicates that at a point well removed from any of the important sources of noise, about 3 dB noise reduction is obtained if the total absorption in the room is doubled. However, in the case of operating rooms the noise levels which are of particular interest are those at or near the operator's ear. Many of the sources of noise are quite near a typically located operator, being either associated with her own or adjacent positions. The effect of increasing the absorption in an operating room, therefore, is less in the case of the room noise at the switchboard than at other points in the room.

1.07 The amounts of absorption provided by different materials, such as plaster walls, etc., are defined in terms of the ratio of their absorption per unit area to that of open window space, the latter being considered to provide perfect absorption. Absorption coefficients are available for the various types of materials used in building construction and for the common types of room contents, including people. For noise problems the numerical averages of the coefficients over the range of frequencies from 256 to 2048 Hz are usually employed. Values for the usual types of materials are given in some textbooks, acoustical handbooks, and specification sheets prepared by various manufacturers for their products.

2. REDUCTION OF ROOM NOISE

2.01 There are two general methods of reducing room noise. The first consists of the elimination of the more important noise sources or the reduction of the magnitude of the noise peaks produced by certain sources. The second general method consists of increasing the total absorption in the room through the application of acoustic materials. Both of these methods have important fields of use in the general treatment of room noise conditions, and the choice between them or of some combination depends upon the relative benefits to

be provided in the particular case and the relative costs.

2.02 The treatment of noise sources in general involves either the elimination of the particular source or changes in the design of the equipment causing the noise to reduce the noise peaks. Such changes in the design of the central office equipment have been made available for most of the important noise sources and can be applied either to new installations or existing rooms. Among these are:

- (1) Sound absorbing cushions for use with cord plugs in order to reduce the noise caused by the seating of the plugs in the keyshelf sockets.
- (2) Quiet dials for use at both the operators' positions and the subscriber type telephone sets located on the miscellaneous operating room desks.
- (3) The switchboard framework surfaces which may be struck by cord weights may be covered with shock absorbing materials.
- (4) Visual signals to replace the audible signals previously used for recalls, supervisor's circuits, desk telephones and trouble positions.
- (5) Noise from the numerical E1 type keys in a panel tandem office may be reduced by mounting the keyset in a sound absorbing frame and insuring the proper spring tensions.
- (6) Provision of room air conditioning.
- (7) Synchronous motor-driven clocks.
- (8) An improved cover for TWX machines to reduce the noises arising from this apparatus.

2.03 In addition, there are often encountered miscellaneous noise sources such as entrance doors, desk and filing cabinet drawers, typewriters and other kinds of office machinery. Other sources include unnecessary noise and confusion when persons are entering or leaving the room, careless handling of the tools and other objects, and unnecessary or loud talking. Many such sources can be eliminated or their importance materially reduced through thoughtful and courteous conversational habits and careful and safe handling of objects. Suitable maintenance methods are usually effective in

reducing miscellaneous sources of noise such as slamming doors and desk and filing cabinet drawers.

2.04 Practically all modern buildings have adequate air conditioning. In such buildings, windows remain closed. This is usually very effective in removing street noise. However, it is essential that occupants do not attempt to open windows in air-conditioned rooms, as the noise level will increase and the effectiveness of the air conditioning will be lost.

2.05 The second general method of reducing room noise is through the use of acoustic treatment in order to increase the total amount of absorption. Various forms of acoustic materials are available for application to ceilings and walls. In addition, carpeting on floors contributes to the total absorption. There is a wide selection of carpeting available, suited to almost any type of wear and environment.

2.06 Determining the type of acoustic treatment for a particular room requires consideration of the relative costs, appearance, life, effect on lighting requirements (particularly with indirect lighting), the usual building considerations, and, of course, the effectiveness of the particular material from an absorption standpoint. In the latter connection it is important to consider the impairment of the acoustic properties through painting.

2.07 New building designs, and frequently remodeling plans, usually include full consideration of acoustic treatment. The consulting architect retained on larger projects will select the acoustical material to be used, specify the mode of application, and estimate the cost. The decorator or the suppliers of acoustical material will provide cost data for smaller remodeling projects.

3. DESIGN AND LAYOUT OF OPERATING ROOMS

3.01 It is particularly important that room noise be considered in the design and layout of operating rooms in as much as the prevention of excessive noise levels at that time is usually more economical than the application of remedial measures later in the existing room. Where alternative plans regarding the building location, the position of the operating room within the building, the layout of the operating room and the types of materials employed in the construction of the room, are being considered, it is of course desirable to

reflect any reactions on the costs of keeping the room noise to reasonable levels.

3.02 The choice of the types of materials to be used in the construction of the operating room may be affected by the room noise considerations. For a given room with a particular layout of switchboard equipment, etc., the room noise will be higher with a small amount of absorption than with a larger amount of absorption.

3.03 In the layout of the operating room it will be desirable to avoid, insofar as practicable, the presence of miscellaneous office machinery, such as typewriters, etc. Similarly, consideration should be given to keeping out of the room such items as the operator's telephone set storage bins. Where it appears necessary to include such items in the operating room, the selection of the types of such equipment and their location in the room may be influenced by their contribution to the overall room noise.

3.04 The selection of the location of test desk rooms involves considerations similar to those outlined above for operating rooms. In general, it is desirable to locate the test desk in a separate room to exclude noise arising from the switch rooms, power equipment, etc. In addition to avoiding excessive street noise, it is desirable to avoid the presence of clerical forces or other employees not associated with the test desk work and to so locate the test room that it will not be used as a hallway.

4. TREATMENT OF EXISTING ROOMS

4.01 Experience with the problem of the reduction of room noise levels in existing rooms and the assembly of information from which there may be determined the desirable remedial measures, has indicated that the most satisfactory approach is room noise measurements made in the particular room. In the application of this general method the following steps have been found desirable:

- (1) Measure the room noise level experienced in the room at several typical locations during the busy hour conditions. These measurements should be made by the use of a sound meter as discussed in Section 870-190-102.
- (2) Determine by observation the important sources of noise in the particular room.

- (3) Determine the levels of the individual sources of noise.
- (4) Obtain data to estimate the frequency of occurrence of the various noise peaks.
- (5) From an inspection of the details of the measurements, the relative importance of the various noise sources may be determined. From this there may be proposed several plans for the application of remedial measures. Such plans will usually include the treatment of several groups of important noise sources and, if the total absorption in the room is relatively low, the use of various amounts of acoustic treatment.
- (6) Estimate the costs involved in the application of the several plans of Item 5.
- (7) Determine the benefits of the noise reductions indicated in Item 6, and evaluate these insofar as it may be practicable. This may be supplemented by the available data, from service observations or other sources, regarding the grades of transmission and traffic service being experienced under existing conditions.

4.02 The above information will permit the presentation of a comprehensive picture of the costs and advantages of the various plans and thus permit a decision regarding the amount of remedial work which is desirable in the particular room.

5. MAINTENANCE OF LOW ROOM NOISE

5.01 The maximum improvement in room noise conditions will, of course, be obtained from the preventive or corrective measures discussed above only if the equipments involving the noise reduction features are properly operated and maintained. For example, where visual signals have been provided to replace the normal supervisory audible signals, any remaining audible signals, such as night alarms, should be used only in those hours of the light load in which they are particularly needed. Likewise it will be desirable to avoid the subsequent placing of typewriters or other similar noisy office machinery in the operating room. Additions to the existing equipment may make it desirable to review the capacity of such existing items as ventilating systems, fans, etc., which are a function of the number of people in the room.