

Engineering an Entertainment Center

There's more to it than putting a television in a box

BY BROOKS TANNER

Entertainment centers have been around since the days of the Victrola, but with the advent of enormous televisions and sound systems that would astonish Thomas Edison, entertainment centers too need to evolve. A modern cabinet not only needs to house the television but also sound and video media, satellite receivers, DVD players, CD players, audio amplifiers and the center-channel speaker.

Most designs today are large boxes that differ little from bookshelves or display cabinets, their only concession to electronics being that they have holes for wires. But a good design for an entertainment center takes a little more planning. It starts by examining the requirements of each component and then integrating everything seamlessly.

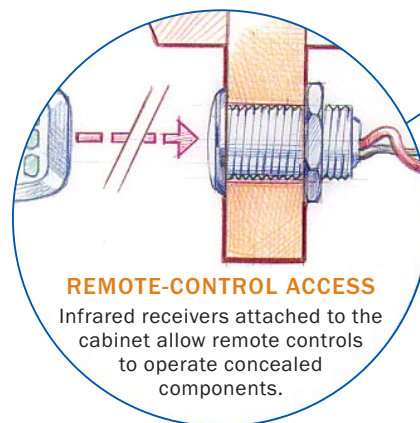
Television is the focal point of the cabinet

Television placement is of primary importance. The center of the screen should be at eye level—approximately 43 in. from the floor, assuming an 18-in.-high seat and 25 in. to eye level from the seat.

Any cabinet built today should be made to house a high-definition television (HDTV), whose wide-screen format will be the only one sold by the year 2006. A screen that is now 24 in. high has a width of 32 in. Under the new format, that same 24-in.-high screen will be approximately 43 in. wide. A cabinet that is made for a present television without extra room on the sides will only fit a future television of shorter height.

The new HDTVs allow for six audio channels, so the entertainment center requires a place for center-channel audio. Because this is where most of the dialog comes out, it is important that the sound seem to emanate from the screen, requiring the speaker to be in the middle of the cabinet, directly above or below the television. If it must be placed away from the television, the speaker should be angled toward the listener; otherwise, information from that speaker will sound as if it's above the listener's head or coming from the floor, depending on the height of the speaker.

Drawers for media storage are almost always located in the bottom of the cabinet, convenient for both children and adults. CDs,



REMOTE-CONTROL ACCESS

Infrared receivers attached to the cabinet allow remote controls to operate concealed components.



DEADEN THE SHELVES

Constructing the shelves from a lamination of MDF and hardboard makes them acoustically dead and less likely to resonate when you listen to music.

