

## Graham Engineering Phantom B-44 tonearm

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The Graham Engineering 1.5 tonearm, originally introduced in 1990, was a thoughtfully executed design that logically addressed all of the basics of good tonearm performance—geometry, resonance control, rigidity, dynamic stability—with effective, sometimes ingenious ideas, while providing exceptional ease and flexibility of setup. Over time, designer Bob Graham came up with ways to significantly improve the 1.5's performance, including the replacement of its brass side weights with heavier ones of tungsten, an improved bearing with a more massive cap, various changes in internal wiring, a far more rigid and better-grounded mounting platform, and a new, sophisticated ceramic armwand. (The original wand had hardly been an afterthought: its heat-bonded, constrained-layer-damped design consisted of an inner tube of stainless steel and an outer tube of aluminum.) The arm's name changed from the 1.5 to the 1.5t (tungsten), then the 1.5t/c (ceramic), and on to the 2.0, 2.1, and 2.2.



Graham 2.2 armwand (left) versus Phantom armwand (right).

Each upgrade changed the arm's sonic performance for the better, mostly in terms of low-frequency weight, solidity, and extension. Even critics of the 1.5's sound gave it top marks for parts and build quality, which is hardly surprising—Bob Graham is a big admirer of SME and its founder, Alastair Robertson-Aikman. (For an outstanding overview of the original Graham 1.5, see Dick Olsher's review in the August 1991 *Stereophile*, Vol.14 No.8.)

The original arm's detractors complained mostly of its lack of deep bass. Bob Graham responded that he'd paid particular attention to reducing the amplitude of the arm/cartridge combination's inevitable low-frequency resonant peak by carefully tuning and decoupling the counterweight, and that some listeners were mistaking the result for an absence of deep bass. Graham also rightfully pointed out the difference between the 1.5's nimble, detailed, well-textured bass and the bloated bottom end of some of the competition's arms. Still, his later upgrades of the 1.5 focused on and improved the arm's bottom-end performance. Clearly, the detractors had been on to something: the original 1.5 *was* somewhat meek in the bottom end.

The Model 2.2 retained the 1.5's attractive bass qualities while dramatically improving the original's weight and extension.

The original 1.5 offered impressive overall performance and was particularly adept at resolving inner detail. I'll never forget the first album I played after installing the 1.5: Joni Mitchell's *Court and Spark*. The arm revealed, for the first time in my listening experience, the dimensions of the isolation booth in which Mitchell had recorded her lead vocals. This was not a musically important detail, but it indicated the arm's exceptional powers of resolution.

Every tonearm design, be it traditional gimbaled bearing, unipivot, duo-pivot, constrained unipivot, or the so-called linear tracker (*tangential tracker* is more accurately descriptive, considering the design's goal), has inherent advantages and limitations. The designer's job, once he or she has chosen the means by which the stylus will be moved across and through the record grooves, is to maximize the strengths and minimize the weaknesses of that choice.

When Bob Graham finished v.2.2 and realized that his original design could be taken no further, he set about designing what he thought would be an even better arm. After two years of work, the Phantom B-44 has arrived (\$4275). Like the original 1.5, the Phantom's parts quality and fit'n'finish rival those of any tonearm made anywhere in the world, and surpass most.

You have to examine the Phantom yourself to appreciate the differences between it and the original. There are conceptual and mechanical similarities between them, but while the Phantom superficially resembles the original 1.5, it is an entirely new tonearm. Graham carefully thought through his original design and concluded that its basic concepts were still sound—the new arm differs from the old mostly in Graham's execution of those concepts and in terms of sheer scale, along with the primary invention of magnetic stabilization. Graham redesigned the arm literally from the inside out, beginning with the pivot and working outward, part by part. Overall, the Phantom is bigger and more massive. The only part remaining from the 1.5 is the butt end: the DIN jack block.



Phantom without armwand, showing stainless steel support stub.

Like the 1.5, the Phantom uses an inverted bearing fixed to a threaded top cap that screws into the cup assembly, which also makes a convenient well for the damping fluid. The bearing itself is a small-radius ( $>0.005''$ ) tungsten-carbide tip riding in a  $0.01''$ -radius sapphire cup. The Phantom has a threaded post for adjusting the vertical tracking angle (VTA) that's similar to the 1.5's, but bigger, beefier, and smoother.

