

Making a Plate Reverb Unit

The weakest link in a small recording studio is usually the reverberation system. Yet sometimes this can be just what makes the difference between a demo- and a master-quality recording.

This article presents plans for making a plate reverb unit, which won't require any electronics other than your mixer and a headphone amp. (If you don't have these items, you're not ready for a reverb plate anyway.) The construction cost will be between \$300-\$500, a lot less than the \$2,500-\$8,500 commercially-available units. The article will describe how to find and evaluate the materials needed, construct the frame, mount and tune the plate, fit the driver and pickups, and add dampening to the plate. It concludes with some "tricks" and techniques for enhancing plate sound.

For the complete do-it-yourselfer, diagrams, photos, and a parts list are included. A kit providing a pre-constructed frame; selected, cut, reinforced, and drilled plate; mounting hardware; driver, and tuning cassette tape is also available from the author. The kit may help facilitate the project by eliminating the hardest parts: locating and evaluating materials and having the custom metal working done.

Almost everyone with a knowledge of recording is familiar with spring reverbs, or at least with their sound. Most low-end or semi-pro reverb units are based on the spring principle, as are most musical instrument amps or accessories with reverb. That "spring sound" can range from excellent to "under water," depending on the unit and the way it is used.

The reason spring units sound the way they do is because that is exactly what they are—springs. There are usually several rows of them, possibly with two or three strung in a series. Just like the springs on your screen door, they will "twang" or "boing" when plucked. However, instead of being plucked, the reverb springs are excited at one end by a driver and "mic'ed" at the other end of a pickup...and so is the twang and boing, especially on transient material.

Although some designers have used tricks to smooth out their sound with excellent results (Craig Anderton's "Hot Springs," Oct., 1980 *MR&M*), they may still have spring characteristics inherent in their sound, as well as a limited bandwidth, especially at high frequencies (8 kHz+).

Plate reverb has none of these drawbacks, although it can go from sounding like a true concert hall to an oil drum being banged with an ax in the subway, again depending on its application and who's using it.

Typically, the plate is a large (one by two meters, or 39.37 by 78.74 inches) sheet of steel suspended in a tubular steel frame. In theory, the plate simulates a large concert hall or church with a decay time (the

time required for the intensity of the reverb to diminish by 60 dB) of approximately five seconds at approximately 500 Hz. A driver attached to the plate excites it, and as the sound waves travel through it, the plate flexes. The plate's motion is then picked up by one or two contact mics and added to the dry signal at the mixer. Transients do not twang or boing, but behave much as they would in a reverberant room, sounding smooth and natural. As an additional feature, incorporating a damping plate to change the decay time of the reverberated signal can be included in the design.

It was at the Broadcast Technical Institute in Nuremburg, and later at the Institute for Broadcast

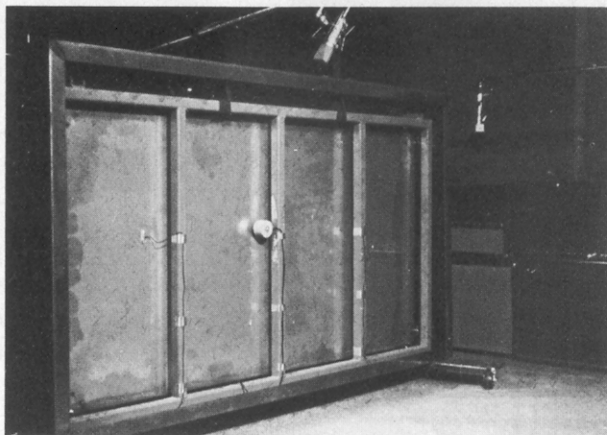


Figure 1. The finished reverberation plate. Note the oil stains; a thin coat of very light machine oil has been applied to the plate to prevent rust and corrosion. (photo by Mark Demcovitz)

Engineering in Hamburg, West Germany, that the first reverberation plate using these principles was developed. EMT (in Germany) patented and made the only available units until the patents ran out a few years ago. Since then, several American and foreign companies have come out with newer units. The plans presented here are of a hybrid unit that can be optimized to the design of any of the commercial units you may favor.

Construction of the Unit

As mentioned in the introduction, the design of this unit will incorporate your mixer and cue (headphone) system as all the electronics that are required. We will mostly concentrate on the construction of the mechanical system and the transducers—the frame, plate, driver, and pickups.