CENTER SPEAKER SHOULD BE HEARD, NOT SEEN

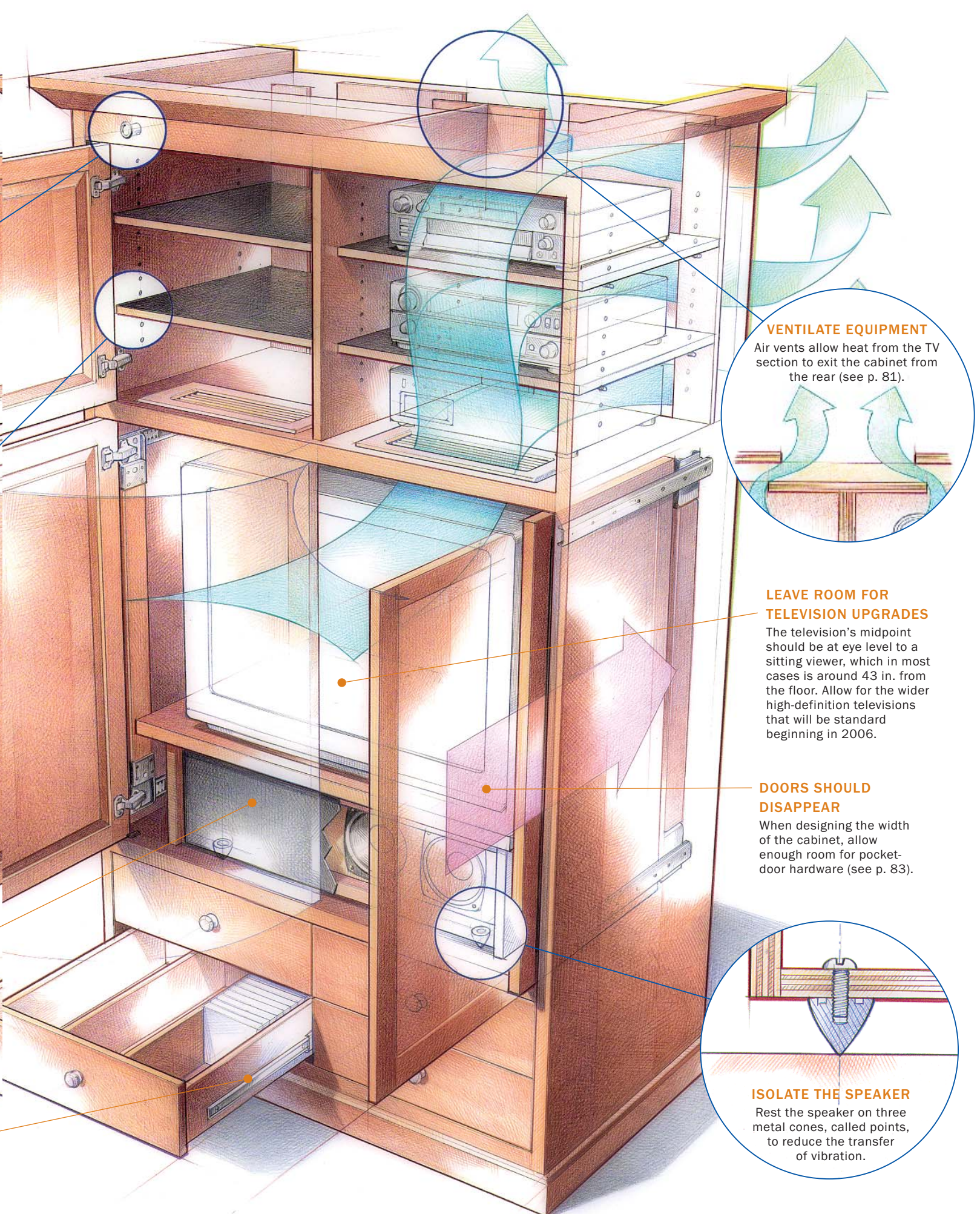
Modern home-theater systems include a center-channel speaker, which must be placed as close as possible to the television. Raw silk forms an attractive screen for the speaker but won't alter the tone.

DESIGN AROUND THE COMPONENTS

A number of features distinguish a dedicated entertainment center from an ordinary cabinet that happens to house your television and stereo system.

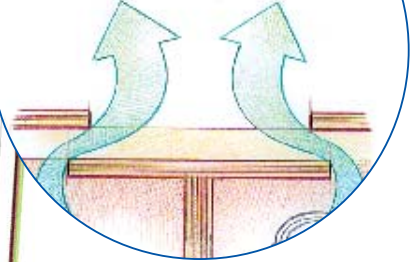
DON'T SKIMP ON HARDWARE

Cheap drawer slides are likely to vibrate and rattle when you crank up the volume.



VENTILATE EQUIPMENT

Air vents allow heat from the TV section to exit the cabinet from the rear (see p. 81).

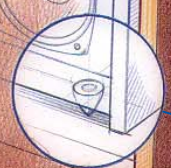


LEAVE ROOM FOR TELEVISION UPGRADES

The television's midpoint should be at eye level to a sitting viewer, which in most cases is around 43 in. from the floor. Allow for the wider high-definition televisions that will be standard beginning in 2006.

DOORS SHOULD DISAPPEAR

When designing the width of the cabinet, allow enough room for pocket-door hardware (see p. 83).



ISOLATE THE SPEAKER

Rest the speaker on three metal cones, called points, to reduce the transfer of vibration.