The Phantom also has a removable, Lorzig-ceramic armwand similar to the 1.5's, but far more rigid, precise, and easier to replace. The armwand has a wider diameter and is progressively extruded to suppress standing waves, and the tube features a glossy, proprietary overlay of glass that damps vibrations and looks better than the 1.5's tube. The new connection mechanism is far more robust and secure, with a protruding post of stainless steel that fits deeply into the wand before being screwed in and held under tension at two points. The clearance between post and wand is said to be about  $0.001''$ ; lateral play is nil.

The electrical contact pins are of high-copper-content phosphor bronze, to both maintain tension and avoid deformation. The wand's internal wiring has been improved from the 2.2's, and is now precision-twisted by machine and layered to isolate the channels from each other, before being encased in a silicone jacket. The entire package is then inserted as a unit into the wand, with the result of another level of damping.

Gone are the outriggers that helped stabilize the 1.5 during play and kept the arm's center of gravity below the pivot point to create a *stable balance* system, much as in a laboratory balance scale. This good design is typical of most arms, but it creates a condition wherein the arm, when deflected, tries to return to a resting position (as when trying to track a warped record) instead of following the warp. As a result, the cantilever is deflected, as tracking-force consistency cannot be maintained and the cartridge generator system's linearity is compromised.

The reason you are advised to measure vertical tracking force (VTF) *at* the record surface and not above it is because most tonearms are stable-balanced. The higher above the record surface you lift the arm, the more force it will exert trying to get back down to its rest position. The farther above the record surface you measure VTF, the greater it will be compared to what you'll measure at the record surface, which is where you want it to be accurate. If you have an accurate VTF gauge, measure your arm's VTF as close to the platter surface as possible, and then again with the gauge sitting on a thick magazine to lift it above the platter. The reading will be significantly higher the farther you raise the gauge, as Bob Graham demonstrated to me with his 2.2.

The Phantom's tracking force remained constant at all heights. That's because the arm is neutrally balanced—the system's center of gravity is *at* the pivot point, not above or below it. The arm wants to remain wherever it is in the vertical dimension, rather than try to fight its way back to a specific rest position. Graham says that the amount of mass used in the design, and especially the *distribution* of that mass, contribute to the arm's stability while playing an LP.

Unfortunately, neutral balance works both vertically and laterally, meaning that the arm would list one way or the other and then remain there, depending on its lateral weight distribution—not good. Graham's new Magne glide system solves the problem while providing an easy means of adjusting both azimuth angle and antiskating force.

The Magneglide system consists of an ABEC-7 grade horizontal bearing assembly—the same as SME uses for the main bearing of its V arm—of very low mass. The bearing's actual mass is 10gm, but since a large percentage of this mass, including the ball-bearing itself, is at or near the center of rotation, its *effective* mass is much less. This assembly never "sees" the unipivot bearing—its only contact with the main bearing assembly is magnetic, via opposite-pole neodymium magnets: one on the assembly, one on the unipivot bearing housing, and both precisely located horizontally from the pivot point.

The magnets' magnetic forces act to laterally stabilize the arm at the pivot point and give it the feel of a traditional gimballed arm. Even while playing a record, the arm will not roll. An adjustment screw lets you change the angle at which the two magnets meet, and thus sets azimuth by changing the angle of magnetic attraction; an assembly of rod, weight, and thread attached to the bearing assembly adjusts the antiskating force by physically deflecting the assembly from the position in which it would normally rest based on magnetic attraction alone. There is no physical contact between antiskating mechanism and bearing. Plus, the Magneglide bearing never makes contact or interferes with the unipivot bearing. As the arm traverses the record surface, both the main magnet and the one mounted on the Magneglide move, tracking it without contact and thus, hopefully, without lag.



With the exception of the Magneglide azimuth adjustment, the Phantom sets up like the 2.2 in terms of VTA, VTF, antiskating, and geometry, which means setup is both convenient and repeatable—important features for a tonearm that lets you easily switch armtubes. If you want more details about Graham's ingenious remote gauge for adjusting overhang and zenith, see Dick Olsher's original review of the 1.5.

