PART IV

TURNTABLES

Arm/Cartridge Resonance

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Is a low mass tonearm better than a high mass tonearm? The answer is a resounding NO! Well, then, is a high mass tonearm better than a low mass tonearm? Again, the answer is NO!

That sounds rather contradictory, doesn't it? But it isn't really. The solution is that there is only one *proper* mass for a tonearm with a given pickup. That particular mass is determined by the compliance of the pickup and the mass of the tonearm which results in the desired low frequency resonance of 8 to 10 Hz.

The terminology of a "low" or "high" mass in relation to a tonearm is really rather academic. If a pickup has a very high compliance (and more times than not, it is unnecessarily high), a low mass tonearm can have the proper arm mass so that the combination resonates in the 8 to 10 Hz range. On the other hand, a pickup with average compliance used in a high mass arm can also resonate at the proper 8 to 10 Hz. So you see the *actual* mass of the tonearm is relatively unimportant, as long as it is mated with a pickup of the proper compliance, so that the proper resonant frequency is achieved.

The danger in all this is that, unless a rare happening occurs, all pickup and tonearm combinations will be mismatched to some degree.

Effect of Improper Resonance

If a pickup of average compliance resonates at the proper frequency of 8 to 10 Hz in a high mass tonearm, then when this cartridge is installed in a low mass arm, the combination will resonate at a higher frequency, e.g. 14 to 15 Hz. The audible result is mistracking in the high and low frequencies, that is a thin bass and rather frizzy highs with a loss of dimensional reproduction.

If a pickup with the proper compliance for a low mass arm, i.e. the combination resonates at 8 to 10 Hz, is mounted in a high mass arm, this results in a lower resonant frequency, e.g. 5 to 6 Hz. The result for the user is no reduction in tracking capability, but audibly there would be greater bass output. This increase in bass is not bass energy reproduced from the disc, but rather is a result of the interaction between the cartridge/tonearm's resonant frequency and the turntable suspension's resonant frequency. This could be considered as feedback which is just beginning to intrude into the sound. This sounds like overuse of a loudness contour control, where the audible bass becomes soft and spongy and there is a large dip in the mid frequencies.

If this same pickup were installed in a very, very high mass arm, then the above condition would be worse and the pickup/tonearm combination would be very susceptible to feedback. This is because the closer the tonearm/cartridge resonant frequency gets to the suspension resonant frequency, the more prone to feedback the system becomes. However, the further away the tonearm/cartridge resonant frequency is moved from the resonant frequency of the turntable's suspension, the less prone the system is to feedback but the more prone it is to mistracking.

One can see from the above discussion that the low mass tonearm can cause mistracking, distortion, and record damage when used with a pickup of improper compliance. The use of a high mass tonearm will only tend to alter the character of the reproduced sound, making it bass heavy, and possibly alter the system's sensitivity to feedback. The presence of feedback sensitivity is a danger signal even the amateur audiophile can instantly recognize and make an effort to correct. However, between the light mistracking, which isn't always recognizable as it adds an "airy" quality to the reproduced sound that is in reality distortion, and actual mistracking, there is an awful lot of potential for record damage.

Adjusting Arm Mass

Looking at Fig. 1, it is easy to see what the effects are when the pickup compliance is not mated to an arm of proper mass so that the combination resonates at 8 to 10 Hz. (Please note that the graph is for illustrative purposes and is not calibrated.)

The obvious question is how one is to tell when the arm/cartridge combination is properly resonating at 8 to 10 Hz. Well, there are special test records which can be used with electronic test equipment to determine the resonant frequency of the combination. These records, however, are not of much use to the average audiophile, as they are designed for engineering and technical applications

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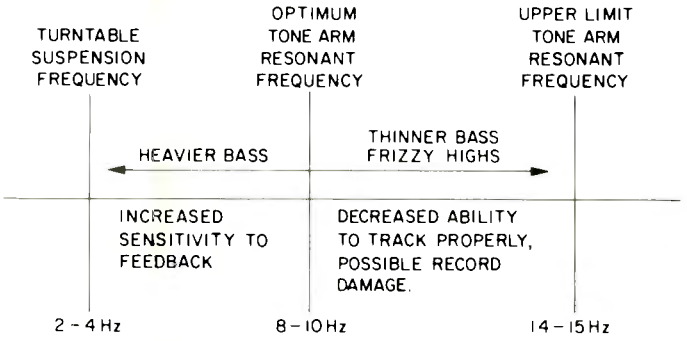
Fig. 1—Sonic effects of improper resonant frequency of the tonearm/cartridge combination.



and require special test equipment for proper evaluation.

