

ANALOG CORNER

BY MICHAEL FREMER

THIS ISSUE: Bergmann Audio's Galder turntable & Odin tangential-tracking tonearm.

Deliberately Danish

Bergmann Audio launched its first turntable—the Sindre, which featured an integrated tonearm—in 2008. The Sindre's acrylic platter and tangential-tracking tonearm both floated on air bearings; it had an outboard motor controller, a separate air pump for the air bearings, and cost \$21,000.

Founder, designer, and mechanical engineer Johnnie Bergmann Rasmussen makes everything in-house in the small town of Hobro (pop. 11,000) in northern Denmark, on the Jutland Peninsula, at the head of the country's longest fjord, the Mariager. He says that his first hi-fi system, which he bought in the 1980s as a teenager, included a Micro-Seiki turntable fitted with a Rega Research tonearm and Ortofon cartridge; an NAD preamplifier and power amplifier; and DALI 8 speakers. Even then, he felt that air bearings were the way to go, despite the problems experienced by many owners. After earning his degree in mechanical engineering, Rasmussen set about designing and building air-bearing turntables that would be user friendly, mechanically stable, perform well, and sound good.

I've been looking at Bergmann turntables at audio shows ever since the launch of the Sindre 10 years ago. (It's named for Sindri, a dwarf in Norse mythology who created a gold ring for the chief god, Odin, who is associated with wisdom, healing, super-expensive cables, and other mostly positive attributes. He was married to the goddess Frigg—hence, I believe, the common expression “None of your friggin’ business.”)

I wasn't interested in reviewing the Sindre, for several reasons. First, I don't like acrylic platters, especially on costly turntables. Second, you couldn't buy a Sindre without its integrated arm, which I felt was a serious limitation, especially as, based on my experience, I'm also no big fan of air-bearing, tangential-tracking tonearms—and especially of the Sindre's “orifice compensated” arm, in which a sleeve slides along on a cushion of air pushed through tiny holes in the top surface of a rail. In other words, it's not a captured bearing, which is pressurized equally throughout its range of movement, and is the only kind of bearing that can maintain precise geometry in all desired axes. I was sort of indoctrinated in this area by Rockport Technologies' Andy Payor and the late Tim Sheridan, of Professional Instruments Company (www.airbearings.com), who worked with Payor in the design and manufacture of Rockport's System III Sirius, an air-bearing arm and platter that in today's dollars would cost

well over \$125,000. (PIC continues to build air-bearing machine tools used to make nuclear weapons—secondary to turntables in importance, perhaps, but still significant.)

However, when I saw Bergmann's new air-bearing, belt-drive turntable, the Galder, at the 2016 High End show in Munich, I decided that it deserved a thorough review.¹ Rasmussen has taken his design to new heights of physical beauty in a distinctly Mark Levinson/Madrigal way, and now uses a 26-lb platter of machined aluminum. The Galder is available without tonearm, but you can have up to four arms simultaneously set up on it—though for convenience's sake I'd stop at three, so you're not constantly banging into them while playing records. With air-bearing platter and vacuum record hold-down,

the Galder costs \$26,800; another \$8900 gets you the Odin tonearm, whose air bearing uses the Galder's air supply, for a total of \$35,700. (The Odin is available separately, with its own air supply, for \$12,900.)

Bergmann Galder turntable: Description

I requested a Bergmann Galder with vacuum holddown and Odin tonearm. Johnnie Rasmussen visited to set it all up, though the task was mostly simple thanks to the Galder's elegant design and excellent instructions, with illustrations. The only tricky part was setting the Odin's vertical tracking angle (VTA) and stylus rake angle (SRA) but even that wasn't particularly difficult.

Late in the review period I had to remove the Galder from the Harmonic Resolution Systems base I'd placed it on, to better access the back of my darTZeel NHB-18S preamplifier. That required disassembling the turntable, and I'm glad I did. Taking the Galder apart and putting it all back together again allowed me to better appreciate its elegance and ingenuity.

The Galder measures 18.9" wide by 7.5" high by 14.4" deep and weighs 84 lb. Its top deck is in two unequal halves of die-cast, powder-coated aluminum. The leftward, larger half contains the platter bearing and tonearm mounts,

¹ Watch Johnnie Rasmussen conduct a tour of the Galder at <http://tinyurl.com/y763yzma>.



and the rightward, smaller half the motor and electronic speed controller. The two halves look entirely separate but are actually joined by a single, thin internal base, also of die-cast aluminum. The larger half is bolted to this base, while the smaller half rests on it, its underside secured with a circular cutout that fits into a hole machined in the base, and by its overhanging outer and front edges, both of which firmly secure it while hiding the main plinth. The internal base itself rests on three big, height-adjustable, circular aluminum feet. The overall result is a turntable with clean, attractive lines.

