

1 **Safety testing of powered and active loudspeakers**

2 Questions about powered (or active) loudspeakers were referred to me by the Chairman of IEC TC108.
3 The text has been redacted to preserve confidentiality.

4 **QUESTION 1**

5 *We are preparing to perform heating tests on a powered loudspeaker and are trying to determine the*
6 *proper way to determine the non-clipped output power according to Clause 4.2.4 of IEC/EN 60065. We*
7 *are using a 1 kHz sine wave to determine the clipping point of the built-in amplifier. What defines the*
8 *'onset of clipping'? The question centres on the time constant for measuring clipping. If the gain of the*
9 *input to the amplifier is slowly increased and the output monitored, the output signal rises until the*
10 *protection circuit operates and the amplifier shuts down. The amplifier cannot sustain this maximum level*
11 *of power for more than a second or two. A lower level can be sustained for longer durations. But how long*
12 *does the amplifier need to operate before we determine the clipping level?*

13 **ANSWER 1**

14 The industry has not reached any sort of consensus on testing powered and active loudspeakers, either
15 for performance or safety, and doesn't seem intent on reaching one. They are, in fact, quite difficult
16 subjects. My opinion is that since a heating test could last for 4 hours (see Note 1 to 7.1.1), you have to
17 set the output to a level that can be maintained for at least that period.

18 But some parts in the amplifier(s) might get hotter under different conditions, so your own testing might
19 include an investigation of that, just for reliability considerations at least, but also to check that accessible
20 parts (e.g. heatsinks) don't reach grossly excessive temperatures.

21 **QUESTION 2**

22 *How would one determine the outset of clipping? Would measuring distortion be useful? We do this*
23 *visually, where we look for clipping or distortion of the sine wave, but it seems very imprecise.*

24 **ANSWER 2** For some amplifiers, observing the waveform doesn't work at all well, because they have
25 'soft clipping' or even automatic gain control that entirely prevents clipping. For those cases, you can just
26 use the level that doesn't change by more than 0.5 dB when you increase the input level by 3 dB. The
27 numbers are my invention, but it's a defensible method for your safety assessment file, I think.

28 You can use a distortion measurement if the curve of distortion versus input level is 'well behaved', i.e. it
29 follows a very low distortion level up to a certain input level and then sharply increases, without turning
30 downwards again. A criterion of 2 % THD used to be used in days gone by as the 'onset of clipping'.

31 There seems to be a further difficulty with Class D amplifiers, as different designs respond to excessive
32 input level differently. Some behave like non-switching ('analogue') amplifiers with anti-clipping AGC.