The Great Alnico / Ferrite Debate

The subject of Alnico vs ferrite magnet drivers comes up fairly regularly on our site. The following is my attempt to clarify some of the issues involved. Before I get into a discussion on the merits and disadvantages of each magnet type, it is important to separate fact from fiction. To understand how this debate began, it is necessary to know a bit about loudspeaker history. Up until the late 70's, most high end speaker manufactures used Alnico magnets due to their greater energy/weight ratio. Starting in 1978, all major manufactures (JBL, EV, Altec, Tannoy etc.) switched to ferrite drivers. That was when the myths began.

Myth #1 – Speaker manufactures switched to ferrite as a way to lower their production costs and cheapen the quality of their drivers.

Fact – The switch to ferrite was in response to a crisis situation whereby Alnico became totally unavailable. A civil war in Zaire led to the complete embargo of the world's only source of commercial cobalt used in Alnico. There was no choice but to switch. This is why, in less than one year, every major Alnico speaker manufacturer had switched to ferrite.

Myth #2 – Due to the lower energy/weight ratio of ferrite, drivers using this material have lower total flux and lower flux densities compared to the previous Alnico drivers.

Fact – The initial ferrite conversion had the exact same magnetic energy of Alnico drivers they replaced. For JBL, the initial conversion effort focused on bass drivers since that represented their largest consumption of magnets. They had sufficient magnet stock on hand to continue Alnico compression drivers for a number of months.

To be able to continue production of the speaker systems in their catalogs, the ferrite bass drivers had to be the exact sonic equivalents of the Alnico drivers they replaced. Otherwise, the entire systems would have to be re-engineered and there was no time to do this. To give you an example, the L300 Summit, both before and after the ferrite bass driver conversion, used the exact same Alnico tweeter, Alnico compression driver, enclosure and network. The only change was that the 136A driver had its Alnico motor replaced with a ferrite motor to become the 136H. The basket, cone and suspension remained identical. The only way this could work was if the ferrite motor had the exact same magnetic energy as the Alnico motor.

As the demand for high power drivers increased, the magnetic energy of the ferrite drivers began to exceed the former Alnico systems. As an example, the last ferrite version of the Altec 515 had a flux density of

15kgauss compared to the 14kgauss of the Alnico version. The Alnico embargo proved short lived. Alnico became available in limited quantities after a year or so, but at a much higher cost. This happened before the compression drivers were converted and it was decided to continue their production to save the costs of redesign. Therefore, Alnico HF drivers remained in production for another three or four years, until it became too cost prohibitive to continue. Around 1983, they were converted to ferrite motors as well.

Nonetheless, the costs of the ferrite replacements in constant dollars remained about the same as the Alnico drivers before the civil war broke out in Zaire. Any savings in cheaper magnetic materials were outweighed by the sheer size of the magnets and the need for a large pole piece to accommodate the external magnet topology.

Now to factual differences. There are three main advantages of Alnico over ferrite:

1) greater immunity to flux modulation

2) greater heat stability.

3) greater suitability to shielded applications

There is also one significant disadvantage – Alnico is susceptible to demagnetization due to large voice coil currents.

None of these differences are absolute. It is possible to design out all of the limitations of each material. However the issue becomes one of cost.

Ferrite designs can equal or exceed an Alnico magnet's flux stability with the addition of a copper shorting ring around the pole piece. With the use of vented cooling and heat sinking, you can manage the heat build-up on a ferrite driver to where it stays below the threshold of non-linear response. Finally with the addition of secondary magnets, you can shield the motor of a ferrite driver to the same degree as an internal ferrite equivalent.

In the same manner, Alnico drivers can be engineered to be immune to demagnetization from overpowering. JBL has done this though the use of a series of flux stabilization rings in their new 1500AL driver. However it is extremely expensive.

All in all, the major speaker manufacturers have found it more cost effective to engineer out the limitations of ferrite drivers than to do so with Alnico drivers and hence the dominance of ferrite designs.

In conclusion, I believe the modern ferrite drivers are superior to the vintage Alnico designs. This is not because ferrite is inherently superior to Alnico. Instead, manufacturers have been able to engineer out any limitations of ferrite and apply the advantages of 25 years of technological progress in driver designs unrelated to magnets. For example, cone materials, suspension design and construction has progressed significantly since the last Alnico drivers were made.

(Don McRitchie - JBL)

Here's the Scoop

Ferrite magnets do not demagnitize with time or drive. They are affected by temperature but that is reversible. They will return to normal when they return to room temperature. Ferrite is basically a lousy magnet material for speakers but it is cheap and readily available. JBL has done a ton of things within the magnetic circuit to make the material behave in a more stable manner. At 100 degrees F, a Ferrite motor will be down about 1.5 dB in level which means the midband of the woofer will be lower by that much and there will be increased output around the system resonance. The TS parameters will be completely different - as though the BL was reduced by about 18%.

Alnico magnets, by their nature are easy to demagnitize with drive. They will not change with time and their dependence on temperature is really small - maybe 1% at 100 deg.F. Alnico stability and resistance to back EMF is really good. This is why they make the best sounding magnetic structures. Unfortunatelly, given a big enough pulse of magnetic energy, they will demagnitize by up to 3 dB. The sensitivity to demagging is dependent on the specifics of the magnetic circuit and the length of the coil providing the field. Underhung woofers (LE15 and such) midranges, tweeters and compression drivers do not have sufficient back EMF fields to push the operating point of the structure below the knee. They are essentially stable regardless of input signal. The short-gap, long-coil speakers are the ones that have a problem. A 2235 can take a hit of up to 3 dB if a big enough hit of current takes place. 1.5 dB to 2 dB is more common. The effect does not get better or worse with time, it solely depends on how much current is driven through the coil. The more current, the more field. Once the field is bigger than a certain number, some amount of demagnitizing occurs. It is perminent (until externally recharged) and will only increase if a larger sustained current hit occurs.

Therefore, if you have a qualifying alnico woofer and you have played it loudly you have some damagging. You can have the unit recharged and it

will be fine until you play it again. Exceed the critical level and it will start happening. If you never do, it won't ever demag. Most of these designs trace back to the 50's and 60's where 15 - 30 watt tube amps were the rule. They didn't have the current capability to hurt anything. With the advent of big solid state amps, the current levels went up and the problems started to surface.

Most of the qualifying 4" motors will loose 1 - 1.5 dB unless they are pummeled. Some of the older 3" with really short magnets, like the 2213A and 123A will typically be around 3 dB down. They go really easily. The old Decade woofers (116A and 127A) only had to see an amplifier in the room and they got really nervous. FYI, the new 1500Al used in the S9800 can take continued pulses of 5000 watts and loose no more than 1%. The test can only be done a few times before the coil is destroyed, but the magnetic assembly is totally stable.

(Greg Timbers post about Alnico Re-Mag - JBL)