APPENDIX E: ACOUSTICS

E.1. Introduction. This appendix covers general acoustics information, designed to help a design professional or facility program manager in understanding in more detail, individual aspects not covered in section 23 and Appendix A.

E.2 Definitions.

E.2.1. A-weighted decibels (dBA): The A-weighted scale of a sound level meter measures decibels in a manner that discriminates against lower frequencies in the same manner as does human hearing. Therefore, sound measured in dBA is a fair measure of how loud we perceive a source.

E.2.2. CAC (Ceiling Attenuation Class): CAC values measure the amount of sound that is blocked by an acoustic tile ceiling for the sound path that goes from one room, through its acoustic tile ceiling, into a standard plenum, and back through the acoustic tile ceiling into a neighboring room. The CAC value applies just to this path through the plenum, and is analogous to the STC rating for a wall. Higher values indicate a greater ability to block sound.

E.2.3 Coefficient of absorption. All materials absorb some sound, and this percentage of sound is measured (in laboratory tests) as a coefficient of absorption. Coefficients of absorption range in value from close to 0 (no absorption) to nearly 1.0 (100 % efficient); these coefficients vary as a function of frequency. Materials that are most efficient at absorbing sound include soft porous "fuzzy" materials such as glass fiber, mineral wool, carpet, curtains, acoustic tile, and other specialty materials. Materials that depend on their porosity to absorb sound should not be painted in a way which will clog their pores, and thus degrade their acoustical performance.

E.2.4. Decibels (dB). Sound energy is measured in decibels (dB), which corresponds to loudness. The decibel scale ranges from 0 dB (threshold of hearing) to over 100 dB (painful and injurious to one's health). Decibels are a logarithmic scale, which means that you can not add decibels directly (50 dB + 50 dB equals 53 dB, and does not equal 100 dB). Discussions that follow will avoid detailed calculations or technical analysis.

E.2.5. Frequency (Hz). The frequency of vibrations for a sound source is measured in cycles per second, or Hertz (Hz), which corresponds to pitch. Human hearing responds to sound from 20 Hz (very low tones) to 20,000 Hz (very high tones). Frequencies of sound relate to types of noise sources (e.g., diesel engines produce low frequency sound, human speech carries intelligibility at higher frequencies), sound paths (some materials and constructions are better at blocking or absorbing sound at certain frequencies than at other frequencies), and the receivers (humans are most sensitive to sounds at mid- to high-frequencies of 500 Hz and above).

E.2.6. IIC (Impact Isolation Class): IIC is a single number rating system for the ability of a floor/ceiling construction system to reduce the noise of impact or structure-borne energy. Higher values indicate a greater ability to reduce impact noise.

E.2.7. NC (Noise Criteria level): NC is a single number rating system for level and spectrum of steady-state background noise levels in buildings, as determined by the noise of mechanical systems. Minimum and maximum ratings per room are listed in Appendix "A".

E.2.8. NIC (Noise Isolation Class): NIC is the single number rating based on field tests of how well all inter-connected constructions around a room block sound. NIC will often be less than the STC rating for the same construction by about 4 to 8 decibels. The NIC ratings include the contribution of all sound paths between adjacent spaces (including doors, ceilings, windows, etc.). Higher values indicate a greater ability to block sound.

E.2.9. NR (Noise Reduction): NR is another measure of all the sound transfer between two spaces, by way of multiple paths (such as walls, floors, doors, ceilings, windows, etc.) The NR is the difference in A-weighted sound levels (dBA) from source to receiver. Higher values indicate a greater ability to block sound.

E.2.10. NRC (Noise Reduction Coefficient): NRC is a measure of the sound absorption of a material within a space. It is the average of absorption coefficients of the mid-frequencies that are most typical of general office and speech use. NRC values range from 0 to 1, with the value being rounded to the nearest .05 value. Higher values indicate a greater ability to absorb sound.

E.2.11. Source/Path/Receiver. Every acoustics problem and issue can be analyzed by looking at the separate elements that comprise the source/path/receiver outline. The source may be a neighbor talking, mechanical equipment, a vibrating pump, music from a stereo, or outside traffic. The path may be the building envelope, the intervening construction between two spaces and the multiple paths by which sound may travel, the air in a room, the building structure (in the case of structure-borne transmission), or several of these elements together. The receiver is the human occupant (patient, office worker, neighbor) whose health and welfare are the goal of the acoustical design.

E.2.12. STC (Sound Transmission Class): STC is the single number rating based on laboratory tests of how well a particular construction type blocks sound. STC values are determined from TL data (see below). Higher values indicate a greater ability to block sound.

E.2.13. TL (Transmission Loss): The ability of materials to block sound is measured in a laboratory as the Transmission Loss, TL. TL covers a wide range of discrete octave band or one-third octave band frequencies. A higher TL means that less sound is transmitted through the construction, and hence provides better sound isolation. TL is mainly useful in order to derive the single number STC value for a material (see above).