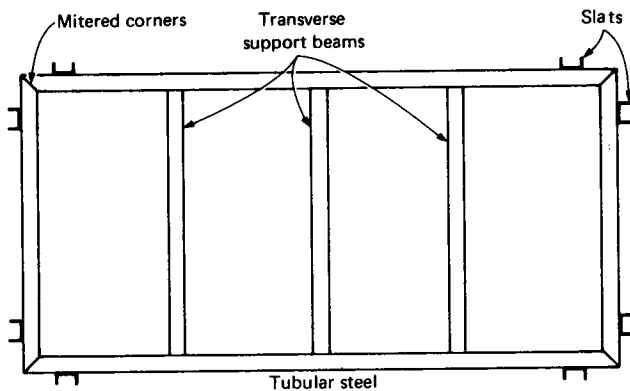


Figure 2. The tubular steel frame is reinforced with three transverse support beams.

Selection of Plate Materials

This is probably the most critical of all the steps involved in the process, so be careful. The plate is actually "the instrument" used for the reverb, so it should be chosen as if it were a fine acoustic instrument. EMT uses a one meter by two meter cold-rolled steel plate approximately 1/64-inch thick. Lawson, who manufactures "The plate" (LP1 and LP2), uses basically the same size plate, but it's a little thinner. On the other hand, some manufacturers use stainless steel. The Ecoplate by Studio Technologies uses approximately the same gauge in stainless, while DB Cassette of Sweden, who manufacture the

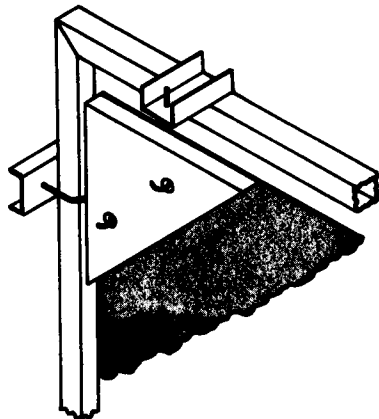


Figure 3. Corner detail, showing triangular reinforcement plate welded in place.

Stocktronics Plate, use a stretched hardened piece of cold-rolled stainless approximately 0.03 inches thick. The question of what kind of steel to use is totally subjective. Reasons claimed for using stainless steel include consistency, high density, and the fact that it's tarnish proof, while regular steel users claim smooth, more natural sounding reverb and a less "metallic" decay. Only you can decide what sound you prefer.

Befriend your local steel warehouse owner, bring two associates, and prepare to listen. Most steel sheets come in 3-foot wide sheets; this is close enough to one meter for our purposes. The length, however, is usually eight feet long and cutting charges to make it six feet might be added to the price of the steel. Some places also have minimum orders, so try to buy your plate and frame materials from the same source to save added expense.

If the owner of the shop will allow—and it's worth a healthy tip to have him help you out—have your two friends hold the sheet of steel horizontally as tight and

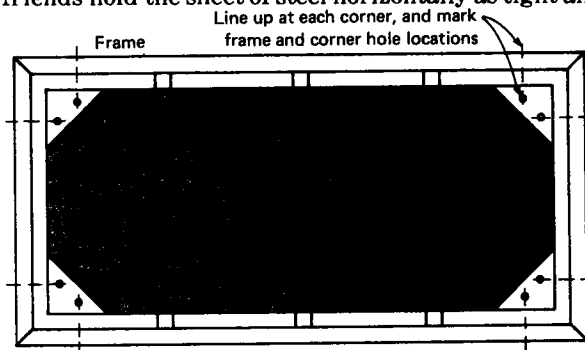


Figure 4. With the plate carefully positioned on the frame, both the frame and the plate may be marked so the holes will be properly aligned with the hooks.

still as possible, such that it doesn't "thunder." Tap it in the center with a key and listen for a "sizzle" and long decay in the high frequency, as opposed to a "clangy" sound. The delicacy and length of the high frequency decay are what you are really after, since the bottom and mids can be dealt with more successfully by tensioning. Try several pieces of different types until you find what you want. Be selective and take as much time as possible, because this is the heart of your system and you must be happy with it.

Including the cutting, the steel sheet should run between \$50 and \$100, depending on the type you choose. Reinforcing the corners by spot welding a triangular piece of steel on each one is the recommended procedure. For corner-cutting by the cost conscious, however, it's not totally necessary, since it could run \$25 to \$50 additionally. But, it really *should* be done if at all possible because the plate will be put under heavy tension and holes will be drilled in those corners later in the plate-preparation procedure. The holes should be drilled after the frame is completed so a more "custom" fit may be made.

