This isn't a statement this thing is perfect or even good. It's just what I did and why. Your input is invited :-).

The Rando Taz4 enclosure

Features:

Sturdy steel-jointed 2x2 pressure-treated wooden frame

Large volume to completely enclose printer with ease

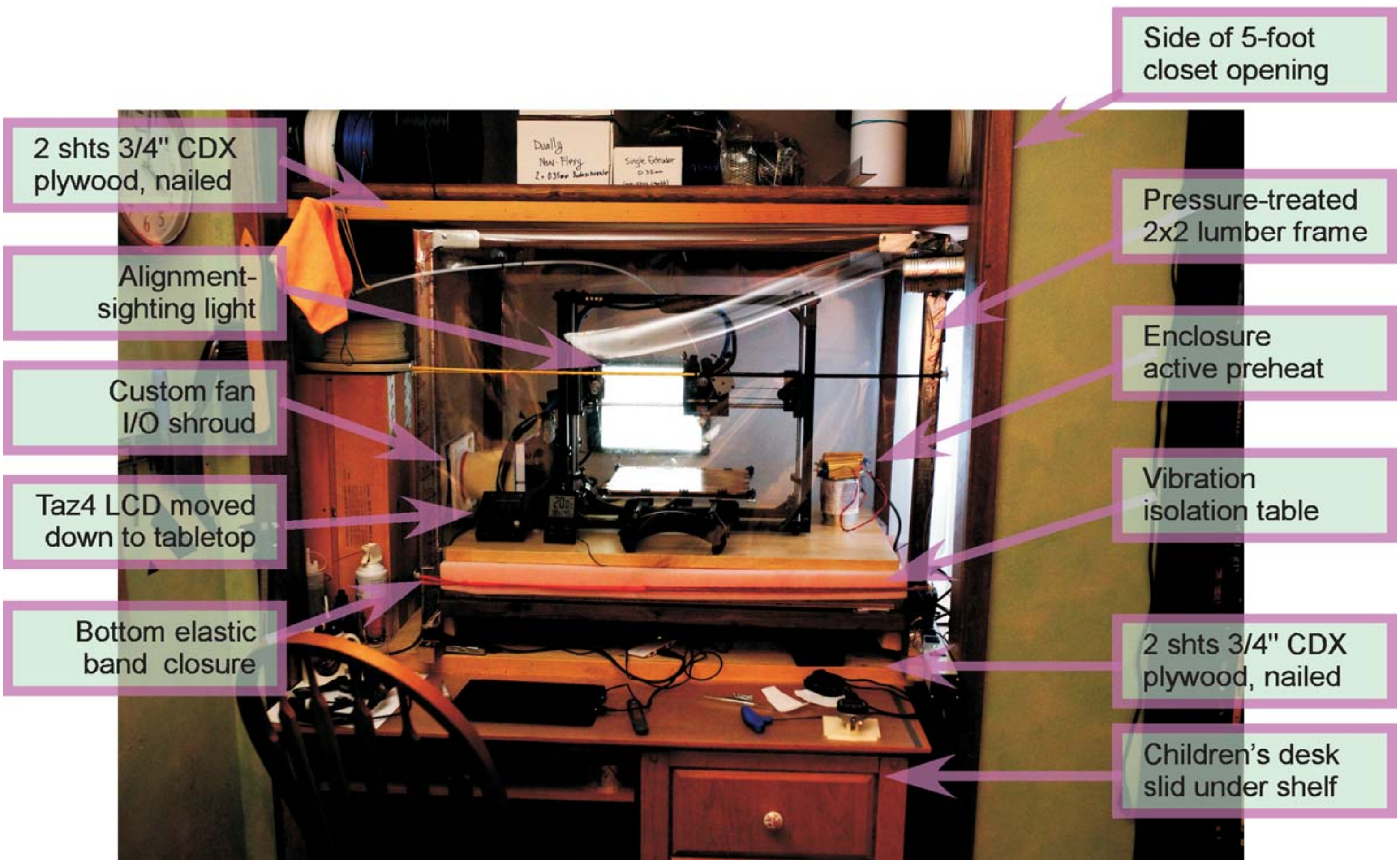
Clear vinyl sheeting provides excellent visibility and heat retention

Isolated air systems between electronics box and the build chamber, without requiring moving the box or lengthening the cables. Greatly reduces stress on electronics, and helps avoid thermal runaway.

Vibration isolation table to reduce the sound output of the printer, as well as reduce perimeter distortions arising from undamped flexing stress on the printer frame arising from normal head acceleration.

