A "how-to" paper from Active Thermal Management

The trusted name in Thermal Management…

By Frank Federman, CEO

Cooling the "impossible" enclosure

The installer will, more often than he would like, run into a home theater installation in a cabinet that seems impossible to cool. You've probably run into it (or one very much like it) yourself…. It's built-in, of course, and can't be moved. It often backs up to an outside wall, so forget venting into little Johnny's bedroom closet… The left side butts up against a fireplace, and the right side either (pick one) ends at a wall, continues into the next cabinet, or is considered untouchable by the wife. The top? No – either we can't get permission to use the top for ventilation, or it's made of granite…!

Closets can be difficult, too – they can be located at the intersection of two exterior walls, with the third wall blocked by a fireplace or cabinetry. This paper will refer to cooling cabinets, but the general principles described apply to closets as well. Details specific to closets will be italicized.

The cabinet was designed and built with no thought given to cooling the audio-video gear that was to be housed within it. You can be sure that the owner gave a lot of thought to that gear – you probably spent a LOT of time discussing it with him! The cabinet maker was told to "allow for ventilation", and said he would...

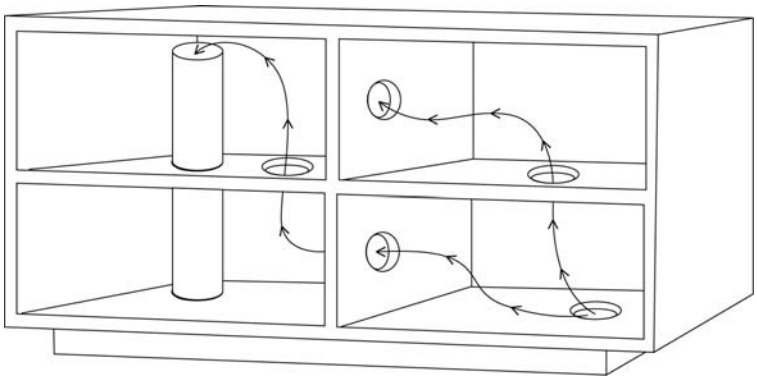
He didn't.

Now the ball is in your court, but it's more of a hot potato, with the emphasis on "hot". Mr. Satellite Receiver, or Mr. Cable Box, (both hi-def, of course) is going to run 24/7, and boy, do they throw off BTU's! Let's not forget Mr. TiVo, either! Add in the multi-channel receiver, DVD player, and Junior's video games and you have a bake-at-350-degrees-until-done recipe for trouble. Don't give up yet – there's probably a way out of this. The magic words are "basement" and "crawl space". (Readers in California and Florida may want to look these words up in their dictionaries, after which they can stop reading this paper.)

An accessible space below the cabinet, be it a full basement or just a crawl space, can be just the place to dump that overheated air. If the air quality in the space is acceptable, it can also be a source of "make up" cool air. (Remember – for every cubic foot of hot air we move out of the cabinet, an equal volume of fresh air must enter.) There's a bit of work to be done, but it isn't difficult, especially if the basement is unfinished or the crawl space has enough headroom to allow you to work comfortably.

The plan is to pull the heated air out of the cabinet and exhaust it into the lower level, the term we'll use for the rest of this paper, because "basement or crawl space" is too long! Make up air is supplied either by air from the lower level or the room in which the cabinet is located. Let's start by assuming that the air in the lower level is free of odors, dust, dampness, and bugs – it's good enough to bring into the cabinet and living space; this leads us to "Plan A", and yes, there is a Plan B…

Following Plan A, we get ourselves down to the neighborhood home improvement store, orange or otherwise. We buy a 5' length of 3" PVC or ABS tubing and a hole saw that's just a little larger in diameter than the tubing. You'll need a bit extension for your 3/8" (or larger) drill, because you're going to be making a hole in the floor of the cabinet near one of the rear corners and down through the floor itself so that you can create a "snorkel" running from just an inch or so below the top of the cabinet down into the lower level where it can be attached to the intake (suction) side of an Active Thermal Management Cool-cube®, ordered with 4" flex tubing. *If we're cooling a large, or walk-in closet, the Cool-cube may not have the power needed. The System 1, a similar but more powerful product, may be required.* The general layout is illustrated above. If there are any shelves or vertical dividers in the cabinet, you'll have to make generous (two 3" minimum or one 4") holes in these as well, to ensure free air movement. The Cool-cube is going to pull the hot air down from the cabinet's interior and exhaust it into the lower level. Plumbers' tape, actually a perforated metal or plastic strap, can be used to support the bottom end of the tubing; fasten it to the closest floor joist or the underside of the subflooring.

