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"CONCISE PARAMETERS FOR ASSESSING A PRO AUDIO SYSTEM FOR SOUND REINFORCEMENT USE"

part III

In part II of this short series, after a large amount of "reasoning" which I hope readers managed to follow, I finally put forward my proposal for concise **"quantitative"** parameters, as an alternative to the senseless use of "Watts", for assessing professional sound reinforcement systems.
I gave a completely hypothetical example, shown again below, of how these parameters can be used by who – for example – has to draw up a technical data/spec sheet, but obviously not only for the sound reinforcement of a certain event, or a series of events such as a tour.

SOUND SYSTEM FOR "Rock Music" (Pop, Jazz, Heavy Metal, Classical etc.)

"100 dB SPL Max at 30 metres over 90°" (The values shown here are only examples)

Reading it, I think everybody will notice the immediacy and usefulness of the definition of a professional sound reinforcement system from the point of view of **quantitative** "performance" necessary for whoever makes the request with a well-defined aim in mind, as is stressed in the article. This type of "characterization", which even includes the type of music for which the system must be suitable, is easily understandable and can even be prepared by people who are not acoustics experts, as is generally the case with artistic professionals or whoever organizes performances in the music field and who, for commercial (budget) reasons, conditions choices which should not be left to them, as they do not have sufficient knowledge of the matter. This is one of the main "deformities" in the Sound Reinforcement sector, which led to the rash use of "Watts" as the discriminating element as far as quantity is concerned.

What's behind the simple concise characterization of the example?

To understand this, some consideration must be made which – although anything but concise – are simply necessary.

The basis of these considerations, or rather the "bricks" of this logic construction, have been all (or almost all) listed, described and illustrated in previous articles.
In this last part, we shall analyse the importance of these "bricks" in drawing up the hypothetical example shown above and how, in the same way, they would affect the drawing up of any other real example.

First of all, it's necessary to understand the reason why the type of music the sound system will be required to reproduce must be established before the numerical values.

In fact, this information is essential in order to establish the size of the sound reinforcement system, which for economic reasons is never generally so redundant as to be able to meet the power requirements of music genres that are very different as far as audio spectrum content is concerned.

I have already covered this problem in sufficient detail in issue N° 14 of December 98 (1) of this magazine and gave a bibliography to be referred to for more in-depth information.

This includes the IEC 268-1 1985 standard, which refers precisely to the application of a loudspeaker test signal that simulates the signal of the music program actually applied, following a procedure that there is no need to describe in its entirety, but which used pink noise with suitable frequency filtering and a low Crest Factor: 3dB (1.41).