DIMENSIONS TO CONSIDER

The needs of the components determine the dimensions more than aesthetic considerations do.

COMPONENT SIZES

Standard components are less than 18 in. wide and about 5 in. high. Allow at least 6 in. of space between the shelves for airflow.

CABINET DEPTH

HDTVs are shallower than conventional models, so a cabinet deep enough to accommodate current technology should be fine for future televisions.

CABINET HEIGHT

The height of the cabinet is determined by the number of components and the amount of media storage needed.

TV DIMENSIONS

The new HDTV format is wider than current televisions, with a 24-in.-high screen having a width of 43 in.

TV STAND

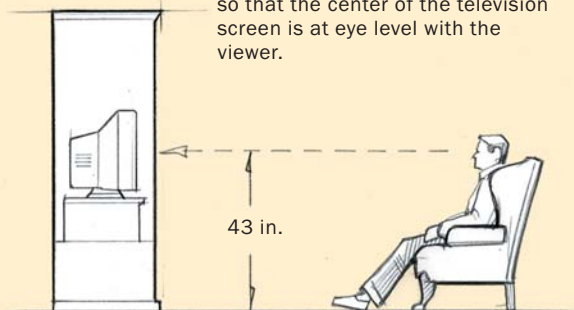
The stand must be sturdy enough to support the weight of the television. The stand cannot be installed until the pocket-door hinges have been attached. Allow up to 2½ in. of clearance on both sides for the pocket-door hinges.

MEDIA STORAGE

CDs, videos and DVDs all require a drawer that is a little over 6 in. high. Audio cassettes require an exterior height of a little over 3 in.

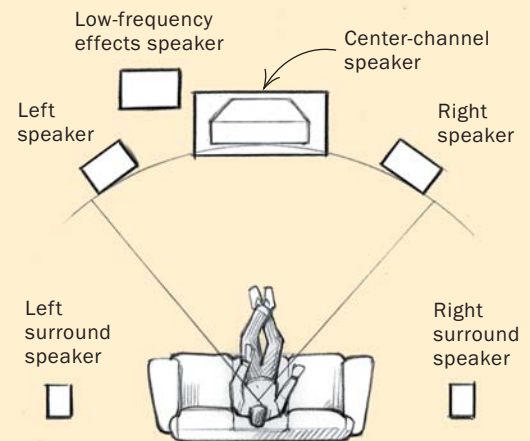
KEEP THE VIEWER IN MIND

Design the entertainment center so that the center of the television screen is at eye level with the viewer.



SURROUNDED BY SOUND

The HDTV format allows transmission of six audio channels. While the center-channel speaker is the most important, delivering up to 80% of the sound, correct placement of the other speakers is necessary to appreciate the full effect.



DVDs and videotapes fit in a drawer that has an external height of a little over 6 in. To separate media and keep them in neat rows, I usually attach a ¾-in.-high wood spline to the drawer bottom with double-faced tape. The spline can be removed if the drawer function changes. If small children will use the drawers, plastic media holders usually work better at keeping the contents in order.

The space above the television is reserved for the other electronic components, such as VCRs and CD or DVD players. Mount-

ed on adjustable shelves, the equipment is at eye level for adults and out of reach of young children.

A solid structure minimizes vibration

In addition to eating prime cabinet space, the center-channel speaker may introduce vibration into the cabinet, if played at a high volume. Vibration can cause both visual and audio distortion. Another effect is the rattling of doors and other cabinet compo-



RATTLE-FREE PANELS

More panels make less noise. Small rear panels are less likely to resonate than one large sheet.



Hot-melt glue makes a cushion. To reduce vibration, shim the rear panels down into their grooves and then apply hot-melt glue in a few areas. Remove the shims after the glue has set.

nents. For this reason, antivibration solutions should be employed in cabinet construction as well as in speaker mounting.

Cabinets should be as acoustically dead as possible. This is done by keeping the structure rigid and eliminating as many large, thin, flat areas as possible. Medium-density fiberboard (MDF) is one of the better readily available materials for carcass construction. Although MDF is acoustically superior to plywood, I still usually use veneer plywood for the primary carcass. It is stronger and lighter, and by designing a rigid structure, I believe I minimize the acoustical difference between the two materials.

