

CLOSEUP

SF speaker cabinet tackles the show-biz circuit

"The only thing tougher than military specs is rock 'n' roll specs," declares Bill Keezer, design engineer with Bose Corp., Framingham, Mass.

Keezer is referring to the design requirements of the new Bose 802 professional speaker system. The 802 replaced a previous model, which was designed with a housing constructed of wood, metal and vinyl. The 802 concept represented a revolutionary development in Bose's approach to cabinet design; it is made from mica-filled high-density polyethylene structural foam.

"The main property requirement was high impact resistance over a broad range of temperatures, with the emphasis on low temperatures," Keezer states. "A normal day for a professional musician's speaker may include sitting in a van overnight at -10F or -15F in Minnesota; being unloaded and dropped onto a sidewalk; being set up for a performance under tremendously hot floodlights; and then being jostled back outside and thrown into the freezing van for the trip to the next engagement. Basically, the musician doesn't mind too much if the equipment suffers a few bumps and scratches; but he counts on perfect performance—which he wouldn't get if there was any chance of the speaker cabinet cracking."

In the search for the right material, Bose engineers tried a number of resins, including filled polypropylene; but Instron and Gardner testing showed the filled HDPE to offer the most satisfactory performance for this application, within the cost limitation.

The finished speaker measures 13¼ by 20¼ by 13¼ inches and weighs 30¼ lb. When the cover is fitted, it increases the front-to-back measurement to 16⅞ inches and the weight to approximately 36 lb.

Heavy ribbing designed into the interior serves two purposes: to increase the overall strength of the cabinet, and to

serve as mounts for various electronic components and assemblies.

"The ribs were one of the main reasons we elected to go with structural foam," says Keezer. "They range in height from ½ inch to 1½ inches. We needed a way to avoid external-surface sink marks and to minimize molded-in stresses. However, the foam gave us an added benefit; it tended to absorb impact, increasing the force actually needed to fracture the cabinet. Similarly, the use of mica flakes to fill the resin proved beneficial; we chose it to reduce shrink, which it did—but it also provided greater part-to-part uniformity and higher heat-distortion temperature. By nucleating a more uniform cell structure, the mica-filled cabinets have significantly higher impact resistance than those of unfilled foam."

In addition to ribs, bosses are molded into the cabinet interior for mounting components and other hardware. However, only blind holes and push-in inserts are used. Through-holes are avoided throughout, to ensure that the cabinet, with the exception of the front speaker panel, remains airtight and watertight. The handle on the cover, located in a recess to maintain a flush surface, is molded into the part so that no mechanical fasteners are required.

"That's also the reason we selected the EmaBond process for assembling the back panel to the cabinet," Keezer points out. "We insert an electromagnetic HDPE tape 5.6 ft long into the groove of the back panel; we fit the back panel into place and run the assembly through a welding station. The electromagnetic tape, containing metal powders, devel-



Professional speakers from Bose Corp. are designed so that the cover can also serve as a stand (left). Behind the grille are the individual speakers (top, right) and the cabinet's ribs (bottom, right) both reinforce the structure and serve as mounts for electronic components. At far right is illustrated the bonding technique that fastens the back panel to the cabinet. The cabinet is made of mica-filled high-density polyethylene structural foam.

ops heat losses, causing the strip to melt and flow, and thus bonding the abutting surfaces—the flange and the panel. Not only is the bond practically 100 percent reliable, it's also the only type of bond that we found strong enough to withstand, over an extended period of time, the considerable abuse the speaker is subjected to during use."

Internal pressures are created by the oscillation of air columns, the principle upon which the design of the speaker system is based. Leaks in the cabinet would cause a whistling effect—hence the need for a reliable airtight bond.

The average wall thickness throughout the cabinet is 0.260 inch. A 0.5-deg draft angle is designed in, and corners are filleted with an 0.120-inch radius. Tolerances are specified on a must-fit basis, calling for limits of ± 4 mm part to part. A

decorative texture is formed into the cabinet's surface during molding.

"The cabinet has been tested pretty rigorously," Keezer adds. "After a 48-hour salt-fog test, not only was the cabinet itself still in first-class shape, the acoustics were also up to spec. It has also survived a 10-day accelerated-aging test, which was run to military specifications. And the drop test we ran showed that the cabinet would survive dropping onto a corner, from up to 4 ft, at -30°F ." Further emphasizing the hardness of the design is the fact that the cabinet meets the National Safe Transit Assn.'s specifications, having survived transportation tests both with and without a shipping carton. **PDF**