In addition, I believe that the audiophile has for years been mislead by compliance figures which have no real meaning. Why? Because these figures are usually not calibrated to a standard. Imagine what a mess things would be if each amplifier maker had his own wattage reference and there was no information available on how each manufacturer made his calculations. Total chaos! And this is, I believe, what is generally happening in the compliance race, and yet this could be easily and quickly cleared up—with one tonearm and one record.

The tonearm would be of a fixed standard mass and would not be made for regular operational use in the home. In addition, it would have as small a tracking error as possible for a very short swing over the record. The test disc would have short sections cut with single frequencies from 4 through 20 Hz, and these sections would be placed on the disc coinciding with the tonearm's optimum tracking radius. Since the tonearm would be of a fixed standard mass, the engineer would simply play each band to determine the resonant frequency of the pickup.

If the arm were a fixed, standard mass, then a calibrated chart could be supplied with the tonearm and record which would give the figures for dynamic compliance for each recorded frequency. Further, the signals cut into the record could be vertical, lateral, and 45/45, allowing a reading for symmetry of the compliance.

It sounds great for the audio engineer, doesn't it, but not so great for the consumer. But let's take a look at the total picture.

If a phono pickup manufacturer had such a standard to work with, then he could specify a compliance rating according to the standard. If such were the case, then the tonearm manufacturer could specify the mass of his arm including the weight of the pickup for the proper resonant frequency of the rated compliance. The audiophile could easily consult the chart to determine the proper pickup and tonearm combination.

I'll go out on this limb even further. All arms should be and I hope will be made available with adjustable mass. A simple sliding weight on the tonearm tube is all that would be required. Slide the weight toward the pickup, as in Fig. 3, and the arm mass increases. Slide the weight toward the base or mounting of the tonearm, and the arm mass decreases, as shown in

Fig. 2—Idealized drawing of record and tonearm of standardized mass used to determine phono cartridge compliance.

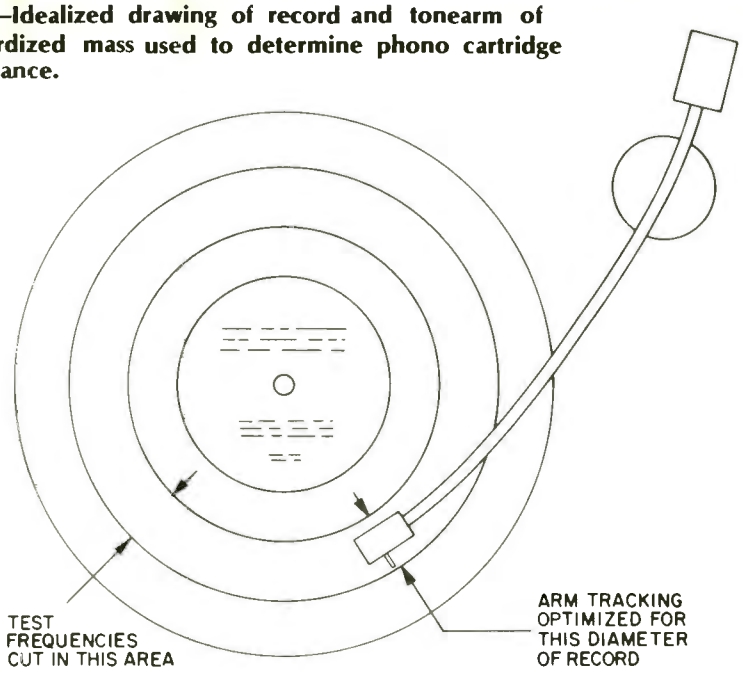


Fig. 4. It would then be a simple matter to tune the mass of the tonearm to the pickup's compliance for optimum results.

If such a standard system were available, it would be a simple matter for the pickup compliance specification supplied by the maker to be checked against the proper tonearm mass to produce an optimum resonant frequency of 8 to 10 Hz. The consumer would then simply slide the adjustable weight along the arm to the point where the proper mass is produced, and there you have an optimum pickup compliance and tonearm mass situation.