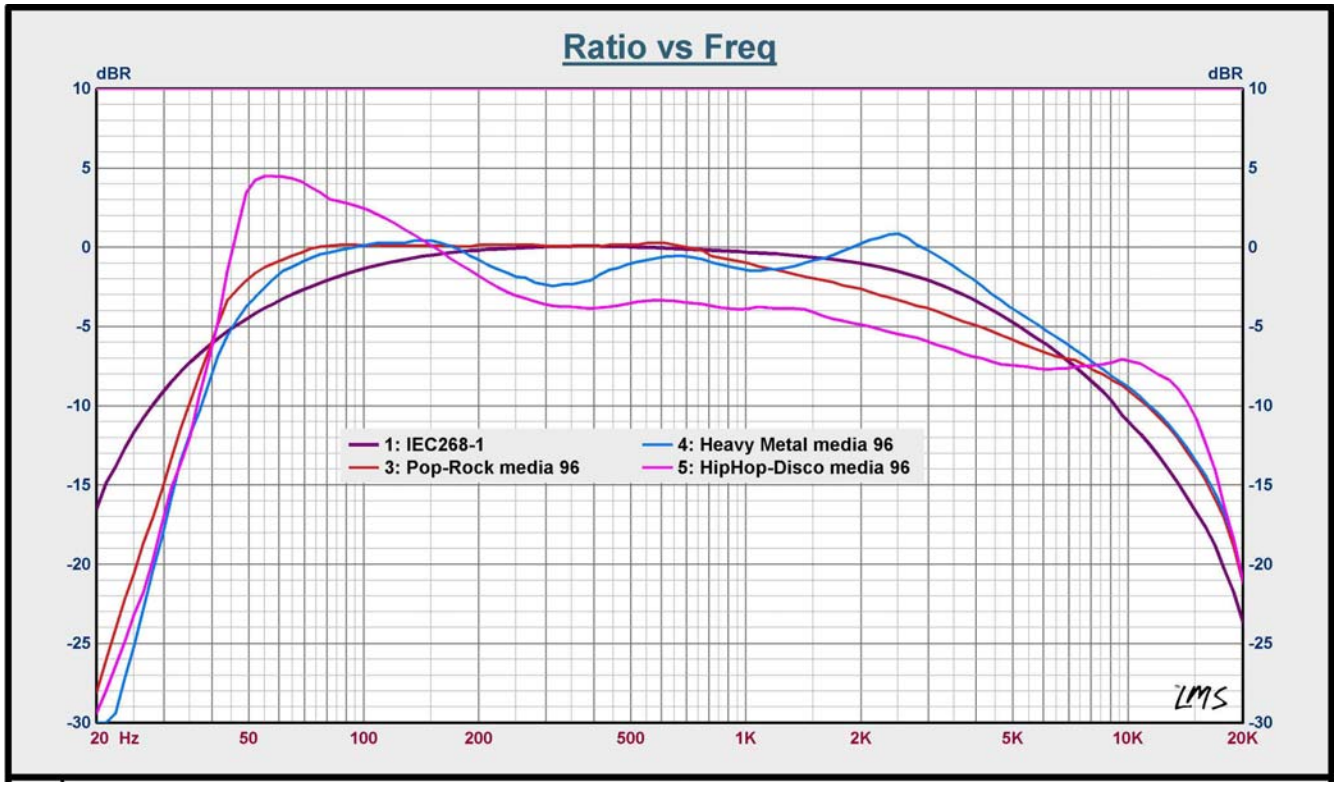
The aim is to submit the loudspeaker enclosure to the worst possible stress conditions for the entire duration of the test.

If, on one hand, this method (i.e. the IEC test signal) leads to establishing the maximum continuous power that can be handled for 100 hours by the loudspeaker or enclosure, without such stress as to lead to differences of over 10% in the parameters measured 24 hours after the test, on the other, this signal would be excessively stressing at low frequencies compared to the real music signal, as can be seen from a later study (in 1996) by Peter John Chapman (2).

Moreover, according to this study, the IEC signal would not be particularly suitable, as far as spectral content is concerned, for maximum short or long term power tests, and lastly, would not even correctly represent the music signal from the point of view of the Crest Factor, i.e. the relationship between the RMS (average) value and Peak value, which a selection of signals found in the most recent CD recordings reflecting live music productions, shows to be on average higher than those made before 1985, the year in which the aforementioned IEC Standard was published.

However, we can see in the following graph the curves of the power spectrum regarding some of the music genres that, from the point of view of their correct amplification, are most frequently involved in the live concert sound reinforcement sector. These curves, which can be found in the aforementioned study by Chapman, along with numerous others, enabled the author to propose an alternative test signal to the IEC, which is also probably more suited to representing a more realistic average signal, to which the enclosures being tested are submitted, compared to the spectral content of the overwhelming majority of music genres.

Fig.1 - The graph shows the spectral averages of the signals found in Pop, Rock, Heavy Metal, Hip Hop and Disco music, drawn up by Chapman, compared with the Standard IEC curve.