150W Active pre-heating for enclosure

Internal top-and-bottom temperature monitoring



WARNING: As depicted here, this enclosure does not provide adequate venting of ABS fumes. For your safety and that of others, always use only with adequate ventilation.

The Rando Taz4 enclosure frame

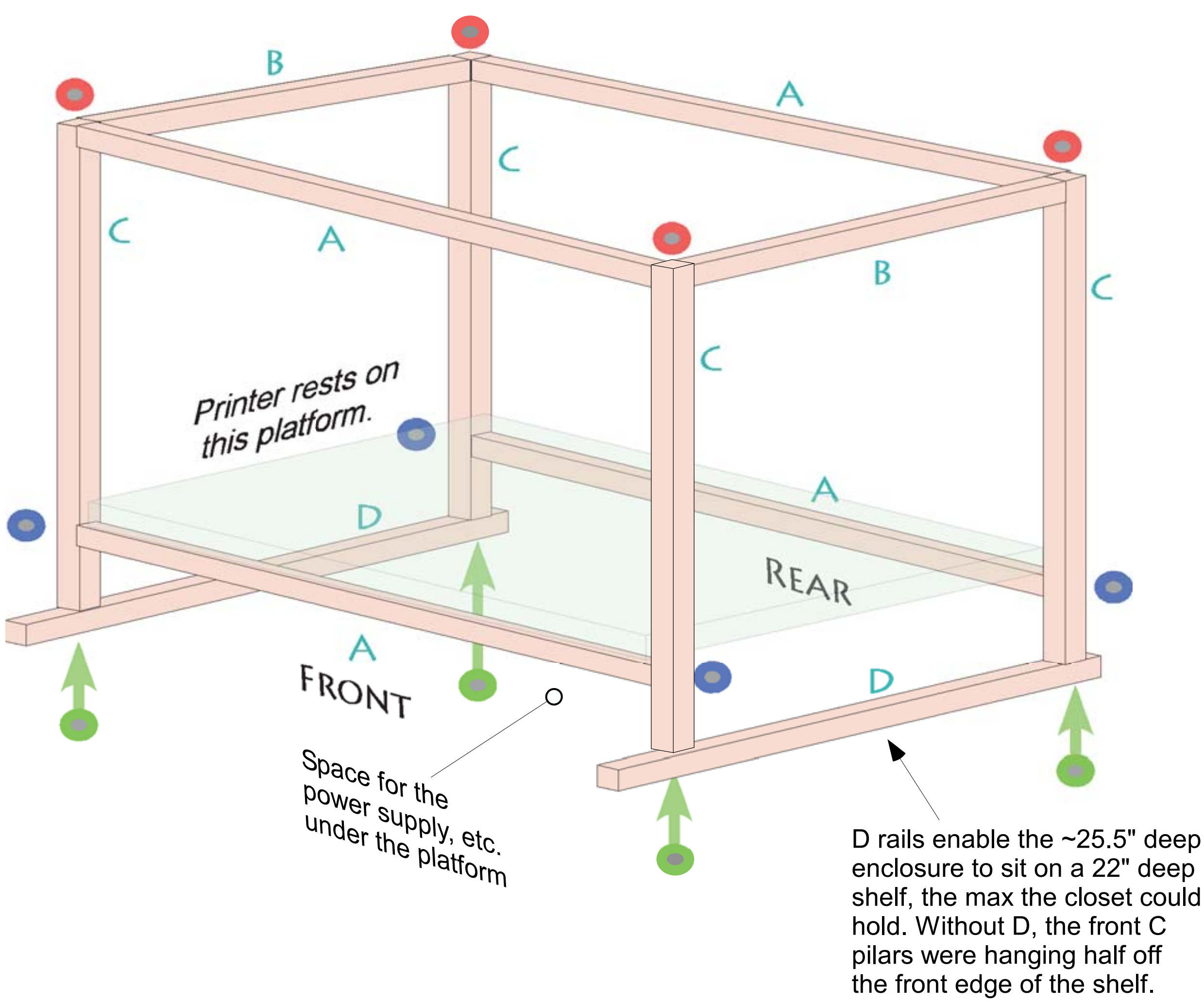
Featuring:

- Sturdy steel-jointed 2x2 pressure-treated wooden frame
- Large volume: 35.5w x 22d x 23h = 8.9 cu. ft (902x559x584mm=295l)
- Table that the printer rests on is completely enclosed
- Foam rubber draft prevention around table
- Simple external filament routing

Parts for the frame:

4 x Simpson Strong-Tie RTC22Z (3-axis) or similar
4 x Simpson Strong-Tie RTA2Z (2-axis) or similar
~80 x 1-1/2" deck screws to attach ties
4 x 4-5" deck screws to attch D rails to C pilars
A 4 x pressure-treated 2x2, 36.5" (927 mm)
B 2 x pressure-treated 2x2, 21.0" (533 mm)
C 4 x pressure-treated 2x2, 30.5" (775 mm)
D 2 x pressure-treated 2x2 26.0" (660 mm)

Adjust parts lengths to fit your area.