The air-bearing platter, topped by a 3mm-thick acrylic mat, rotates on a steel spindle with a bearing of low-friction polymer. It's driven by a tachometer-controlled motor with a precision feedback-control system topped with a crowned pulley of polyoxymethylene (POM) or similar plastic. The motor is a DC type. Recessed buttons atop the deck's smaller, motor half select 33 $\frac{1}{3}$ or 45rpm; two smaller buttons can be used to increase or decrease the pitch. The Galder's specified accuracy of speed is $\pm 0.003\%$.

The outboard air supply is a black

box measuring 8.9" wide by 9.3" high by 18.3" deep and weighing 34.4 lb. It electrically connects to the back of the turntable via a multi-pin umbilical, and pneumatically via two hoses, one for the vacuum holddown, the other for the platter and tonearm air bearings.

Bergmann Odin tangential-tracking tonearm

Tracking a record tangentially, the way its original lacquer was cut, seems a no-brainer—until you try making it work. The lacquer-cutting system is a sledgehammer; in comparison, the playback system is more like a delicate feather.

Over the decades, many approaches to tangential tracking have been tried, including a variety of air-bearing systems (from Dennesen, Airtangent, Eminent Technology, Kuzma, Maplenoll, Rockport, Versa Dynamics, Walker), a tiny-wheeled trolley riding on quartz rods (Souther, Clearaudio), and a pantograph-like linkage (Garard). In the 1970s and '80s, Goldmund made one that relied on an LED to detect and correct deviations from tangency. In other words, the tonearm would have to first lose tangency, then be corrected via the LED and

servo-motors, which surely must have slightly overshoot the intended displacement. Sometimes, the Goldmund arm would lift mid-record. Yet, at the time, this was considered the state of the art—and there's no denying the good sound it produced. And let's not forget the more recent pivoted tangential trackers from, among others, Klaudio, Reed, Schröder, and Thales.

When the bearing is stationary and the long rail moves (Eminent Technology, Maplenoll, Walker), you have a large horizontal mass sliding tangentially, and a far smaller mass moving vertically. This produces different horizontal and vertical resonant frequencies, not to mention a displacement of mass that plays havoc with spring-suspended turntables.

I remember reading about the original Eminent Technology ET-1 arm in the mid-'80s.² To my mind, it promised friction-free simplicity of tangential tracking—the perfect solution!—and I immediately bought one. I mounted it on a spring-suspended Oracle Delphi II turntable and quickly learned how the ET-1's large horizontal mass could de-level the table and thus the arm—the worst condition for a frictionless

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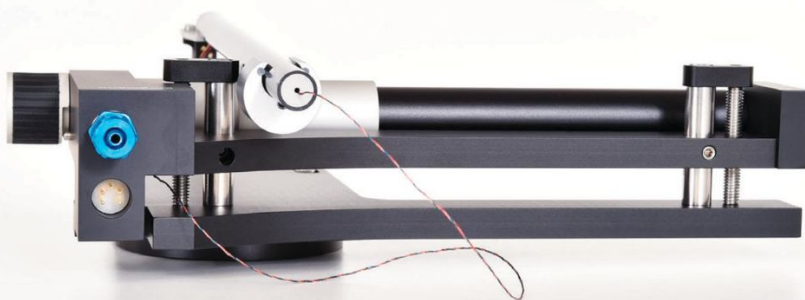
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tangential tracker of high horizontal mass. The ET-2 arm was a big improvement—it decoupled the counterweight mass, and provided more convenient adjustment of VTA and SRA—but it used a noisy aquarium pump, a five-gallon plastic water bottle stuffed with filter floss to smooth the air flow, etc. After a few years of all that . . . Lord, give me a pivoted tonearm!

Later, thanks to Tim Sheridan and Andy Payor, I learned about annular-gap turbulence in *captured* air bearings: the air under pressure in the zone of operation must quickly return to ambient air pressure at the point where the air exits the bearing, which produces a pretty violent high-frequency oscillation similar to what happens when you inflate a balloon and then let go of it.

Even Rockport's ultra-costly groove

compensated air-bearing arm, which eliminated annular-gap turbulence, and effectively dealt with differential horizontal and vertical masses—and, thus, different resonant frequencies—had its own problems, particular one of wimpy bass.

So I approached this review of the Bergmann Odin with some skepticism. I'm skeptical of tangential trackers generally, and consider the amount of distortion created by a pivoted tonearm's linear tracking error (LTE) negligible compared to the cumulative distortions of tangential-tracking arms.

The Odin has a longish armtube of aluminum and carbon fiber, fitted with a decoupled counterweight; the arm's effective mass is 14gm. The wiring is high-quality, super-thin, compliant copper Litz, terminated with gold-

plated copper clips at the cartridge end and, at the other, a five-pin DIN jack.