The Frame

The frame is simply 1 to 1½ inch tubular steel—either round or rectangular—shaped in a rectangle and welded together at the (preferably mitered) corners. The frame should be reinforced by three transverse beams (Figure 2). Near both sides of each of the four corners (eight all together), weld flat pieces or slats of steel, which may be channeled for extra strength. These should extend 1½ to 2 inches beyond the frame, and be about 1 to 2 inches from the corners (Figure 3). Holes will also be drilled in the center of each of the slats. To determine the exact placement of the holes in the slats and in the plate, as well as the exact measurement of the length of the tubular steel for the frame, you must make sure the plate and the frame line up together. Make the *inside* measurement of the frame 1 to 1½ inches larger than the dimensions of the plate. Then lay the plate on top of the frame. On the plate, mark the eight spots where the holes will be drilled. Then mark the frame where the eight slats will be welded. Next, mark the slats where the holes will be

drilled (Figure 4). When all the holes are drilled and the slats welded in place, paint the frame to stop rust and corrosion.

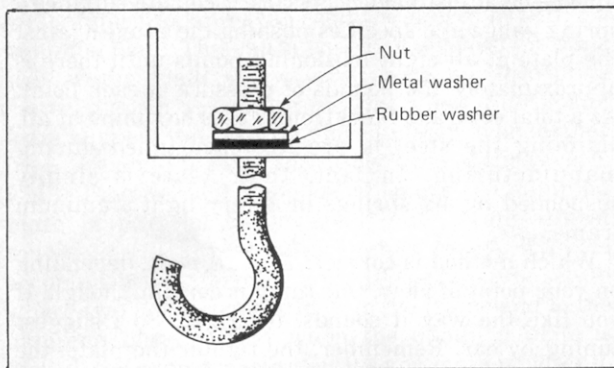


Figure 5. Detail showing correct positioning of suspension hook.

The next step is to suspend the plate in the frame. EMT uses spring clips that hold the plate in place and are also used to determine tensioning. These are weak, and often snap. One of the improvements made by most plate manufacturers is to use stronger, heavier clips or hooks. Ecoplate uses clips similar to those that secure fiber straps used on packages. We will use simple, tempered, hardened-steel hooks, threaded on their shafts. If the hook is plastic-coated, and hard-rubber and metal washers are used, the plate and the frame can be totally isolated as far as direct metal-to-metal contact goes. To suspend the plate, you will probably need help getting the hooks through the holes in the plate. Slip the shaft of each hook through the holes in the slat; thread the washers and a nut of the correct size on the hook shafts, and hand-tighten all nuts (Figure 5). The plate can now be suspended from the frame.

Now comes the subjective and fun part of the project—mounting the driver and pickups, and tuning the plate.

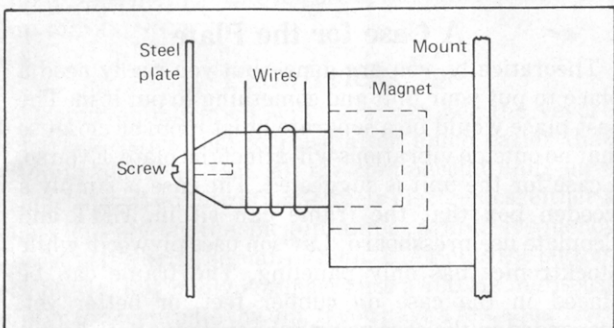


Figure 6. Driver detail, as used on several commercially-available plate systems.

The Driver

EMT, Ecoplate, and Lawson all use similar drivers. A bullet-shaped metal moving-coil “slug” is screwed into the plate. Two wires carrying the signal go to the coil and it is suspended in a large, heavy, circular magnet (Figure 6). It is important to be sure the moving coil assembly does not rub or touch against the sides of the magnet. The coil and magnet are aligned using a plastic alignment disk. The procedure is

delicate, and transporting the unit sometimes misaligns the driver/magnet assembly.

Stocktronics uses a wire rod attached to the plate on one end and to the voice coil of a speaker on the other. It can be moved with no realignment, since there is plenty of “play” in the movement of the rod, and this is restricted to within limits by a rubber guide.