The Rando Taz4 enclosure frame

Enclosure covering:

- Uses inexpensive 15-20 mil thick vinyl sheeting from a fabric store
- Covering offers excellent visibility and good clarity
- Covering is part of air-movement prevention

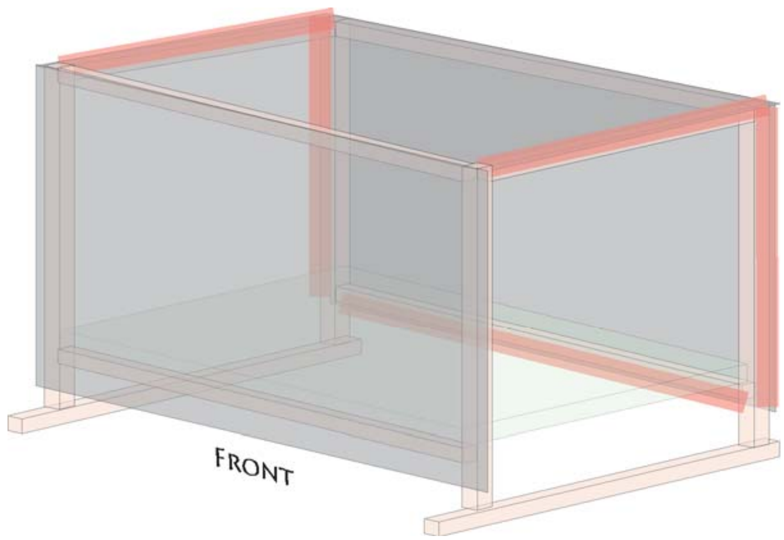
Parts for covering:

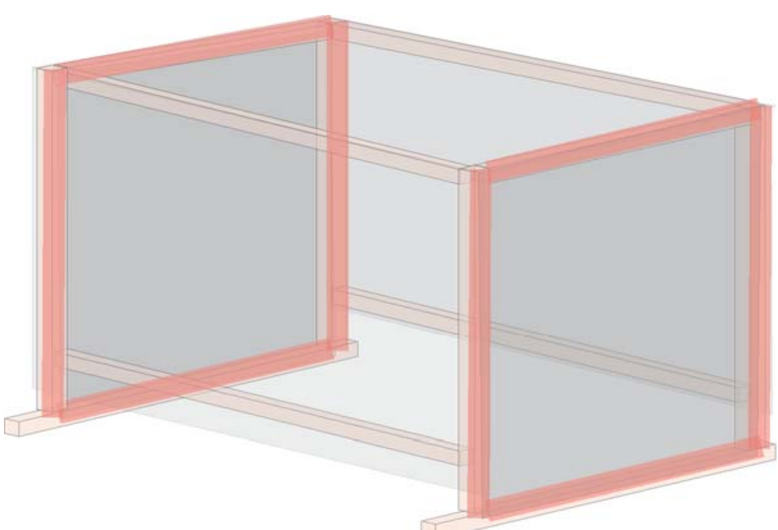
2.5 yds 15-20 mil vinyl sheeting, like from a fabric store
1 roll UL Listed, High-temperature duct tape, e.g., InterTape 698
Not the imitation gooey-adhesive MacGuyver stuff
Stapes, wide-crown 3/8 - 5/8", to hold vinyl to rails
Indoor/Outdoor wired remote thermometer with humidity (optional)

WARNING: As depicted here, this enclosure does not provide adequate venting of ABS fumes. Adequate room ventilation to remove them may be necessary for your safety.

Start from the rear bottom
Staple & seal vinyl to underside of bottom rear A-rail.
Staple & seal vinyl to vertical outside rear C-pilars
Staple & seal vinyl to top B-rails

To open the front, fold it over onto the top of the enclosure. This lets heat out, however.