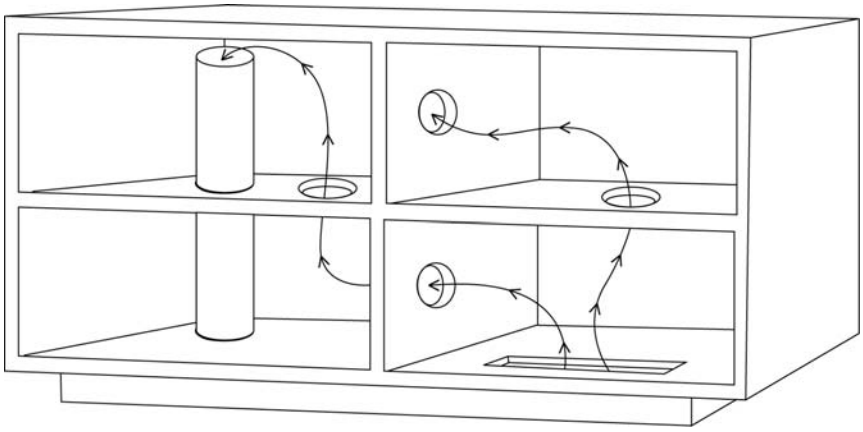


An easy way to mount the Cool-cube fan unit is to fasten a 16" length of 1x8 shelving between the bottom edges of 2 adjacent floor joists, creating a small shelf. Place the Cool-cube on the shelf, and run a short length of the 4" tubing from the intake (suction) port to the bottom of the vertical tubing. The fit won't be exact; use duct tape and a large adjustable worm-gear hose clamp to make the connection. No connection is made to the exhaust port of the Cool-cube.

A second hole is made from the lower level up into the cabinet near the front corner diagonally opposite the exhaust tubing hole. Here, the tubing is cut just long enough so that it's flush with the cabinet floor and extends down into the lower level an inch or so. This opening allows cool air to flow up into the cabinet, replacing the hot air we've taken out. No connection is made to this section of tubing; it's just a passive connection between the lower level and the interior of the cabinet.

There will be situations in which the quality of the air in the lower level is not good enough to bring up into the living area. (Even if this is true for only part of the year - “the rainy season”.) Time for…….. Plan B! Plan B uses the same snorkel arrangement as Plan A to exhaust the hot air into the lower level, although it may be desirable in some cases to use an ATM backdraft damper, or one-way valve, to keep air from “backing up” into the cabinet and out into the living space when the fans aren’t running.

In Plan B however, we create an intake opening in the cabinet to allow room air, rather than lower level air, to enter. The best location for such an opening is in the front, as low as possible, and on the side opposite the vertical exhaust tube (“snorkel”). This will create a cooling air flow in three dimensions; left to right, front to back, and bottom to top. If the cabinet has a recessed base (similar to a kitchen cabinet), one way to provide an intake that’s invisible when the cabinet doors are closed is shown here; note that the slot is cut into the cabinet floor forward of the base, just behind the doors. So that it is always open, but hidden from view when the doors are closed



If the cabinet does not have a recessed base, we have to use our imagination. It’s possible, if one side of the cabinet ends at an interior wall, to create an intake opening by going through the wall. With luck, the other side of the wall is in a utility room, laundry, or a spare bedroom, and you can finish the opening with a wood grille (available from Active Thermal Management in different sizes and species of wood) which can be painted to match the wall.

The same approach can be used if the back of the cabinet is on an interior wall, although this will result in less back-to-front air movement. If one side of the cabinet is visible, and the owners don’t want it used for ventilation, it’s time for a frank discussion of the consequences of not providing ventilation. The thought of replacing equipment every few months may have a chilling (pun intended) effect….!

A skilled woodworker could rout and finish the edges of several 3/8” wide slots near the lower front corner of the side, to integrate ventilation through what would appear to be an element of the cabinet’s design. (If it’s done by the original maker of the cabinet, it might convince him to take ventilation requests more seriously next time!)

Air inlets for closets can be easier. A ¾" gap under the door works well, and usually does not cause an esthetics problem. Beware of closets with fully louvered doors; air may enter through the top louvers, go directly to the exhaust tube, and exit, without cooling the equipment. We recommend covering the top 2/3rds of such a door to ensure that air enters at the lowest level, cooling the equipment as it flows to the top. The covering can be fabric, as there will be no air pressure forcing air through the fabric; the air will enter through the bottom 1/3rd.

Cooling closets large and small in homes without lower levels is covered in a white paper titled "Cooling Large Home Theater Systems". This paper and several others covering a wide range of cooling problems can be downloaded from the Technical info page at www.activethermal.com.

A word about fabric-covered openings – no air will enter through them, and you wouldn't want it to! Quiet fans do not generate powerful air currents, and the lightest-weight fabrics block airflow almost completely. If a sufficiently powerful fan system were used, it would be very loud and the fabric would act as a filter; in a short period of time, the weave would fill with dust, the fabric would discolor and stretch out of shape. There are ways to filter the air going into an enclosure (and Active Thermal Management can supply them), but moving air through cloth-covered openings is not practical.

We have our exhaust, and, one way or another, our intake established; let's finish the job. If there's an AC outlet near the Cool-cube, use it; if not, plug the wall-type power supply into an outlet inside the cabinet and make a small hole for both the low-voltage DC power cord and the thermal switch assembly to run from the interior of the cabinet to the Cool-cube fan unit. Alternately, by slitting the flexible tubing in the lower level, both the DC power cord and the thermal switch assembly can be run through the vertical tubing.

More detailed instructions for Cool-cube and System 1 installations are included with each unit, and can be downloaded from the Technical info page at www.activethermal.com.