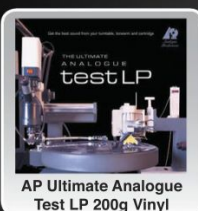
VTA and SRA are adjustable, though not on the fly, which anyway I think is unnecessary as long as you set it, using a digital microscope, to about 92°—"about" because of the measured range of cutting-stylus angles cited in Jon M. Risch and Bruce R. Meier's "More than One Vertical Tracking Angle," the classic article originally published in the March 1981 issue of *Audio*.² In the 1980s, Risch and Meier measured cutting-stylus SRAs at mastering studios all over America. They learned not only that they varied from 91° to 94°, but that the angle had to be greater than 90°, so that the vacuum could suck away the flammable thread of lacquer left behind by the cutting stylus. So, yes, the perfect solution for every record isn't 92° or 93°, as some suggest, to compensate for playback-stylus deflection but for sure, setting the tonearm parallel to the record surface, as is still recommended by too many makers of tonearms, guaran-

² See www.stereophile.com/content/eminent-technology-two-tonearm.

³ See www.analogplanet.com/images/512MFVTA_article.pdf.



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tees nothing. Nor is the solution setting it by ear, if your starting point is nowhere near 92°.

Setting overhang—or, better, *evenhang*, because the stylus's line of travel should bisect the spindle (if it could get that far)—is relatively easy on the Odin. Setting the SRA requires loosening two bolts, so that you can raise or lower the rail along which the arm travels. A level rail is essential; Bergmann supplies a spiral level that's machined to perch on the rail.

While the manual says that the Odin's azimuth is adjustable, it wasn't possible with my review sample. Hopefully, it's coming soon.

The Odin's rail is fixed at both ends. Along its top surface is a row of 18 pinholes, from which low-pressure air constantly flows. The bearing employs a sleeve that slides along the rail on a thin film of air. Only the area of the sleeve directly above the rail is pressurized. Too much pressure would raise the sleeve too high, until its bottom scraped along the bottom of the rail. Too little pressure and sleeve couldn't rise high enough to produce a friction-free ride. At any given point in its travel, the 3"-long sleeve covers only 9 of the rail's 18 holes, to ensure that, between tube and rail, there is always a cushion of air of just the right thickness for virtually frictionless movement.

Speed and Resonant Frequency

The Galder turntable's speed adjustability meant that it was easy for me to get it to run at the correct speed. More important, its *consistency* of rotation speed was outstanding, more or less matching the excellent performance of a preproduction unit of Technics' SL-1000R Direct Drive 'table, though the Feickert Analogue Platter Speed graphics (figs.1 & 2) don't look as "pretty."

I used *Hi-Fi News & Record Review's* Test Record (LP, Hi-Fi News HFN 001). The lateral resonant frequency of the Odin tonearm with Lyra Atlas SL cartridge was about 10Hz, the vertical resonant frequency about 9Hz. All good, and the numbers speak for themselves: Johnnie Rasmussen has done his tonearm homework.

The Galder is among the best isolated turntables I've ever banged on.

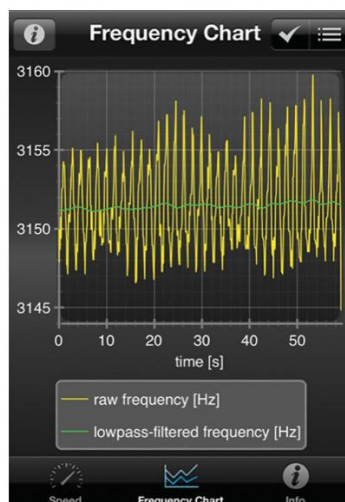
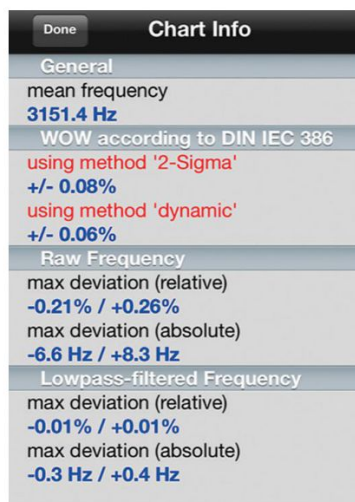


Fig.1 (far left) Bergmann Audio Galder, speed stability data.

Fig.2 (left) Bergmann Audio Galder, speed stability (raw frequency yellow; low-pass filtered frequency green).

confirmed my real-time observations.

The Odin-Galder's bass control and extension were both very good, and better than I'd expected, based on my previous experiences with air-bearing arms. I heard nothing wimpy or less than fully extended

When I tapped or even rapped on the plinth or the base it rests on, *nothing* made it through the speakers. That's unusual, especially for a suspensionless turntable, and must be at least partly due to the decoupling effects of the air-bearing arm and platter.