The system we will use is similar to both, but unique unto itself. It is also one of the main reasons that this plate can be built so reasonably. This design uses an Acoustic 2000 driver—similar to what used to be offered as a “coneless speaker” several years ago. Whatever the driver is attached to becomes the “sounding board” and vibrates enough to reproduce sound. Therefore, if screwed into a door, it would become a “speaker.” The Acoustic 2000 (see Figure 7) is an improved version of the coneless speaker. It offers an excellent frequency response from 30-20 kHz. It can safely handle 35 watts rms and 100 watt peaks, and has a built-in crossover with a replaceable capacitor to change the crossover frequency. Best of all it is simple to use and install and is reasonably priced (list \$89.95-\$79.95 through kit offer).

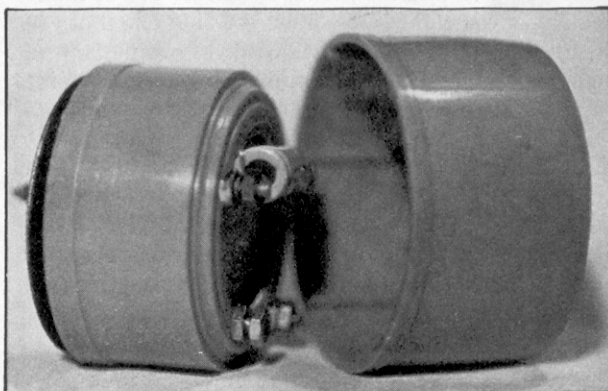


Figure 7. The Acoustic 2000 driver, showing cover (right), crossover capacitor and input terminals. (photo by Mark Demcovitz)

To install the driver, simply drill a small hole, the size for the screw on the driver, in the center of the plate 2½ inches off to one side of the center of the beam of the frame. (For optimum placement, see our review of this project in next month’s *MR&M*—Ed.) Screw the driver in the side of the plate, with the frame reinforcements toward you, about half way until tight. Attach a speaker cable to the two terminals on the driver. Be neat and run the cable down the reinforcement with “ty-raps” or tape. Now the fun begins. Move the plate into your studio. Make sure the plate is standing upright. Connect the other end of the speaker cable attached to the driver to the output of your cue (headphone) amp. Put on a tape with a steady snare-drum track or a constant vocal track. Send only the selected track to your cue and, *voilà*, the signal will be heard on the plate. Assuming it is the snare track, what you should hear is a thunderous snare sound similar to “Bridge Over Troubled Water” or “The Boxer” by Simon and Garfunkel (although I think they used an elevator shaft for their reverb chamber). But, anyway, congratulations! You have a working plate reverb! Now comes the real fun part—using your

opinions, taste, and ego to get it to sound just the way you want. This will require your choice of pickups as well as tuning and equalization.

Pickups

All the commercial units use Piezoelectric pickups or accelerometers. These are basically contact mic'/pickups and are available from dozens of manufacturers. As a matter of fact, you probably already own one, or at least know someone who does. Some examples of available units are Barcus-Berry, "Hot Dots," and the "It" by Frap, Shadow Pickups, Countryman Associates, etc. Some pickups need no preamp and can be plugged into the echo return(s) on your. Some have their own preamps, but these tend to be rather noisy. An MXR Micro-amp or similar FET preamp would be a good substitute if needed because it uses a TLO 81 or similar low-noise, high-slew FET for excellent quality. You can also return the output of the pickups through two mic' inputs on your mixer if you have any modules free. Or, you can use a direct box or transformer to a line input. These are some of the variables that you must work out depending on the mixer you own and the pickups you use. Try as many pickups as you can borrow until you find one that you like and that easily interfaces with your mixer. For a mono reverb, place the pickup near one of the side frame reinforcements. Experiment by moving the pickup up around, and down, on both sides of the reinforcement, until you find the spot you like. Then secure the pickup by epoxy, wax, putty, or whatever the pickup manufacturer recommends. Run the pickup wire down the reinforcement, again using "ty-raps" or tape. For a stereo unit, do the same thing on the other side (Figure 8).