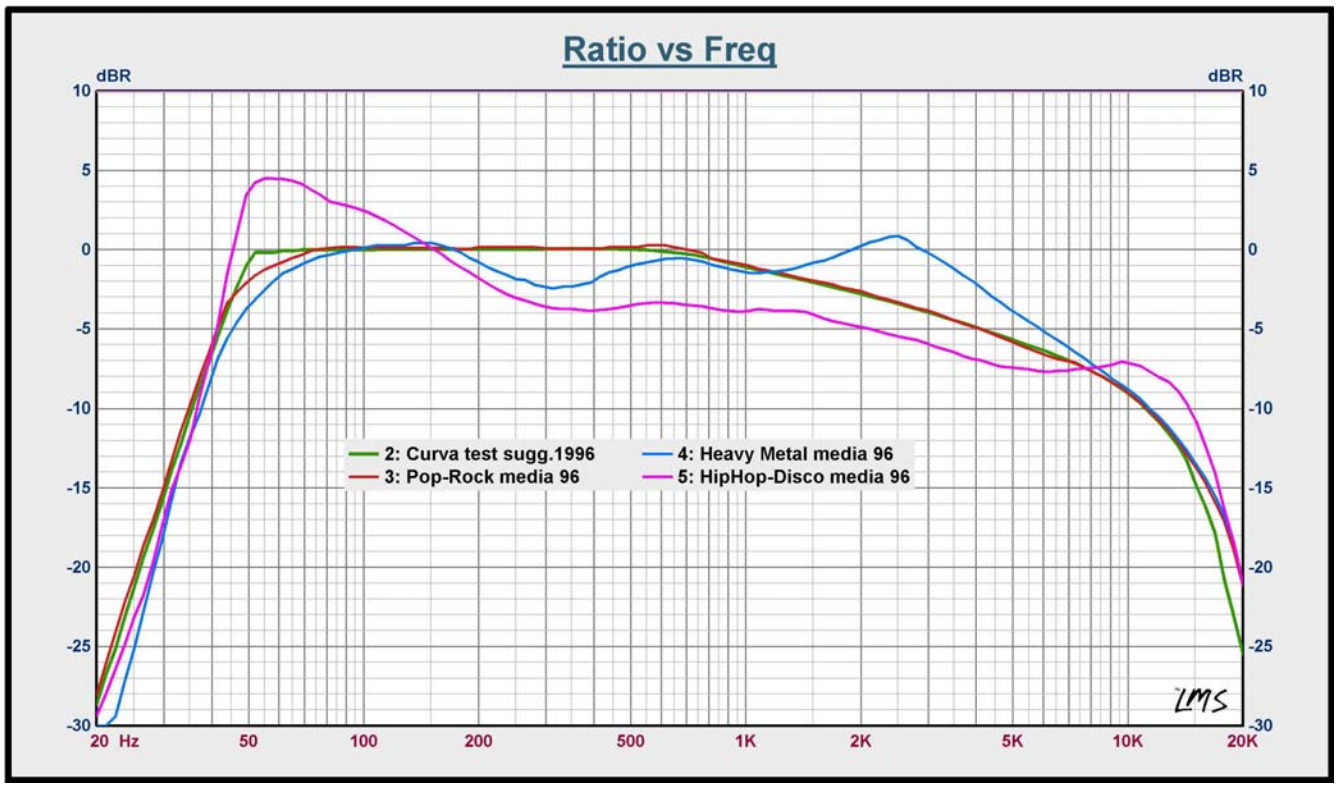
It must be remembered that the curves of the power spectrum, typical of these music genres are certainly those with the widest frequency band and the highest energy content. For the aim proposed by this article, this makes the analysis of the spectral contents of the other music genres unnecessary, so those who wish to go into this in greater depth will have to obtain the complete study from the Italy's regional branch of the AES.

Analysing the graph, it can be seen how much the various spectral curves differ from the IEC curve, once again confirming Chapman's conclusive statements, shown above, regarding the suitability of the IEC signal for power tests on enclosures or loudspeakers.

Moreover, in the graph shown below, which completes the overview, it can be seen how the alternative curve suggested by the scholar, regarding these music genres, which are definitely among the most representative for sound reinforcement issues, necessary in the large majority of live concerts and tours, is also rather far from representing a realistic signal to which loudspeaker enclosures being tested should be submitted in order to check their suitability for trouble-free reproduction of the aforementioned music genres.

