Subject: Loudspeaker defects and distortion spectrum
Posted by Wayne Parham on Wed, 16 Apr 2008 18:33:02 GMT
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If the suspension has sagged, I would suggest having the suspension replaced. Either recone the speaker or replace it. If the cone is offset from center at its rest position, then the spider has stretched and lost its elasticity. What that means is there will have to be extra force applied to compress the spider, to overcome its extra length. Then once you get past the point where compression is no longer needed, it will tend to spring back and push the cone.This will make a very weird motion, sort of a mechanical two-state travel. Picture a membrane switch, how you can click it in one of two positions. It is either extended or compressed, but it is difficult to get it to stay in between. In terms of distortion that's produced, this will create high-orders, sort of like what happens in a complementary class B amplifier, or what can happen in a class AB amplifier with the bias set too low. There is an anomaly in the waveform as you pass through the resting position. The zero crossing forms a ripple, which sounds real dirty.The T/S parameters usually shift very far when the spider is malformed this way too. I measured a pair of woofers for a friend just a couple of months ago. One had this exact problem, although the cone must have been facing upwards when the spider hardened. It's resting position was then offset down into the basket. I measured each of their electro-mechanical parameters and found one to be extremely far off. Only then did I notice the cone offset.The distortion spectrum of a good quality speaker is mostly low orders. They tend to be well behaved at low power levels, with distortion levels rising proportional to power levels. The harmonic series generally drops with increasing order. That is to say there is more second and third harmonics than fourth and fifth and so on.Some technologies and configurations will slightly modify the distortion spectrum, like progressive spiders, braking coils, shorting rings, differential drive or push-pull drive. Each of these technologies are intended to solve a particular problem, and each modifies the mechanical properties in a way that affects distortion. Most are intended to reduce distortion or to mechanically throttle cone motion at high excursion levels. Anything that affects cone travel symmetrically will have an effect on odd harmonics and those that affects travel asymmetrically will modify even harmonics.As an example, differential and push-pull drive reduces even harmonics because it tends to correct asymmetries. Progressive spiders and braking coils limit motion at excursion extremes, acting on both cycles makes them increase odd harmonics at high power levels. If a progressive spider or braking coil generates a little more force on one cycle than the other, then it will increase even harmonics too. So certain technologies can modify the harmonic series but in general, speakers generate only low order distortion with harmonic series that drops with increasing order.A damaged speaker can generate unusually high order distortion products. The voice coil may be rubbing or there may be mechanical interference. The spider may be stretched. Each of these kinds of problems has its own characteristic distortion "signature" that is fairly distinctive. Production line QA testers use these properties to find defects. Measurement systems can easily find a defective driver by watching for specific distortion components that indicate a misaligned coil or defective suspension.Measurement of Impulsive Distortion, Rub and Buzz and other Disturbances, Wolfgang KlippelHigher Order Harmonic Signature Analysis for Loudspeaker Defect Detection, Dan Foley, Dr. Robert Celmer, Scott Galway, and Matthew LaBruzzo