My biggest concern was the effect the Magneglide assembly might have on the Phantom's lateral tracking and responsiveness. Given the benefits of neutral balance and what seemed to be the pivot's true vertical stability, I figured that any tradeoff would probably be worth it.

### **The Sound of the Phantom**

Because the Phantom is designed to be a drop-in replacement for the 1.5 and its successors, I was able to spend an hour listening to the combo of 2.2 and Lyra Titan cartridge and then, 15 minutes later, listen again, this time with the Titan in the Phantom's headshell. The biggest

difference—which I heard easily, unmistakably, and immediately—was in the bottom octaves, where the Phantom delivered lightning strikes of deep, fast, ultratight bass. Massive attacks dissipated as quickly as they'd struck, leaving no residue.

I was moved to dig out Reference Recordings' famous *Däfos* (45rpm LP, RR-12), originally issued in 1983—I wasn't even in this business back then. A new generation of analog fans deserve to hear this collaboration by Brazilian percussionist Airto Moreira and Grateful Dead drummer Mickey Hart—especially The Beast, an enormous drum that Hart toys with, bangs, and, during "The Gates of Däfos," even sends crashing to the floor.

The Phantom's performance was dazzling on this audiophile warhorse and on all of the other discs I played, guiding the Lyra Titan to new performance heights—and not just at the very bottom. The Phantom is to the Graham 2.2 what Arnold Schwarzenegger is to Wally Cox (youngsters: do a Google search). That analogy may be over the top, but those who felt the original Graham was somewhat meek and reticent will have no such reservations about the Phantom.

The Phantom's bottom octaves had full weight, as well as the articulation and speed of the 2.2—but more than that, the Phantom delivered a harmonic vividness and sense of musical envelopment that even the 2.2 doesn't quite get. There was a greater expression of bloom and air, with no loss of detail or control. Every performance parameter seemed expressed with greater confidence and authority, including image solidity and stability.

The 2.2 was always an arm I could respect and—more important to a reviewer—rely on, but I never fell in love with it. *That* emotion seemed reserved for the Immedia RPM-2 tonearm, which is one reason I had both the 2.2 and the Immedia installed on a Yorke dual armboard. The Immedia has a lusher, richer balance than any of the earlier Grahams, as well as a more open, pristine, and liquid top end and a greater sense of musical *flow*. But the Phantom easily overtook the Immedia's superb overall performance, with greater stability, weight, transient articulation, speed, and, especially, a see-into-it transparency that is one of the Immedia's most attractive qualities. (Immedia's Allen Perkins told me at the 2005 Consumer Electronics Show that he's working on his own brand-new tonearm.)

The 2.2 could sound a bit on the mechanical and medicinal side of neutral and analytical; the Phantom is more like an exuberant figure skater who not only gets all the technical moves right, but also manages to exude an emotional intensity that borders on reckless abandon. The Phantom generates musical excitement even as it scores points on the compulsories.

Any worries I may have had about the Phantom's tracking abilities were quickly erased. The arm admirably acquitted itself on difficult musical passages and test tracks alike. It allowed the Lyra Titan to track the next-to-last, highly modulated antiskating track on the *Hi-Fi News Analogue Test LP* without any buzzing; more important, the combination's technical performance on musical torture tracks was flawless, particularly on difficult-to-track inner-groove orchestral crescendos and female vocal sibilants. So smooth and effortless was the Phantom's sibilant performance that I was reminded of Shure's 1973 *Audio Obstacle Course: Era III* LP (TTR-110), which includes Sergio Mendes and Brasil '66's "Mais Que Nada," recorded at increasingly higher levels. I hadn't played that cut in a long time, but I remembered never being able to track its sibilants properly at the higher levels. The Phantom and Titan sailed through it without smear.

Watching the Phantom confidently navigate a badly warped copy of Clannad's *Crann Ull* (Tara 3007) convinced me that Bob Graham's claims of the Phantom's neutral balance are justified. The Phantom tracked as if guided by lasers.