The main sections of the center are glued and dadoed, reinforced with angled nails from a nail gun. I also use multiple rear stress panels, not just one over the entire cabinet back. Hot-melt glue applied around each rear panel eliminates any chance of a

stant airflow to prevent overheating. The easiest solution is not to use doors, allowing the components to sit in free air. A typical cabinet, however, has doors in front of the components, and with the doors closed, there is no airflow. Many commercial units have air slots in the rear panel that allow heat to escape and also serve as a wire chase. The problem with these slots is that the shelves block the slots and reduce or eliminate airflow.

My solution to the airflow problem is twofold: First, I make a labyrinth in back of the shelves consisting of two panels attached to the cabinet sides and a third panel screwed to the rear of the center divider. A 2-in.-thick batten is then attached to the top and bottom of these three panels, and two panels of ¼-in.-thick plywood are screwed to the battens. These panels overlap the side and center panels and disguise the opening. The labyrinth

rattle and also allows some flexing during seasonal changes. Pocket doors have tight closure hardware, with thick felt padding between the door and the face frame. Use good, tight slides for drawers. Most important, use your head when constructing the cabinet—look and listen for anything that may rattle or resonate.

The transmission of vibration from the center-channel speaker to the cabinet also should be minimized by mounting the speaker on three points—which are sharp metal cones available from audio suppliers. By minimizing contact between the speaker and the cabinet, the points reduce the transmission of vibration energy. An easier and cheaper method is to place foam rubber between the speaker and the cabinet.

Designing airflow into the cabinet keeps components cool

The television and the other electrical components all produce heat and require constant



WIRE CHASE AND VENTILATION

A labyrinth of overlapping panels provides airflow and access for wires. Attach a piece of ½-in.-thick hardwood to the back of the top vertical divider.

Install the side panels. Use pocket screws or biscuits to attach similar hardwood panels to the sides of the cabinet.



Two plywood panels come last. Attach 2-in.-thick battens across the top and bottom of the opening. Then screw on two ¼-in.-thick panels so that they overlap the center and side panels.

SHOPMADE AIR GRILLE



To make a grille for ventilating the TV cabinet, first build a mitered frame with a rabbet on the inside and outside edges. Then glue in strips of wood with smaller pieces acting as spacers.



creates two wire chases for each side of shelves, allowing separation of AC power and signal. This design also creates a rear outlet for airflow.

By itself this labyrinth is insufficient to cool the electronics because air must flow across the components. For better cooling I set the shelves a couple of inches back from the door. An air grille is then inset in the front of the shelf above the television to allow air to flow from the compartment below. With this method, cool air is

drawn into the TV area and flows up through the grille, across the components and out the back. If additional cooling is necessary, fans may be located in the grille area for forced ventilation.

Considerable importance rests on the shelves

After time has been spent designing a center that is rigid and rattle free, many woodworkers put in shelving without thought. A shelf is just a shelf, right? Well, not really. A shelf should be acoustically dead: One of the worst shelves I see in many cabinets is glass. It's beautiful, and it saves space. But from an acoustical standpoint, it is one of the poorest-performing shelves you could use. The rigidity of glass makes it highly resonant at audio frequencies. Just think of how well a fine wine glass resonates when you tap it.

Composite shelves work well and look good

—Shelves for the serious audiophile are available at specialty stores, starting at \$100 per shelf and increasing to more than \$1,000. These prices indicate the importance placed on shelving, but inexpensive, shopmade alternatives are available. From a cost and availability standpoint, MDF is a good choice. But a better choice is to use a lamination of dissimilar materials, such as MDF and hardboard. Together, dissimilar materials acoustically dampen each other, a process called constrained layer dampening. I join ½-in.-thick MDF on one side