Tuning the Plate

With the pickups in place, the plate itself now comes into focus for tuning. In theory, think of the plate as similar to a drum head—the tighter it is, the higher the pitch. Also, correct tuning means all the lugs are equally tensioned. So, start by holding the hooks suspending the plate in the frame with a pair of "vice grips" or similar pliers, and tighten the nut on that hook with a ratchet wrench. Do this evenly around all eight hooks. How do you know when the plate is tuned? Good question. You don't, really, because every manufacturer used their own method for tuning. EMT ships units pre-tuned except for four nuts which are supposed to be tightened by exactly $\frac{1}{4}$ turn when installed. Most independent EMT servicemen will tell

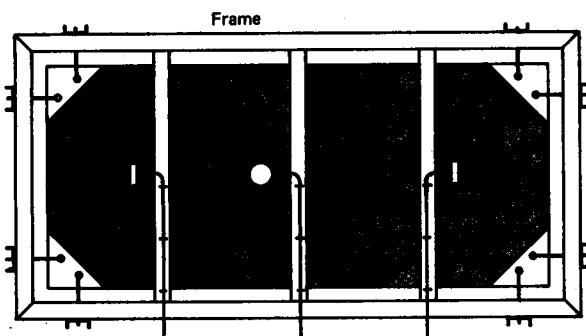


Figure 8. The finished reverberation system, with driver and pickup(s) in place.

you to tighten the plate until a spring suspension clip breaks, and then replace it and tighten until $\frac{1}{2}$ of a turn before it breaks again! Lawson ships its units pre-tuned—no adjustment necessary. Ecoplate supplies a spring gauge and specifies pushing the gauge against the plate at all eight tensioning points until there is approximately 150 pounds of pressure at each point. As a total contrast, Stocktronics uses no tuning at all, claiming the steel is pre-stretched/tuned during manufacturing. In fact, their plate is simply suspended by six springs in a very light aluminum frame.

Which method is correct? Any/all/none, depending on your point of view. One thing is certain, though. If you like the way it sounds, it's right. So I suggest tuning by ear. Remember, the tighter the plate, the more highs and the less bottom. It is usually better to over-tension than under-tension. Also, listen for "flutters" or "beats" (like two slightly out-of-tune guitar strings) on the decay of the reverb, and even-out the tension until they disappear. EMT warns about the "oil can effect," a very metallic sound that is heard on an obviously out-of-tune plate. What I suggest is to find an existing plate you like in a studio near where you live. Rent an hour of time, and bring along a tape of various tracks—snare alone, drum kit, congas, tambourine, voices, piano, and run it through the plate. Record the reverb return on one track of a two-track or cassette, and your original dry signal on the other. Bring it back to your place and pan the dry signal to the center of your monitors, and the reverb send from their plate on the right. Send the dry signal to your plate, return it to your mixer, and pan it to the left. Now you can directly compare your plate to theirs, and tune and equalize until the sound of yours equals or betters theirs (subjectively)! (A tape like this is available in the kit offer. It is made from an EMT 140 ST tube unit—the "classic plate" sound. Notice the deep, smooth base, and crisp, sparkling highs—as well as smooth decay. Sends chills up your spine, huh?) Use your ears and you can't go wrong.

A Case for the Plate

Theoretically, you are done—but you really need a place to put your unit and something to put it in. The best place would be a separate quiet room or closet so that no outside vibrations will affect the plate. Even so, a case for the unit is suggested. The case is simply a wooden box that the frame can sit in. EMT and Ecoplate use pressboard, Lawson uses plywood, while Stocktronics has only paneling. The frame can be placed in the case on rubber feet, or better yet, suspended in the case using rubber straps with hooks, such as those found in automotive stores for holding down luggage. The straps can be wrapped around the frame and the hooks hooked to holes or eyelets in the case. This way you can literally pound the case with little vibration. Eyelets can also be put on the outside of the case on each side so that rods can be inserted for carrying. If you are only using the plate during mixdown, the studio isn't a bad place for it. It probably has the best isolation from your monitors and has easy access to your mic' inputs and headphone jacks. The case only has to be a few inches bigger than the entire unit on each side, unless you plan on using the next step—damping.

Damping

The decay time for the reverb as it now stands is approximately 5 seconds at 500 Hz. This is fine for most applications, but can easily be altered by fitting a damping plate. This can be a piece of plywood the same size as the plate and covered with an absorptive material (such as compressed fiberglass, Styrofoam, foam rubber) that can be moved closer to or farther from the plate to alter the decay time of the reverb. EMT, Lawson, and Ecoplate all move the damping plate in parallel to the steel plate, from almost touching ($\frac{1}{8}$ -inch) to 6-8 inches away. This is accomplished by forming a parallelogram type set-up where two metal arms attach to the frame and to the damping plate so that when the damping plate is moved, the arms travel sideways and move it closer to the steel (Figure 9). Stocktronics simply hinges their Styrofoam damping plate at the bottom and then pulls