The Graham Phantom is a tonearm whose pure, effortless sound I can respect *and* love. Because it's a true unipivot but, unlike most such designs—which rely on a second pivot point or a constraining system with added contact points—it doesn't flop over, it feels good in the hand while retaining all of the benefits of a preloaded, single-point-bearing unipivot design. It's also easy to set up.

Because the heights of turntable platters, armboards, and playing surfaces are not standardized, some turntables and cartridges may require the addition of a spacer between the cartridge and the Phantom's headshell in order to get the optimal range of VTA adjustment. Graham provides a spacer made of Richlite, a composite of phenolic resin and wood fiber that incorporates some of the blue damping material also used in Graham headshells. Bob Graham says the spacer offers such outstanding damping properties that he recommends trying it even if you don't need it. The Lyra Titan didn't need it, and once I had it dialed in I wasn't about to start over, but I did try Graham's Nightingale cartridge with and without the spacer and can't say I heard any difference.

### **Conclusions**

The Graham 2.2 remains an outstanding tonearm, so moving on to the Phantom wasn't the revelation that first hearing the 1.5 had been all those years ago. But the new Phantom is now *the* pivoted arm to beat, based on my listening experience and its physical and sonic performance and ease of use.

There are some other tonearm contenders that I have yet to hear, such as the Swiss DaVinci Audio Labs Grandezza and the Basis Vector. (Basis designer A.J. Conti won't send me a sample of the latter because he doesn't believe in cantilevered armboards—never mind that every arm I've reviewed has been on one, and no one has complained about the results I've heard.) I also wouldn't mind giving a listen to one of the Schöder arms, but Frank Schröder apparently can't keep up with demand—a review is the last thing he needs. Whatever those arms' sonic merits—they're said to be considerable—the Phantom's switchable armwands makes it an ideal choice for stereo/monophiles.

The Phantom, with all accessories, including Graham's unique alignment jig, will set you back \$4275. Is it worth upgrading from the 2.2 or one of the older Graham arms? I was expecting a modest improvement when I dropped the Phantom into my system, but the differences were not subtle. (This will be especially true if, like me, you have a full-range system that goes down to 20Hz or below.) Only after the immediately obvious improvements had settled in did the subtler ones—those having to do with musical flow and a sense of certainty, those that kept me listening long into the night, night after night—begin to assert themselves.

### **Michael Fremer returned to the Phantom in January 2006 (Vol.29 No.1):**

In order to let me evaluate the Continuum Caliburn independent of the Cobra, Continuum made an adapter plate that allowed Graham Engineering's Phantom B-44 tonearm to be

mounted opposite the Cobra. Continuum has the utmost respect for Bob Graham and his arm, considering it among the best out there.

Direct comparisons using the same cartridge told me that these are two of the finest tonearms I have ever heard. The Graham was slightly more reserved and grounded, the Cobra a bit more airy and effusive.

Wally Malewicz's skate-blade-like device for setting VTA is mandatory with the Cobra, as it's impossible to reference parallel to the platter play without it. I set the VTA by eye when I first installed the Lyra Titan cartridge, and I had the back of the arm way too high. No wonder my first impression was that the Cobra was a bit bright and emphasized the top end! But once I'd established true parallel and dropped the pivot a bit, the Cobra's balance became essentially neutral and the brightness disappeared. The Caliburn took the Graham to new performance heights—especially in terms of dynamics and bass extension compared to the Yorke S7 arm.—**Michael Fremer**

## **Graham Engineering Phantom B-44 tonearm B44 Mk.II, October 2009**

**Michael Fremer wrote about the Phantom B-44 II in October 2009 (Vol. 32 No.10):**

Bob Graham has been refining his tonearm since it first appeared in prototype form as the McIntosh Excalibur, back in the 1980s. As reported by Ken Kessler in his terrific book *McIntosh "...for the love of music..."*, Graham, then at MIT and independently developing his tonearm, was introduced to McIntosh's Gordon Gow, who was in Massachusetts visiting area audio retailers. Gow was sufficiently impressed to fund further development and help Graham patent his design. However, a hitch in the accompanying McIntosh turntable's development and the advent of the Compact Disc meant that the project was canceled, leaving Graham to independently fund and market his Model 1 arm, which was first reviewed in *Stereophile*, by Dick Olsher, in March 1991.