Use

The Bergmann Galder is one of the easiest, most convenient air-bearing, vacuum-holddown turntables I've ever used. At the beginning of a listening session, you push the appropriate speed button once to start the flow of air. Press it again to start the platter spinning. It's designed to get up to speed slowly, to lengthen the life of the drive belt. Once it's up to speed, you can leave it spinning the entire time. Don't worry about scratching a record by placing it on the spinning platter—the "lips" of the vacuum holddown cushion the drop. That done, place the puck over the spindle, and the record is sucked down against the mat. Remove the puck, and it's easy to lift the record off of the platter.

The Galder and Odin have been in constant use here since Johnnie Bergmann installed them in mid-January. They performed flawlessly the entire time. Not once did the Odin stick—something that can destroy a cartridge's cantilever—nor did anything require adjusting or tweaking. The air pump was silent. There was no bad news.

Sound

I tried a range of cartridges in the Odin after using them in the Swedish Analog Technologies tonearm with the Continuum Audio Labs Caliburn turntable, and I made a few 24-bit/96kHz recordings that later

from a series of LPs, including *The Unknowable*, by saxophonist Dave Liebman and percussionists Tatsuya Nakatani and Adam Rudolph (2 45rpm LPs, RareNoise RNR 089), a new album with mystical Zen overtones filled with drums, gongs, and a dizzying variety of unusual percussion instruments. "Benediction (Opening)" has some ridiculously deep rumblings—especially if you accidentally play it at 33 $\frac{1}{3}$ rpm, as I did at first—there's no indication of the correct speed!

There's nothing at all polite about this trio's dynamic performance, and macrodynamics and general slam were equally generous. Aural images were stable and well-focused, and the soundstage seemed actually somewhat wider than through my reference SAT-Caliburn record player—especially when I compared files of the last five minutes or so of a reissue of pianist Earl Wild performing Gershwin's *Rhapsody in Blue* with Arthur Fiedler and the Boston Pops (LP, RCA Living Stereo/Analogue Productions LSC-2367).

However, the picture's bigger size was partly due to somewhat more diffuse and larger images. The far more expensive SAT-Caliburn combo produced greater precision and focus of images, as well as more sharply drawn transients, but I'm sure that when I play these files at audio shows, more listeners will prefer the Bergmann's more generous and, seemingly, more spacious picture. That said, I doubt anyone will be able to correctly identify which was the tangential tracker and which the 9" pivoted tonearm. (I did this experiment once before, with a Thales pivoted tangential tracker and Continuum's 9" Cobra arm; some guessed correctly, but no one knew for certain.

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Among the other records I used was pianist Robert Silverman's positively mesmerizing *Chopin's Last Waltz*, recorded in DSD256 by Ray Kimber (LP, IsoMike 5606). Performance and sound are exquisite. Via the far more expensive rig, Silverman's attacks were somewhat more precise, the piano's sustain better connected to the instrument and more easily delineated from the generous room sound. This put the image of the piano in greater relief and focus.

Through the Bergmann rig, the piano sounded slightly softer and somewhat less focused, its soundboard blending in somewhat with the room reverb. Don't get me wrong—without something far more expensive to compare it to, the Bergmann's overall performance provided me with months of pleasure with every musical genre.

It had been years since I'd played the UK version of *The Clash* (LP, CBS 82000), and my memories of its sound were pretty meek compared to what I heard through the Bergmann and Continuum. Yes, the drums, particularly the cymbals, were nicely recorded, but I hadn't realized how deep the stage was, or how well focused in three dimensions were the voices, often

arranged in clusters. My reference rig delivered greater delineation of those clusters, but the Bergmanns' reproduction of them was equally entertaining and engagingly slammin'.

Abruptly switching gears, I played the Electric Recording Company's reissue of Bruckner's Symphony 8 on two separate LPs, with Carl Schuricht conducting the Vienna Philharmonic (2 LPs, EMI ASD 602 and 603/ERC 033 and 034), originally issued in 1964. I don't know what ERC charged for this edition, which was limited to 99 copies and immediately sold out. It probably was costly, but it must have been a bargain compared to what originals are still selling for. (Last February, a copy went for more than \$5000.) Probably some of these records' high value can be accounted for by this recording's sensationally natural instrumental textures and harmonics, and its overall transparency and spaciousness.

The music itself is curious; to me, it sounds like musical tapas—a collection of short, sonically tasty appetizers completely unconnected to each other. But it makes for a great demo record, and it showed off all of the Odin-Galder's qualities of ear-pleasing texture, tonality,

and harmonic richness. There's plenty here to like, and nothing to dislike.

Conclusion

In terms of quality of sound and, especially, engineering and build, Bergmann Audio's Odin tonearm and Galder turntable perform way above their total price of \$35,700. They sound and perform as well as their appearance suggests. ■

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