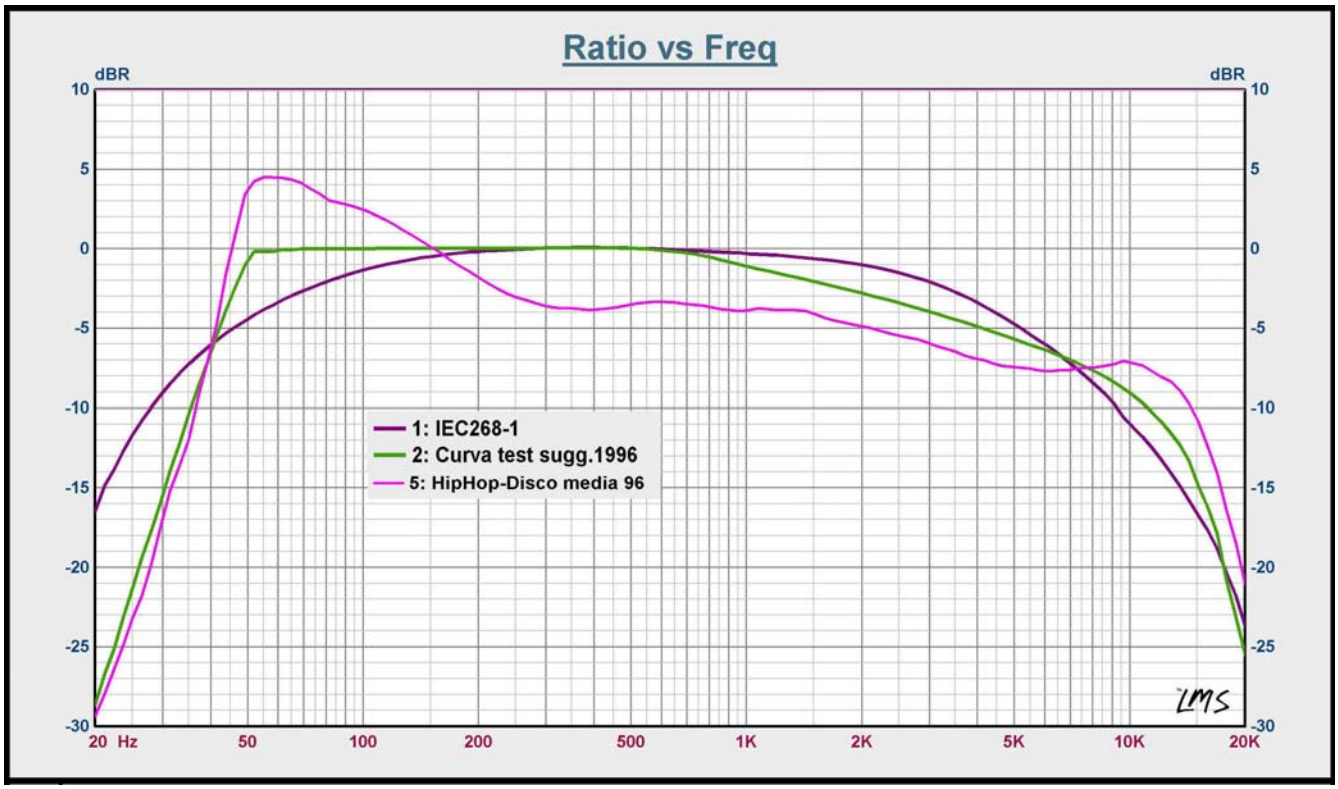
Even if it seems a step forward, in my opinion (based precisely on the data provide by Chapman) the alternative test signal he suggested is still not sufficient to simulate the real signal to which live sound reinforcement systems are effectively submitted. **Once again, the average of the averages can't be the most suitable solution to the problem.**

Fig. 2 - The graph shows the spectral averages of the signals found in Pop, Rock, Heavy Metal, Hip Hop and Disco music, compared with the alternative curve suggested by Chapman.



The differences between the suggested curve and the spectral curves regarding the music genres shown are definitely smaller than those seen when compared with the Standard IEC curve, but are in any case large enough (around 3-4 dB even for wide portions of the spectrum according to the genre taken into consideration) not be able to be overlooked. In fact, these differences establish the need (or not) to double the sound reinforcement system or at least double the power available for reproduction without excessive stress or needless redundancy. for one type of music or the other.
This can be seen very clearly in another graph hereunder, in which the differences are highlighted between the IEC curve, the alternative curve suggested by Chapman and the spectral curve of one of the most significant music genres as far as spectral content is concerned among those he analysed and included in his study

Fig. 3 – The graph shows the test signal curves for testing the enclosures, according to IEC Standard 268-1 and according to Chapman's study.



Observing the graph, the differences between the two curves are clear. Below 40 Hz, the IEC signal is uselessly stressful compared to the values obtained from the average of numerous tunes analysed among all or almost all the music genres, including the most recent, such as Dance music, Techno and club sounds in general. It is again uselessly so from approximately 900 to 6000 Hz, and is then not representative by defect from 6500 to 17000 Hz.
For the signal regarding Hip-Hop shown in the graph, on the other hand, between 40 and 160 Hz there is a great difference of energy that neither of the averages (IEC and Chapman) would take into consideration in a hypothetical test, with a consequent underestimation of the real necessities in this particular frequency band.
Whereas, between 160 and 7000 Hz approximately, it is clear how the curves are uselessly "stressful", compared to the spectral content of the genre in question. Above this band, direct comparison emphasizes underestimation of the energy contained in the test signals compared to the necessary energy required from the real signal.