Graham's original inverted-unipivot arm went through numerous upgrades and iterations before being replaced, in 2005, by the Phantom B-44. Though superficially similar to the old design, the B-44 represented a significant reimagining of the basic concept, with all new parts and a major innovation Graham called Magneglide: a magnet-based system that had the stability of a fixed-bearing arm while retaining the advantages of a unipivot (see my review for a detailed description of the arm).

In the new Phantom B-44 II (\$4900), the material of the interchangeable armtube has been changed from ceramic to titanium. The taller, more massive headshell moves the cartridge-mounting surface down to the level of the center of the armtube. According to Graham, that provides for a greater range of adjustability of vertical tracking angle (VTA), compatibility with a wider variety of cartridges, and makes the Phantom more easy to "drop in" as a replacement for Graham 2.2 arms. More important, this change is said to provide a more efficient transfer of energy. An additional stainless-steel guide pin aids insertion of the wand in the pillar and better secures its rotational positioning. The wand attaches under tension to a

nearly half-inch-wide post and connector of stainless steel, to produce what Graham claims is essentially a "connector-less connection."

The arm wand's internal wiring has been changed to a twisted pair of shielded, solid-silver wires with Teflon dielectric, finished with a silicone jacket that better damps the wand. The internal wiring of the wand connector to the DIN terminal block is a thinner Litz type because Graham found that the original, stiffer, Teflon-insulated wire tended to ever so slightly impede the arm's horizontal movement, which otherwise was essentially frictionless.

The improved Magne glide system uses smaller magnets placed closer together, which lowers the arm's mass and increases its stability. In addition, according to Graham, the new system provides better damping and produces a lot of "grabbing force without yanking." I'm all for eliminating yanking.

Graham has added a spirit level to the cylindrical bearing housing (patent pending). This makes adjustment of VTA accurate and repeatable, and is particularly useful in determining the starting point for such adjustments, when the armtube should be parallel to the surface of the LP. When the bubble sits between the two red lines, the arm is parallel to the record surface.

The precision tolerance of the B-44 II's VTA adjustment tower makes most other arms I've reviewed feel loose and sloppy—in fact, you needn't tighten the tower's grub screw, because it won't change the vertical alignment, nor will you hear a difference.

A heavier counterweight now better accommodates a wider variety of cartridges and, more important, can be placed closer to the pivot point to reduce the arm's moment of inertia. Graham has also slightly modified the pivot's bearing cup to help ensure that the bearing fits perfectly as soon as it's been inserted.

Installed in the Continuum Audio Labs Caliburn turntable's secondary arm-mount position, the original Phantom B-44 was my alternative reference tonearm to Continuum's own Cobra. The Graham's sonic performance was very good, but no match for the Cobra's speed and tonal neutrality; though still very good, the Phantom sounded somewhat slower and thicker. Various reports from readers comparing the Phantom to some other arms, such as the Breuer and Triplanar, claimed those designs were faster and more detailed. I found the Triplanar somewhat faster and airier as well, but the Phantom was still of reference quality, and the interchangeable arm wands, coupled with the Cobra's fussy setup needs, made the Graham design invaluable as a cartridge-reviewing tool.

It was easy enough to compare the Phantom B-44 with the Phantom B-44 II, and I easily heard major improvements in speed, air, high-frequency extension, and detail. Using the Lyra Titan *i* phono cartridge, the Phantom II sounded considerably faster and more open on top. Bass performance was unchanged, which was fine, as it was already well extended and extremely well controlled.

With its ease of setup, tracking agility, arm interchangeability, and ultra-high build quality, I consider the Phantom B-44 II to be among the most desirable arms currently available. While the Continuum Cobra sounds more linear, and is easily the most neutral-sounding arm I've heard (Image Hi-Fi's Dirk Sommers thinks the Cobra may be the Caliburn's "secret weapon"), the Phantom is now not far behind.—**Michael Fremer**