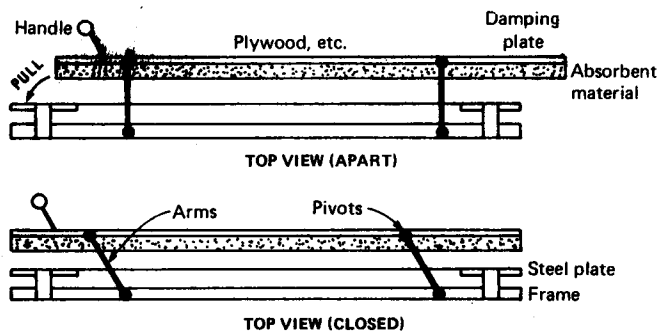


Figure 9. A parallelogram-style damping plate.

the top closer to, or farther from, the steel, claiming this gives a more uniform frequency response in the decay characteristics. A handle or lever on the damping plate facilitates moving it. It can also be remote-controlled using servo motors and cams, but this is beyond the scope of this article. The choices of materials, method, or even use of damping at all is left up to you.

Plate Tricks

Using equalization will help you get the reverb characteristics that you are after much easier than tuning alone. In fact, all the commercial units have some sort of equalization in their electronics, either a bass cut-off on the pickup amps, a high-frequency boost to the drive signal, or both. EMT cuts the bottom at 80 Hz, but many engineers use a 700 Hz high-pass filter to accentuate the top. If you have a few equalizers to spare, it would be a good idea to patch one to the send and one to each return. This will allow you to match the sound of almost any of the commercial plates or any plate sound you have heard. In fact, Studio Technologies has released a product with a parametric equalizer on the send and one on each return, as well as a delay and noise gate, all in one unit. The delay and gate help with some plate "tricks" you can use for some of the popular effects you have heard.

- **DELAYED SEND**—Take the send to the plate and first put it into your delay line. Use a full-bandwidth setting so that you don't lose any top end. The effect is that you're in a large hall where the first reflection isn't heard until milliseconds after the initial dry signal.

The longer the delay, the bigger the hall. A good example of an extra long pre-delay is the reverb on the snare at the end of "It Keeps You Running" by the Doobie Brothers. You hear the snare hit first—and the reverb later. Sort of "boom...cha!" This will also bring out the deficiencies of a unit, and if you try it on a twangy spring, the time delay doesn't let the program mask the boing of the snare transient. But with a plate, this is no problem.

To shorten the decay without damping, a noise gate comes in handy. Placed on the return, the release time can be shortened. When the attenuation and threshold are properly set, the decay will be gradual and smooth, only shorter. If the controls are set to dramatically attenuate the decay, it can be rhythmic. For example, if hand-claps are done on the downbeat, the reverb decay can end sharply and completely on the upbeat.

You can also gate the send to the plate such that you only reverberate certain signals. For example, if you want reverb only on the snare track, and it wasn't gated when recorded, gate the snare track to the send, and you will only get the reverb on the snare beats, not on any tom toms, bass drum, or cymbals that might have leaked onto your snare mike.

Experiment and you can get any sound you've heard, and some you haven't.

"So, if I use one plate reverb with a lot of top end and a gate for the snare, and another one with a lot of bottom for 'thunder toms,' and one more with a long pre-send delay and high frequency boost for that 'sizzly vocal' sound; maybe one for the strings...with maybe a little flange on the return...and maybe one more...."

Parts List

- 1 Steel Sheet (of choice)
 - 1 Tubular Steel (for frame)
 - 1 Driver (Acoustic 2000)
 - 1 or 2 Pickups (of choice)
 - 8 Hardened, Tempered, Threaded Steel Hooks (Rubber coated if possible)
- Each with rubber washer, steel washer, and nut.

Optional

- 2-4 Rubber Straps for suspending frame
 - Wood (of choice) for Case
 - 1 Damping Plate and Absorbent Material (of choice) with Handle
- A kit containing:

A pre-made, painted frame, selected steel sheet, all mounting hardware, an Acoustic 2000 driver, and tuning cassette tape is available for \$400.00—plus shipping. Shipping is C.O.D. (please specify if you wish a quote on shipping price before kit is shipped, since shipping will vary by distance). The driver and tuning tape only are also available separately for \$85.00, shipping included. NJ residents please include applicable sales tax.

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