## Direct sound or steady-state sound: which is Genelec measuring in their in-room equalization system?

The answer is unambiguously explained in these Genelec publications, all three of which are among the references in my new book.

Mäkivirta, A.V. and Anet, C. (**2001**). "A Survey Study of In-Situ Stereo And Multi-channel Monitoring Conditions". 111th Convention, Audio Eng. Soc., Preprint 5496.

Anet, C. and Martikainen, I. (**2006**). "Acoustical Insights Behind the Development of Genelec AutoCal™", http://www.genelec.com/sites/default/files/media/About%20Us/Magazine_Articles/2006_anet_martikainen_studio_magazin.pdf

Anet, C. (**2014**). "Innovation and Research", Resolution, Jan/Feb. 2014

The 2001 publication is a tour de force of data collection, a survey of 372 Genelec loudspeakers installed in 164 professional monitoring rooms. All loudspeakers were "factory calibrated three way monitors and acoustically calibrated with standardized apparatus".

The current discussion centers on the specific meaning of the last five words: "acoustically calibrated with standardized apparatus".. From Genelec publications it is evident that the target performance was dictated by their broadcast users. They say: **"**Back in the 70's the engineers who wrote the original Nordic Broadcast N12 specification for monitoring conditions in control rooms were very modern thinkers. One of the most advanced requirements was probably that the specification of the monitor's frequency response was defined, with acceptable tolerances, in the control room at the engineer's listening position." I don't have a copy of the Nordic Broadcast n12, but from what is said of it, it appears to be in substantial if not perfect alignment with the current international standards (which the 2001 paper clearly use as the reference):

ITU-R BS.775-3 (**2012**). "Multichannel stereophonic sound system with and without accompanying picture", International Telecommunication Union, Geneva.

ITU-R BS.1116-3 (**2015**). "Methods for the subjective assessment of small impairments in audio systems", International Telecommunication Union, Geneva.

EBU Tech. 3276 – 2nd edition (**1998**). "Listening conditions for the assessment of sound programme material: monophonic and two-channel stereophonic".

In my book I take these to task for being out of step with scientific knowledge that mostly, but not all, has been accumulated in recent decades.

All of these standards require a flat **steady-state** frequency response at the listening position. How this is measured is well described in the 2001 paper, in which it is explained how Genelec uses digital measurements to simulate the antiquated pink-noise 1/3-octave Real Time Analyzer method around which the standards were written. They say: “The target for the magnitude response at the listening location, or the room operational response curve, is defined as the third-octave smoothed magnitude response.” In that paper they employed a MLS sequence with a 217 ms period to generate a *steady-state* frequency response which was smoothed by a sliding 1/3-octave band.

The 2006 magazine article says: “The AutoCal™ system uses loudspeaker- generated log-sweep sine signals recorded by a calibrated high quality microphone to determine the correct acoustical alignment for every loudspeaker and subwoofer”. Again this is a *steady-state* measurement method.

They go on to correctly say: “Obviously [in room] equalization has to be applied with proper understanding of the relevant phenomena and only within a frequency range where it can improve the perception. Correcting fine details is unnecessary because the ear/brain is more sensitive at detecting wideband imbalances than narrow band deviations in the magnitude response. This underlines the importance of primarily solving acoustical problems by correct loudspeaker design and placement as well as room acoustic treatment before using equalizers.” So, the automatic room setup is not intended to fix room acoustic problems that can only be addressed by old fashioned acoustical treatment. It is assumed that one starts with a “good” loudspeaker in a “good “room. Absolutely logical.

Consequently, Genelec uses broad “tone control” like spectral tilts and undulations rather than the high resolution “room EQ” schemes that are (incorrectly) promoted by some other providers. They depart from this only at low frequencies, where individual room modes need attenuation. All of this is sensible.

