

VENUE	NCB-curve
Broadcast and recording studios	10
Concert, recital, opera halls	10-15
Large auditoria, churches	<= 20
Small auditoria, cinemas	<= 30
Meeting and conference rooms	<= 30
Bedrooms, hospitals	25 - 40
Private offices	30 - 40
Classrooms and libraries	30 - 40
Small conference rooms	30 - 40
Living rooms	30 - 40
Large office or reception area	30 - 40
Retail shops, restaurants	30 - 40
Lobbies, labs, drafting rooms	40 - 50
Maintenance shops, kitchens	45 - 55
Shops, garages	50 - 60
No hearing-damage risk	<= 70

Table 1: NCB curves at different locations. *S&VC September 1999, pp.60)*

The distance relation as expressed in formula 2-1 is a clear part of the noise measurement. But the distance from listener to the noisy transformer in the listening environment plays the same important role. When a noisy piece of equipment is placed several meters away from the listener, the noise level at the listening spot will be smaller than the level at 1 meter. Rearranging formula 2-1 expresses this relation:

$$SPL_{at\ r\ m} = SPL_{at\ 1\ m} - 20 \log r \quad (2.2)$$

Formula 2-2 is valid under "far field" condition up to the critical distance D_c where the level of direct sound and the level of reverberant sound are equal. See for more details Figure 12. Because it is impossible to know each listening environment, we propose to standardize the noise specifications for the 1 meter distance mentioned. For any particular application the actual noise level can be calculated at the listener spot at a distance r from the noisy transformer using formula 2-2 with the restriction of $r < D_c$.

3 ADVERSE MAINS CONDITIONS AND NOISE MEASUREMENT

We might hope for clean sinusoidal mains voltages with the proper mains frequency. However, reality is different. Sags and surges, spikes, over voltages, DC on the mains, very high frequencies (from computers and GSM phones and radio TV transmitters), lightning residuals, spikes caused by switching on/off of motors, hairdryers switched at lower power with single rectifying diodes causing asymmetrical load to the mains sine wave, such