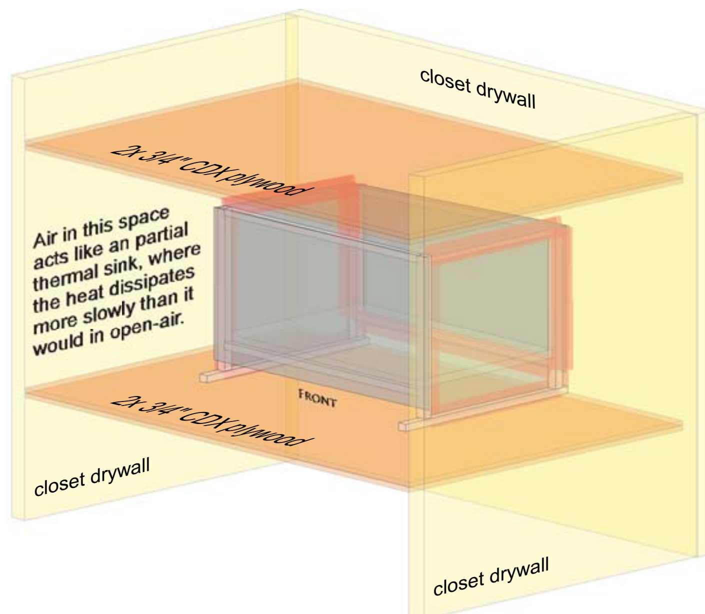
Staple & seal vinyl to outside of left panel
Staple & seal vinyl to outside of right panel

If you're going to put a light on the right-hand side, consider using light-diffusing sheet instead of the clear vinyl.

If you're going to add temperature probes to the enclosure inside, e.g. at the top, now is a good time to do that.

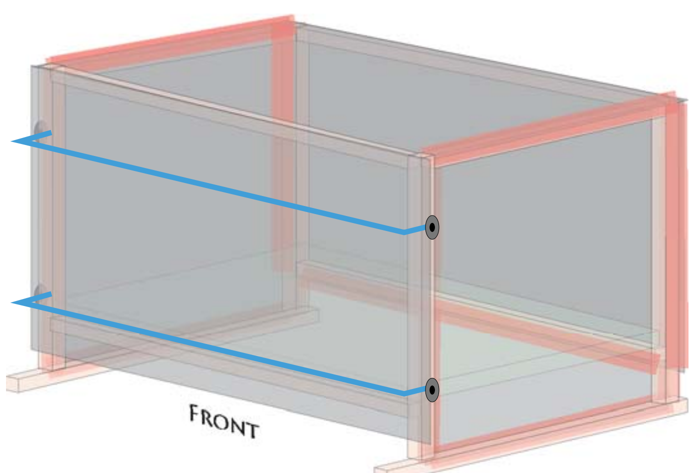
The Rando Taz4 enclosure heat situation

For an enclosure like this one, the thermal characteristics have to take into account the space around the printer. The combination of the vinyl sheeting and the foam-rubber sealing prevents external air movements, even ones caused pressure variations, like quickly opening or closing a door. However, that same vinyl sheeting is somewhat heat-conductive. So, achieving a stable temperature over long builds (without having to construct an active heat injection/extraction system) means understanding what happens to the heat that comes out. In my case, the closet walls and plywood shelving form a sort of five-sided wood-air-wood thermos bottle. Sort of. Schematically, it looks sorta like this:



Front cover closure

To more-positively prevent drafts from entering the enclosure, I added hardware on the side to accept long/chained rubber/elastic hair bands. Combined with an appropriately-notched length of 1" vinyl angle, a quite effective seal can be achieved. Each nub is just a wood screw, fender washer and nylon spacer. Luckily the whole thing is heavy enough that it doesn't seem to move when taking them on and off.