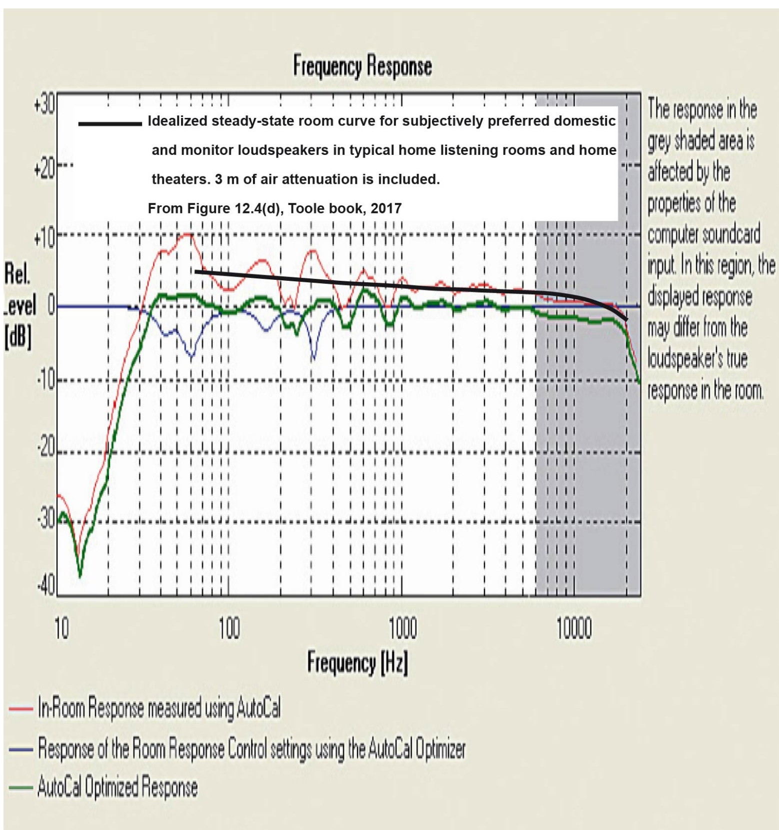
The point of departure comes in the choice of a flat steady-state room curve as the performance target. As I discuss in my book, in audio a “flat frequency response” has been historically considered to be an almost automatic requirement for everything. Certainly, it makes sense for electronics, and in loudspeaker designs from the very early days a flattish anechoic on-axis curve has been the objective. With active loudspeakers incorporating DSP it is easily achieved, even in some eminently affordable products. That done, and with attention to off axis directivity performance to ensure a decent timbral match between direct and reflected sounds the result is high sound quality ratings in double-blind listening tests – and . . . a steady-state in-room curve best described as a gently sloping line. It is because loudspeakers are omnidirectional at low frequencies, becoming increasingly directional at higher frequencies.

As monotonously explained in my papers, starting in 1985-86, to the present day, and summarized with input from others in my new book, listeners in double-blind listening tests gravitate to preferring a flattish direct sound. This is true in domestic and control room sized rooms, as well as in cinema-sized rooms (first shown In blind listening tests done by Ljungberg, a Swede, in 1969 – Chapter 11 in my book).

Achieving the highest scores requires very smooth high resolution responses - 1/20-octave resolution is used in anechoic loudspeaker measurements to reveal audible resonances. Loudspeakers with flattish, smooth, on-axis and listening window responses automatically deliver flattish direct sound to listeners, and they respond favorably.

The following illustration comes from a Genelec publication, showing measurements at the listening position before and after AutoCal optimization. The interesting point is that the "before" curve, the orangish one, is tilted. I have taken the liberty of rescaling it to match the "idealized" steady-state room curve that is expected from subjectively highly rated loudspeakers, discussed in detail in Chapter 12 in my book. As emphasized there, this curve results from well-designed loudspeakers. Equalizing loudspeaker that are not well designed to match this curve guarantees nothing.

That curve is superimposed on the "before" curve and not surprisingly, because Genelec loudspeakers are properly designed, it closely matches the measured steady state "before" curve down to frequencies where adjacent boundary and room resonances become strongly influential.




What the Genelec AutoCal system did was to attenuate some of the worst low frequency irregularities (good) and then turn the bass down to make the overall curve flat. The latter action modifies the anechoic response of the loudspeaker, and it is possible for the sound to appear to be lacking in bass, or exhibiting excessive high frequencies (they amount to the same thing). This will not be noticed if recordings were made and broadcasts originate using monitors equalized in this manner (the circle of confusion is eliminated) but the global reality is that consumers in their homes are much more likely to listen through loudspeakers that yield tilted steady-state room curves. Such tilted "target" curves result without intervention from high quality loudspeakers. They are now in several automatic EQ programs in consumer equipment, and other forum discussions indicate that experimentally minded listeners have concluded that such a tilted curve is preferred. It is of passing interest that it is very similar to a target room curve originated by another Scandinavian (Moller at Bruel and Kjaer, Denmark) in 1974 – see Figure 12.6 in my book.

Obviously, bass problems are handled separately.

This entire discussion can be summarized by Figure 13.2 on p.370 and the associated discussion.  As I have said, the problem is with obsolete standards, not the loudspeakers.