Figure 5 shows you a possible graph, illustrative only of course, showing how the system might work using an average pickup and a tonearm with adjustable mass.

Step 1—See cartridge manufacturer's specification for pickup weight. For example, 5 grams.

Step 2—See pickup specification for compliance. For example, ₄6 on the 1 to 10 scale.

Step 3—Look at the chart to determine the proper mass to the combination to resonate at 8 to 10 Hertz. With the compliance of 6 for our example, go across to the right until you meet the diagonal line, and then read off the proper total arm/cartridge mass from the horizontal scale, 6.5.

Step 4—Mount the pickup on the tonearm, and adjust the tonearm mass for 1.5, which is the 6.5 total from the chart minus the 5 specified by the maker for the cartridge itself. You will then be set for optimum performance.

The procedure would depend somewhat on the cartridge manufacturer maintaining strict quality

Fig. 3—An adjustable weight, able to be moved along the tonearm tube, can be positioned toward the pickup to increase arm mass.

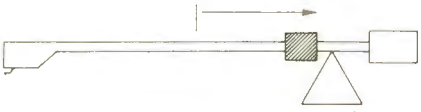


Fig. 4—If the weight is positioned toward the base or mount of the tonearm, then the mass will be decreased.

control of compliance. However, it is my feeling that if a manufacturer cannot maintain consistant compliance, then he should not be in the business. I feel too that such a system as described above will soon appear, so that the audiophile will soon have the means, without any test equipment whatsoever, to very accurately determine the resonant frequency of his particular tonearm and cartridge combination. Knowing the basic resonance frequency and having an adjustable mass arm allows the audiophile to set up the system properly. Best of all, the procedures involved require a minimum of skill for accurate results.

I'd like to digress here to make a point. In the photographic business, the design of enlargers follows some of the design practice used for tonearms. The large negative enlargers are very sturdy and generally the enlargements made with these units are 4X or less (an enlargement from a 4x5-in. negative to a 16x20-in. print is only 4X).

However, enlargers made for the small format negative, 35 mm, are generally rather flimsy when they should be super sturdy. An enlargement to 16x20-in. from a 35-mm negative is a 16X enlargement. The net result is that the print is not as sharp as possible with the particular camera.

I feel a similar situation exists with tonearms since it appears to me that when a designer makes an arm lighter, he usually makes it flimsier. Thus, if a high compliance designed into the cartridge of your choice requires a low mass arm, then be certain you purchase an arm of very sturdy construction or you will be courting disaster.

Beware of an arm tube which can be easily flexed or one where the pivots rattle easily. It really isn't that difficult to design and build a tonearm that is light in mass yet sturdy in construction.

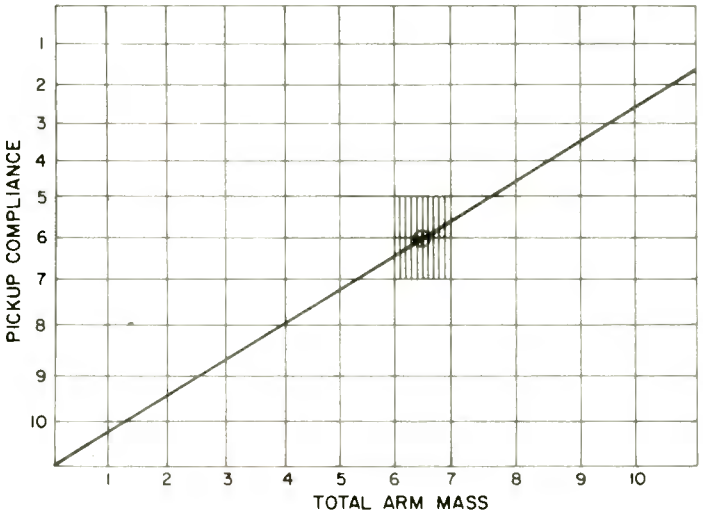


Fig. 5—To properly set the adjustable weight on a moveable-mass tonearm, first find the pickup's specified compliance and weight in the maker's literature. Then go from the compliance figure on the vertical scale until the diagonal line is met, then read off the proper total mass adjustment from the horizontal scale. Subtract the cartridge weight from that figure and you have the mass adjustment setting. For our example, the #6 compliance gives a total mass figure of 6.5, and subtracting the weight, 5, gives a mass setting of 1.5 (Note: Scales are arbitrary.)