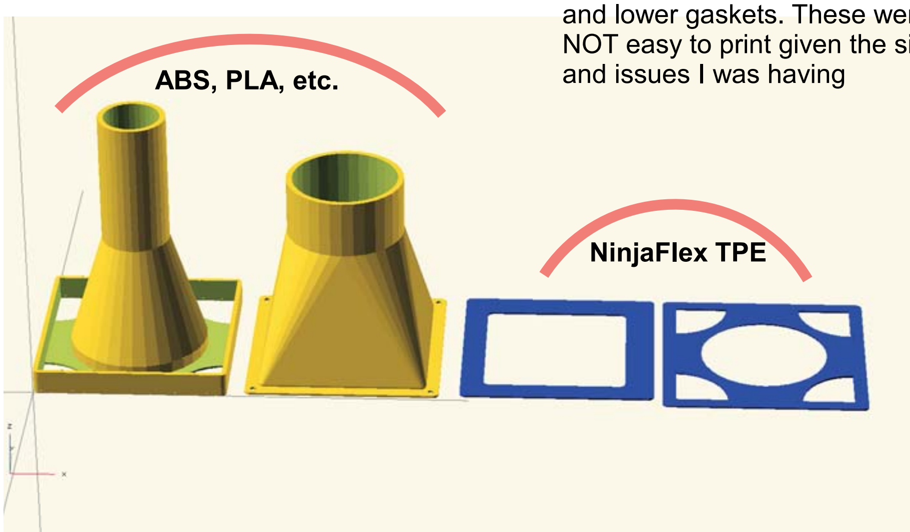


The Rando Taz4 enclosure electronics thermal isolation

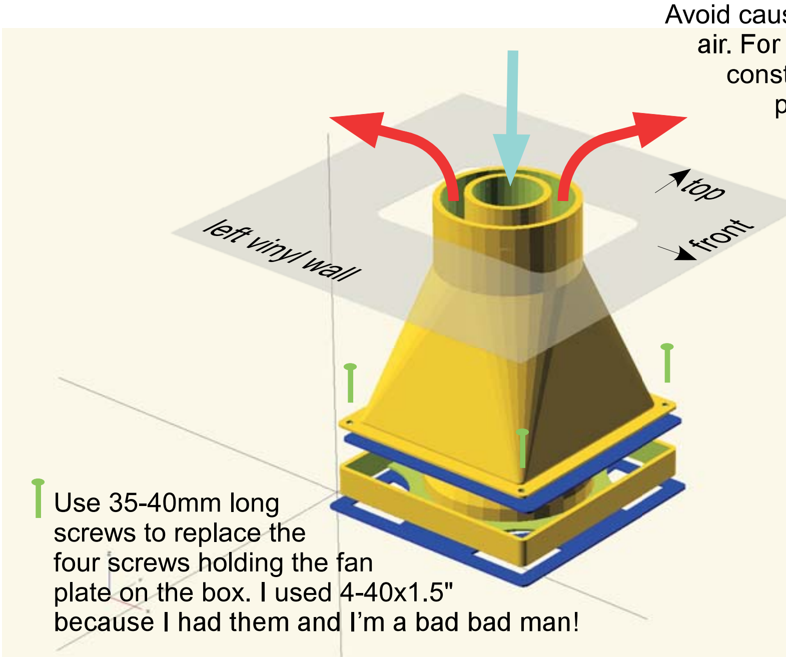
Features:

- Isolates controller electronics ventilation from hot enclosure
- Helps prevent drafts by venting both cool-air intake and hot-air exhaust outside of the heated enclosure
- Helps prevent thermal cutoff/overload of Z-axis drivers
- Helps stabilize enclosure temperatures by removing dynamic heat source
- Helps prevent drafts by venting exhaust outside enclosure
- **Set Z_LATE_ENABLE in configuration_adv.h if you have Z-driver thermal cutoff**
- I'll post the design files soon...I promise!

3D printed parts (L-R):
inlet shroud, outlet shroud, upper and lower gaskets. These were NOT easy to print given the size and issues I was having



Avoid causing the intake to recirculate the hot exhaust air. For example, don't vent both air streams into an constricted area. Thermal runaway is definitely possible. I placed a small black cloth-bladed fan (safe for fingers, bumps, etc.) in the back of the shelf that blows a light stream of cool air across the openings.



Use 35-40mm long screws to replace the four screws holding the fan plate on the box. I used 4-40x1.5" because I had them and I'm a bad bad man!

When cutting the hole in the side, if you're using a vibration isolation platform, the hole needs to be longer front-to-back so the shroud doesn't bind on the vinyl wall during printing. But don't make it so large that you can't effectively seal it. Also, don't cut the hole in the wall vinyl until you've attached the shrouds to the electronics enclosure, and put the printer in its final position on the platform, so your first cut is the right cut.

The Rando Taz4 enclosure electronics thermal isolation details

Thermally isolating the electronics box from the rest of the build enclosure was one solution to:

Allowing the electronics box to use the high-temp air inside the enclosure reduces its ability to effectively cool the electronics.

Without effective cooling, both the short- and long-term reliability is reduced.

Temperature rises with time when unattended, approaching 50C at 20h, so as print time goes up, ever-more expensive electronics-related build failures occur with increasing probability.