This same assessment must obviously be made for live music, for which it is also necessary to consider (to decide the size of a sound reinforcement system), a much higher figure for the Crest Factor that the test signal should have, compared with just 3 dB foreseen by the IEC Standard.

Without adding anything else to the above, to avoid making the concepts covered so far (which are already not easy to follow) even more difficult to understand, I hope that it is definitively clear to everybody the need to have precise detailed information on the type of music pro sound reinforcement systems have to reproduce, in order for them to have correct sufficient dimensions, also for transport and/or cost reasons; unless one has such unlimited means (in every sense) to use a system that is so over-sized that it is able to handle any kind of requirement.

The second parameter of the example regards maximum sound pressure level. This is a parameter that should not require any further in-depth coverage, but since it is linked with the distance and dispersion angle at which this pressure must be available, it is better to clarify the methods of assessment it refers to.

It must not be forgotten that, as I have abundantly illustrated, the maximum pressure value stated for certain “dimension” conditions, such as distance and coverage angle, will also have to take into consideration other fundamental parameters that establish its credibility regarding the actual use of the system.

It fact, is useless “cheating” to make a statement such as that described in the example if, in actual fact, the sound reinforcement system which has been accredited with the ability to give the required performance is not sufficiently large to allow for the so-called output “losses” inevitably caused by the aforementioned parameters.

I’d like to say once again that these parameters are essentially **Power Compression** and **Harmonic Distortion**.

They are closely bound to the reinforcement system’s construction - and consequently quantitative - characteristics (as well as its qualitative features, regarding distortion, which shall not be covered at present) and, in short, its “thermal” performance. In other words, the more active elements (i.e. loudspeakers) are able to eliminate the heat of the voice coils, rapidly and effectively, the lower the effect of Power Compression and consequent Distortion, as well as the unwanted alteration of the **Effective Frequency Band** (see previous articles) reproduced at high sound levels by the complete system.

In other words, if in the sound system, made up of loudspeaker enclosures, manufactured with performance and not necessarily cost as their main objective, quality loudspeakers are used and all the expedients experienced designers can apply are implemented, providing none of the power and control electronics alters or limits signals in any way, there will be a reduction of the negative effects due to low thermal output mentioned above “thanks to” a delayed appearance of Power Compression and the consequences caused by this.

A concert could therefore be held entirely without significant “drops” in the performance of the sound reinforcement system from the point of view of both quantity and quality.

All this is not to be found clearly and explicitly printed on manufacturers’ data sheets, so it is very common for those who read them and have not in-depth knowledge of the topic, to compare figures apparently very similar that often put products that are completely different as far as construction and quality are concerned on the same level.

This fact definitely does not help users to choose a sound reinforcement system, or to make the market transparent. Unfortunately, it is a problem of an ethical nature that no technician can solve by obliging manufacturers to state the characteristics of the sound reinforcement systems complete with all the details that should not be overlooked to enable them to be assessed according to users’ real requirements.

To bypass this stumbling block, the only thing is to insist that those who respond with a proposal to the type of request described in the example assume their responsibilities. It will therefore be up to them (whether they are rental firms, consultants or manufacturers) to shoulder the onus and responsibility of the choice of an adequate system, bearing in mind all the problems listed.

Only in this way will real (not astonishing) information circulate on the performance characteristics of the professional sound reinforcement systems with the permission of supporters of the “Watt”.

I don’t know if my proposal will be favourably welcomed and thus have a follow-up as far as hard facts are concerned, not without the support and suggestions of all those involved, who are invited to improve its applicability via the magazine or even directly to my e-mail address. As far as I’m concerned (and the company I represent), I’m working on further improvement in the direction described, by increasing the already copious technical information currently put at clients’ disposal.

1) The issues of Sound & Lite quoted in this article regarding this matter are: N°14/Dec98, - N° 26/Nov.2000, - N°27/Jan. 2001, - N° 28/Mar. 2001.

2) Programmed Material Analysis - Peter John Chapman. Presented at the 100th AES Convention (May 1996 – Copenhagen).