This is the first article for craftmen.audio and I would like to give you an short introduction of myself.
I am Bernd Hemmen, founder of PrimaryControl, a company specialized in analog audio products. From origin German, I live since more than 20 years in Amsterdam, The Netherlands. As many others in high end audio, my intrest in audio already started in early childhood and was always a part of my life. At a certain point I started to develope and build my own analog frontend and after the first demands from audio friends it devoloped in a way that it became my profession and as I write on my website; German ingeneering made in The Netherlands.
Today, I would like to tell you some details about the development of my first commerial tonearm design, the stabilized unipivot Reference Tonearm.

Origin for the development was a hate-love relationship to unipivot bearing tonearms. Under ideal circumstances, unipivot arms are capable of excellent sonic performance. Unfortunately, the problem is, that the playing of records rarely happens under these ideal conditions. More on that later.
Early employment with this bearing principle led to the realization that the position of the bearing plays a decisive role in the sonic characteristics of the tonearm.
The smaller the distance between the bearing point and the center of gravity of the arm-wand-counterweight assemble, the better the reproduction of the finest details and room information.
Ideally, the bearing point is at the center of gravity of the arm structure to minimize restoring force of vertical movment.
This can not be achieved with a common unipivot tonearm. The proximity to the center of gravity leads to unstability and thus to torsional unstability. Therefore, it is customary to place the center of gravity of the arm rather low to allow the playing of warped records. The arm is now less likely to be accustomed to torsional movement, but has a low center of gravity for vertical movement.
This was the starting point for the construction of the PrimaryControl Reference Tonearm. The sapphire bearing is supported by a second bearing point.
This second bearing point is below the unipivot bearing and the arm does not have a fixed conection to the lower bearing, but is leaning against the bearing.
Simultaneously, the azimuth of the tonearm is also adjusted.

This has the advantage that it is possible to chose the postition of the bearing. Following the ideal, the center of gravity of the tonearm-counterweight assemble is now in the same plane as the unipivot bearing and approximately at record/platter height.

A further point, which is not particularly elegantly solved in most tonearm designs, is the anti-skating device.
A thread-mass construction, a modification thereof or a spring is commonly.
Apart from the fact that this is also a resonating mass storage, most of these devices also introduce some amount of friction.

Take a record without groves and compare the operation of a magnetic anti skating device and the mentioned thread-mass anti skating device.
If with both devices the counterforce is adjusted well and you lower the arm to the record, the arm with magnetic anti skating moves a little around the point where you lowered the arm. This is due to the unevenness of the record and you can see that the arm can freely move lateral. The arm with thread-mass device stays firmly in one

position after lowering.

The skating force is a dynamic force and speed dependent. Therefore, a well-designed anti-skating device is also designed dynamically and has a stronger effect on the outer than on the inner grooves of a record. Unfortunately, the skating force is also varying with the amplitute of the signal in the groove and thus depending on the music playing at this very moment. This is not easy to compensate with traditional methods.

Let us come to another point that was at the 'to do' list for the development of the Reference Tonearm.
A acurate way to adjust the vertical tracking angle (VTA) aka the stylus rake angle (SRA) should be applied. This had already impressed me with the introduction of the Wheaton Tri Planar Tonearm.
By the way, in my opinion, the correct setting of the VTA is not as important as the correct adjustment of the SRA angle. Since the adjustment of the height of the tonearm at his mounting base always changes both settings at the same time, I prefer the correct the adjustment of the SRA.

Anyone who knows my products will notice that I hide technical features in the design of my products.
This has also been done in the development of the Reference Tonearm. For this reason, I occasionally don't use scales and accessible adjustment screws, which make a tonearm look very technically.
Even if these adjustment tools are sometimes quite convenient, I deliberately go a different way. The optical appearance of my products are noticeable different, without compromising the sonical results.

Initially, I had mentioned, that we would like to start from an ideal situation but in most cases the reality differs more or less strongly from it.
This is especially true for playing a record. With a conventional unipivot tonearm, the center of gravity of the tone arm could be brought close to the bearing point (our design goal) if the record was perfectly planar and centered.
But we are far from this ideal situation. Even records, which we judge as plan and centric lead to unimagined interactions in the micro cosmos of record groove scanning.
To be able to measure this effects, I have developed a measuring element (simular to a cartridge) with which I can read out the tracking force fluctuations when playing a record and can graphically represent it via an interface and a software program.

I tested some commercial tonearms and my own designs. It shows interesting results and it sometimes can help to better understand the theory of tonearm design and terms as bearing friction and restoring force of vertical movment.

Maybe a good theme for my next article!