The cables from the various effectors would require extensions or replacement to move th electronics box outside, and would require extensive changes to the Taz4 printer.

Moving the printer left so the fan side is next to a hole would cause air leakage into the build enclosure, drafts,

and unbalance the printer on the vibration isolation table.

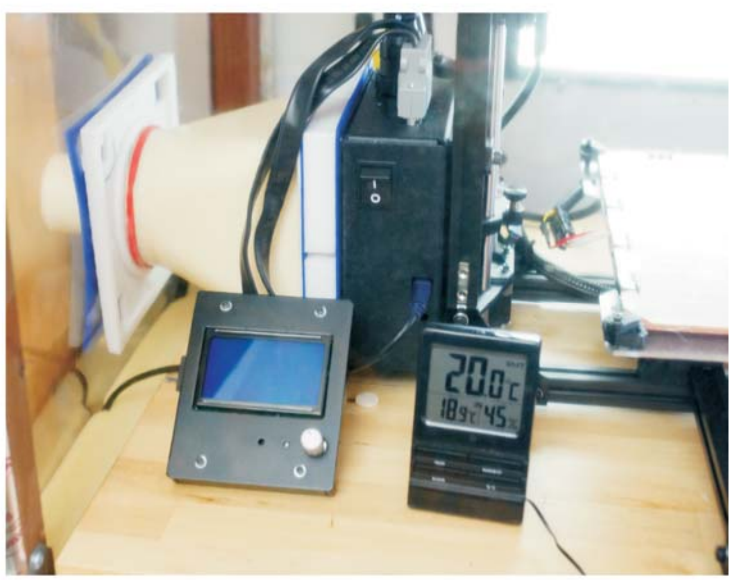
Permanent and complex modification of the stock Taz4, in any way, significantly reduces the manufacturing facility's scalability and maintainability.

When the electronics heat goes into the build enclosure, different sections of a print that require more movement generate significantly more heat, and those changes measurably affect the build enclosure temperature. That combined with the larger amount of hot filament cooling in the enclosure, generate a +/-2C change between long slow perimeters versus big, large heavy infill areas. The constantly-changing heat input will also significantly complicate any active temperature regulation scheme.

The fan inlet and exhuast are both on the same side of the box, and are configured in a way that would allow a coaxial / concentric extension of the electronics air cooling circuit.

Adding water cooling is more complex than I wanted, potentially an issue with leaks, but mostly would require permanent and complex modifications to the printer.

So, you're seeing that I really want to minimize the changes to the printer. Primarily because while one unit might be okay to modify significantly, if I need to scale out to 5 or 10 or more printers over time, that's just not a tenable solution.



Here you can see the seal on the left wall.

During the design and early build attempts, I collected a few failed base and gasket prints, and used those on each side of the wall. White HIPS baseplate inside, blue NinjaFlex base gasket outside. They're held in place by rubber bands (red), to loosely seal the outlet shroud into the enclosure wall. The base plate and gasket are large enough that there's no opening in the wall at any of the movement limits for the vibration isolation platform or the hole in the wall.

During normal operation (with the shroud in place) and printing ABS, this particular instance of this enclosure (I suspect they will each be different) stabilizes at about 45C at the top, and 35C down near the table. I figured maybe the LCD would prefer the lower temps instead of the higher ones, so I disconnected it, relocating it to the somewhat-cooler table top. Again: keeping Taz4 modifications to a minimum was a primary goal, so I opted to not create an extension cable, no matter how easy.

It's important that the vibration isolation platform be able to move freely, and not bind on the ventilation shroud. The wall has enough natural give to manage the flex left-to-right (X-axis). Front-to-back (Y-axis) is handled by the elongated hole in the wall. The Z-axis movement amounts to a rocking motion during some rhythmic areas such as infill, and is handled by the flex of the vinyl wall.

