Acceptable construction details for rectangular ducts, elbows and transformation pieces are shown in Figs. 6 to 10. Other methods are also acceptable, such as the use of angle iron stiffeners for large ducts. Good duct construction is essential to the elimination of duct noises and for the purpose of insuring a sturdy and properly braced installation.

An isometric view of a duct showing the location of the stiffening seams on the top and side panels is shown in Fig. 6. The cross seams should not occur at the same place but should be staggered as indicated. In Fig. 7 will be found a number of typical duct seams. Standing seams are used in joining the longitudinal sheets of ventilation and air conditioning ducts where they are so large that longitudinal seams are necessary. A hammered lock seam is used in ventilation work, for example, in joining rectangular elbows or offsets to their heels and throats. Countersunk grooved seams have application in duct construction where it is desired to have the outside surface smooth and flush. Heating units should be installed as shown in Fig. 8 with the duct connections making an angle of not less than 45 deg, but preferably 60 deg. Whenever a pipe or other obstruction passes through a duct an easement should be placed around the pipe as indicated in Fig. 9. Fan discharge connections should have a maximum slope of 1 in 7, as indicated in Fig. 10.

The recommended gages for rectangular sheet metal duct construction are given in Table 4. Weights of sheet metal per square foot of surface for different gages are given in Table 5. In calculating the weights of duct, it is considered good practice to allow 20 per cent additional for weights of joints and bracings. Various weights and thicknesses of standard copper sheets will be found in Table 6.

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Chapter 31

SOUND CONTROL

Decibel Defined, Apparatus for Measuring Noise, Problem of Sound Control, Acceptable Noise Levels, Controlling Vibration from Machine Mountings, Controlling Noise through Room Wall Surfaces, Noise Transmitted Through Ducts, Duct Lining Factor

IN ventilating and air conditioning a building or a room, the effect of the mechanical system employed must be considered on the acoustics of the space conditioned. It is important to consider also that the use of air conditioning often permits keeping the windows closed, thus giving relief from certain external noises, but at the same time increasing the necessity of providing adequate sound control.

It is not assumed that the ventilating and air conditioning engineer will attempt to improve the acoustics of the space that is being conditioned, but the designer should have at least enough fundamental knowledge of the acoustical effects of the system which is being designed to be sure that no damaging effects occur to the existing acoustical properties. It is assumed that in a given space the architect and acoustical engineer have produced a room or rooms which are satisfactory for speech, music, or other uses. The ventilating engineer's sole function is to ventilate and air condition these rooms properly so that they will be physically comfortable without adding any acoustical hazards.

UNIT OF NOISE MEASUREMENT

By a recently adopted international standard, two terms are used for noise measurement. The *decibel* (db) is the physical unit for expressing intensity or pressure levels. The *phon* is applied to what was formerly called loudness level; that is, the equivalent level in decibels of the equally loud thousand cycle tone. The decibel is defined by the relation $N = 10 \log_{10} \frac{I_1}{I_0}$, where N is the number of decibels by which the intensity flux I_1 exceeds the intensity flux I_0. The intensity flux is the measure of the energy contained in a sound wave and is defined in terms of microwatts per square centimeter of wave front in a freely traveling plane wave. It is usually more convenient to select an arbitrary reference intensity for I_0 and express all other intensities in terms of decibels above that level. For this purpose the threshold of audibility for the average human ear at a frequency of 1000 cycles per second has been selected. This reference threshold is 10^{-16} watts per square centimeter or 10^{-10} microwatts per square centimeter. This reference level also corresponds to a pressure of 0.0002 dynes per square centimeter.

A stated sound level in decibels, unless otherwise defined, will thus be related to a threshold of 10^{-16} watts. For example, a level of 60 db above