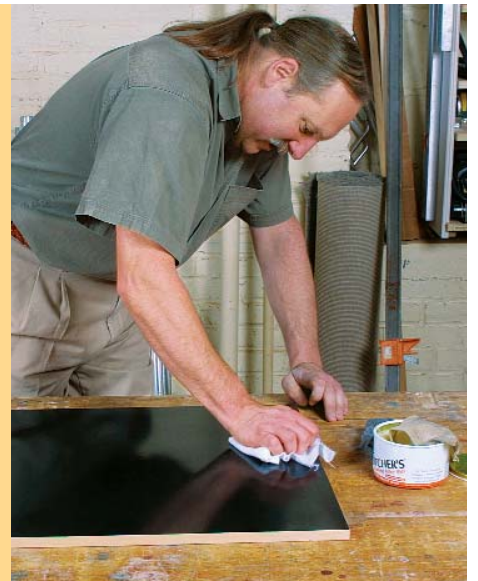
SHELVES THAT DAMPEN NOISE



Make the composite shelf. Use contact cement to laminate sheets of ½-in.-thick MDF and ¼-in.-thick hardboard.



Paint it black. Tanner applies black dye followed by a clearcoat. Afterward, he edge-bands the shelves with solid wood. To simulate the appearance of slate, the finish is rubbed out with 0000 steel wool and then wax (right).



to 1/8-in.-thick hardboard with contact cement. To give an exotic look to this laminated shelving, I apply a black dye to both surfaces. After the dye has dried, I apply wood edge-banding to the edges. When clear coated and rubbed with steel wool and wax, the surface has the luster of polished slate.

Give thought to how the shelves are attached—In a typical installation, I use basic L-type hangers that fit into 1/4-in.-dia. holes. Shelves simply placed on the hangers may rattle at particular frequencies. Attaching the shelf to the hanger with a screw stops the rattle but transfers the vibration from the carcass to the shelf, which in turn will vibrate the component. To stop the rattle you can add a rubber pad that is typically used for mounting glass, but doing so may actually increase the vibration to the shelf at specific frequencies, due to the high rebound (bounce) of the rubber. The best solution I have found is simply to apply a thick felt pad to the surface of the hanger. Felt has a low rebound and allows the carcass and the shelf to move independently of one another, decoupling the vibration.



Cloth-covered frame hides speaker. A raw-silk screen conceals the center-channel speaker but doesn't distort the sound.

Unlike Victorian children, the center speaker should be heard and not seen, which is why the speaker is hidden behind a cloth-covered frame. Many commercial cloths are available as covers, but according to speaker designers, raw silk adds the least acoustical distortion of any fabric. Raw silk does not have the tight, fine weave as the silk used for clothing and scarves. Instead, its texture and appearance are similar to burlap. Usually available through large fabric stores, raw silk is a strong fabric that stretches. When stapling or tacking the fabric to the frame, place thin cardboard tack strips (used in upholstery) over the fabric edge (see the photo above). The strips keep the pressure even and minimize tearing from the staples. Attach the cover to the cabinet with hook-and-loop fasteners, but be sure to leave a pull-tag so that you can access the speaker for maintenance.

Doors in front of electronic components can create problems with remote controls. Several solutions exist: The easiest is to use a glass panel in the door, allowing direct access with the remote. If solid-wood doors are used, a remote repeater may be used. A repeater typically has a receiver that is attached to the outside of the cabinet and has stick-on elements that are placed on the remote-receiver area of the component.

Adding these touches to a cabinet designed around the components distinguishes an entertainment center from a cabinet that just happens to house the television. □

Brooks Tanner builds custom, high-end entertainment centers in Manchester, N.H.



POCKET DOORS

Place the hinges. Although the manufacturer recommends that the hinges be installed on the rails of the door, Tanner prefers to locate them on the top and bottom of the stiles to avoid drilling the 35mm holes just above the tenons.



Do a dry run first. A wood follower connects the upper and lower slides. Tanner finds it easier to measure the cabinet and then test-fit the follower to the slides before installation.



Install the lower slide. To make sure the door closes flush with the front of the cabinet, place shims behind, below and in front of the slide to account for the face-frame overhang and the location of the hinge.