The Rando Taz4 enclosure ventilation isolation attachment

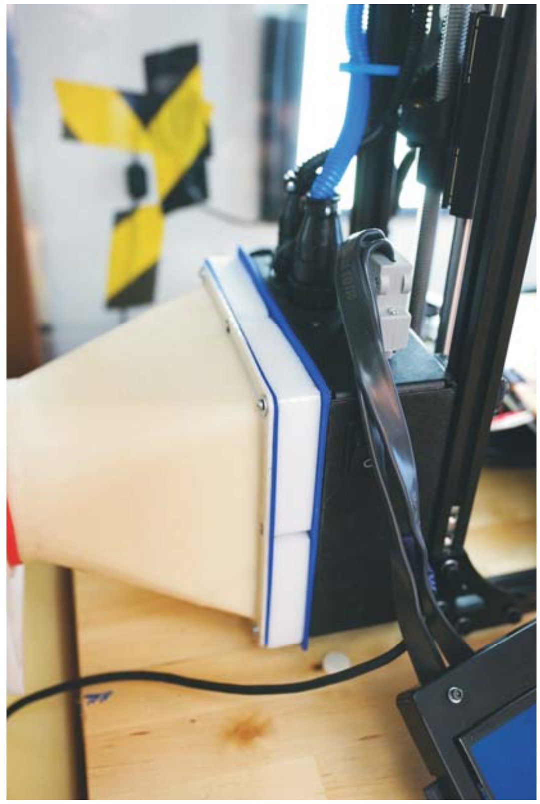
Here's the assembled stack, on the outboard side of the Taz4 electronics enclosure.

The two blue NinjaFlex gaskets can be seen here, with the bottom gasket (5 smaller holes) at the right, on the electronics box. The upper gasket, with the one large hole, is between the base and the outlet shroud.

Current design requires cutting the screw clearance holes in the upper gasket with a hole punch, because of my issues with printing small structures in the NinjaFlex. In the end I'd resolved them, but I already had a good-enough part so didn't update the design.

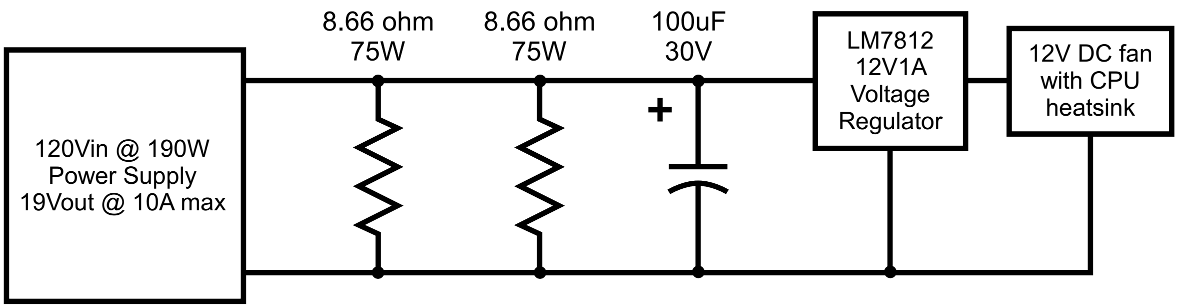
Although this version has eight screw-holes, I only used the corner holes, which corresponded to the existing panel screw holes...mostly.

BTW...did I mention I'd been having print issues? Yes, that's HIPS at the base, and ABS outboard. Don't ask. ;-)



The Rando Taz4 enclosure preheater

To help the enclosure get up to temperature a little faster, I used a cast-off 180W power supply, hooked up two 8.66 ohm, 75W resistors in parallel, added an old CPU heatsink, powering the fan via a simple regulator. It's primary benefit during the print is that it can actually invert the temps top-to-bottom, though I have not seen that help in any way.



The Rando Taz4 enclosure vibration isolation platform

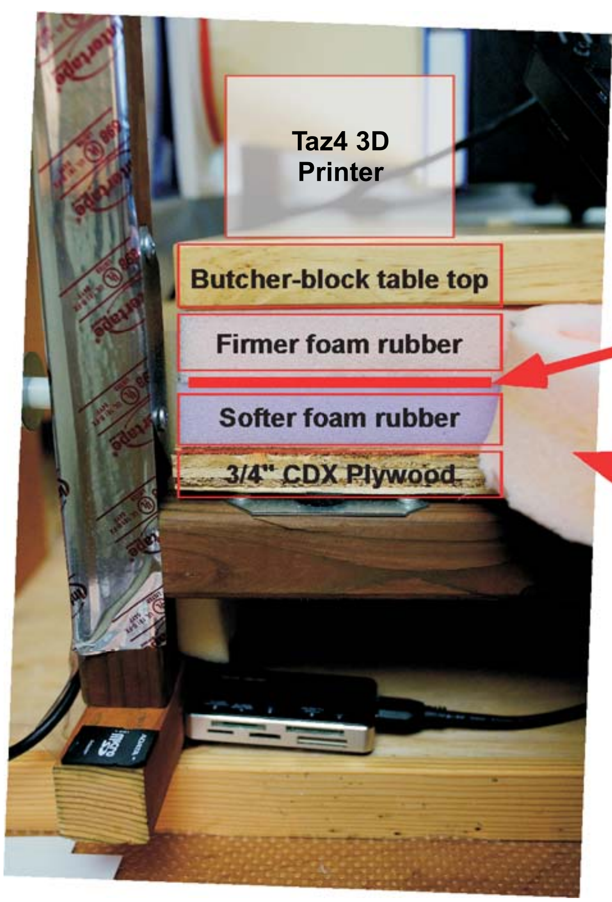
Features:

- Very high absorption and damping of up to 1/2" horizontal-displacement .
- Prevent sounds and vibration from entering the desk and/or walls
- Improve sharp-corner printing by damping frame twist/bend
- Prevent in-house vibrations from affecting print

Parts (listed top to bottom):

1 sheet butcher-block tabletop, 1" thick, 35 x 22" (889 x 559 mm)
1 sheet firmer-supportive closed-cell urethane foam rubber, 35 x 22" (889 x 559 mm)
1 sheet 18ga galvanized steel (or aluminum), 34 x 21" (867 x 533 mm)
1 sheet rubbery-spongy-soft closed-cell foam rubber, 35 x 22" (889 x 559 mm)
1 sheet 3/4" CDX (exterior house plywood), 35 x 22" (889 x 559 mm)

In addition, around the edges, on top of the D-rails, and at the very back
2 pcs 1 x 2 x 22" foam rubber to fill gaps side gaps, positioned on top of D-rails
2 pcs 1 x 2 x 35.5" foam rubber to fill gap at back of platform, and on front for easier enclosure sealing



Rando’s Taz4 enclosure vibration domain without isolation table

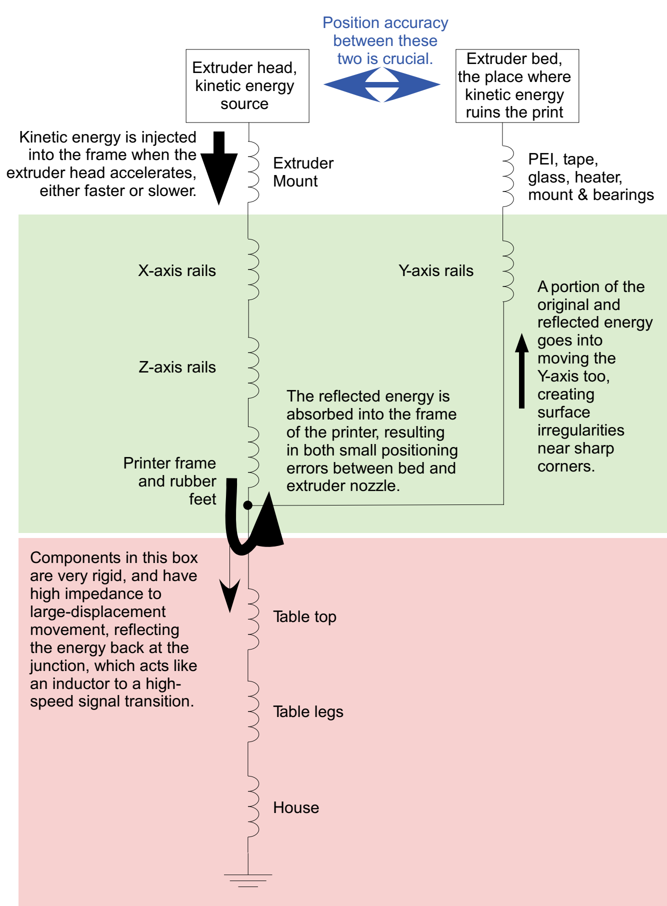
The next two diagrams schematically show how (I envision...) the vibration isolation platform working.

By thinking of the kinetic energy in the moving extrusion head and bed-plate as two sources of electrical potential. The response of the mechanical elements to kinetic energy is like an inductor: it resists changes in the current through it, with a delay akin to stiffness or compliance. We can consider the presence of some types of surface irregularities as a proxy for 3D positioning errors between the extruder, bed and the previous layer.

These include the “ripples” that look like electrical signal overshoot-and-ringing, or just damped oscillations, that appear just after an abrupt stop in the other axis. Sharp and right angles are place it appears most, but lesser angles show it sometimes as well.

After watching my prints show this, especially in black ABS, I realized what was going on, and the vibration-isolation table idea was begat! Hope you find it useful.

Without vibration-isolation table



With vibration-isolation table