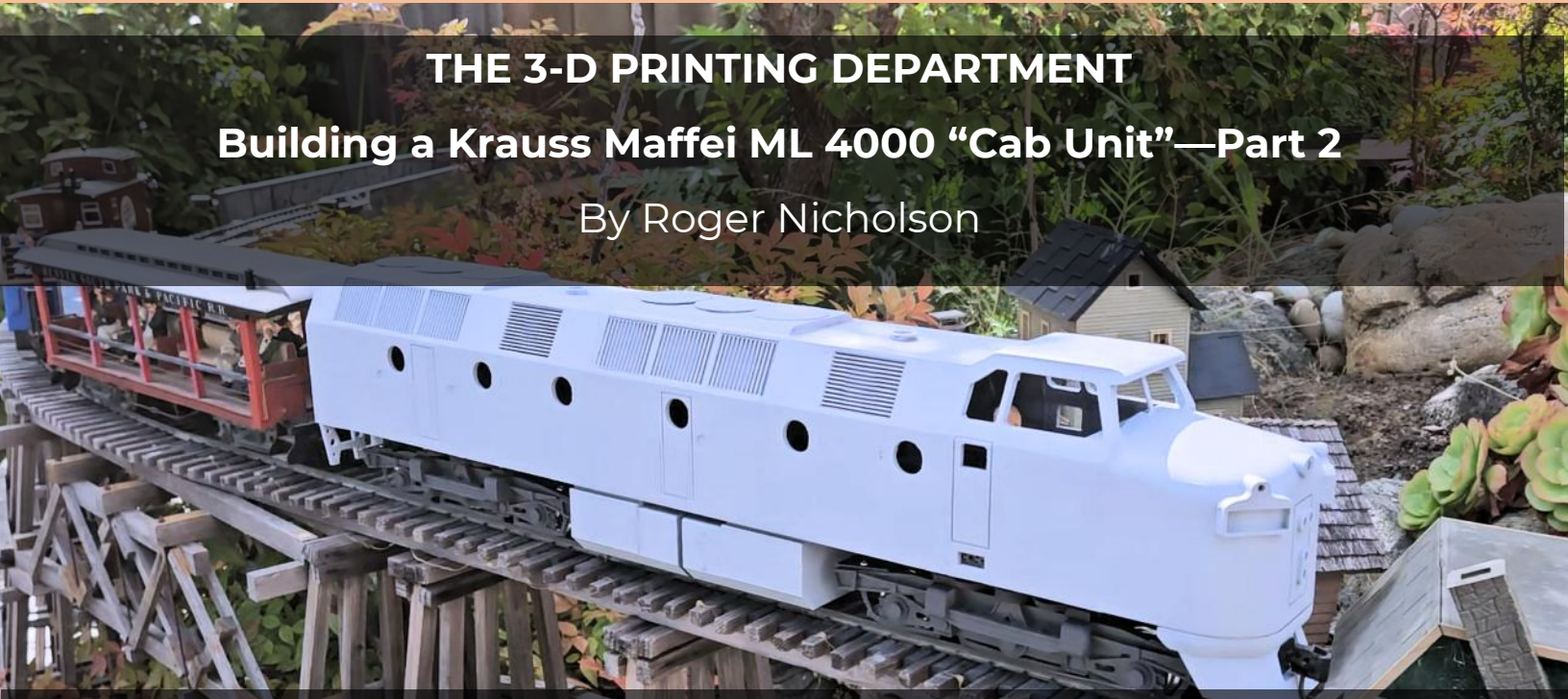
# THE 3-D PRINTING DEPARTMENT

## Building a Krauss Maffei ML 4000 “Cab Unit”—Part 2

By Roger Nicholson

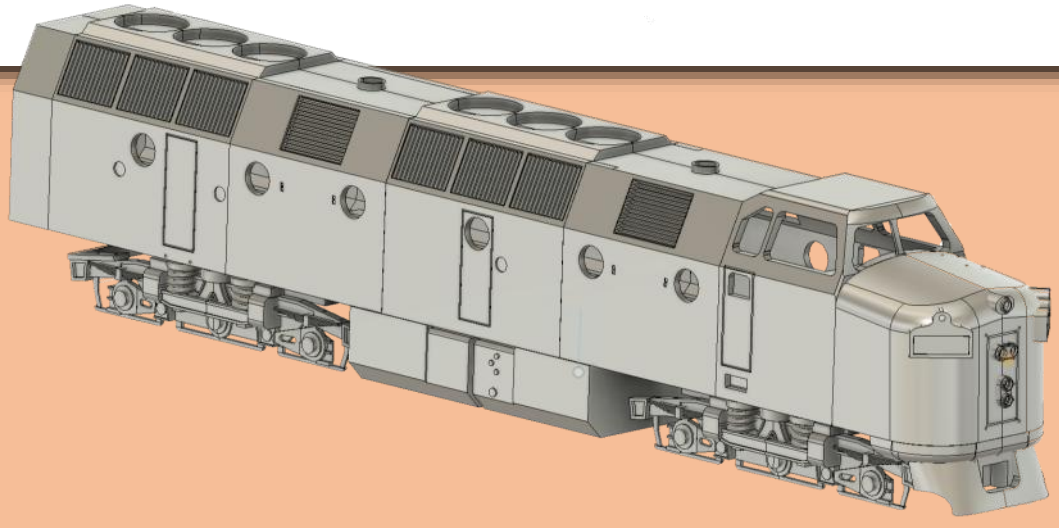


**REPRINT**

**In Part 1, I described the design process in which I built a working set of power trucks and a 3-D printed base for the Krauss Maffei ML 4000.** This installment will illustrate how to build the locomotive body.

I created the 3-D design for the KM using photographs and diagrams that I found online. Of course, working off photos and diagrams does require some amount of “interpolation” to create certain features that may not be illustrated clearly.

Due to the limitations of my own 3-D printers, it was necessary to separate the body into sections printed one at a time. I separated the body into 7. Each section, with the exception of the tail, took between 25 and 30 hours to print using ASA filament.

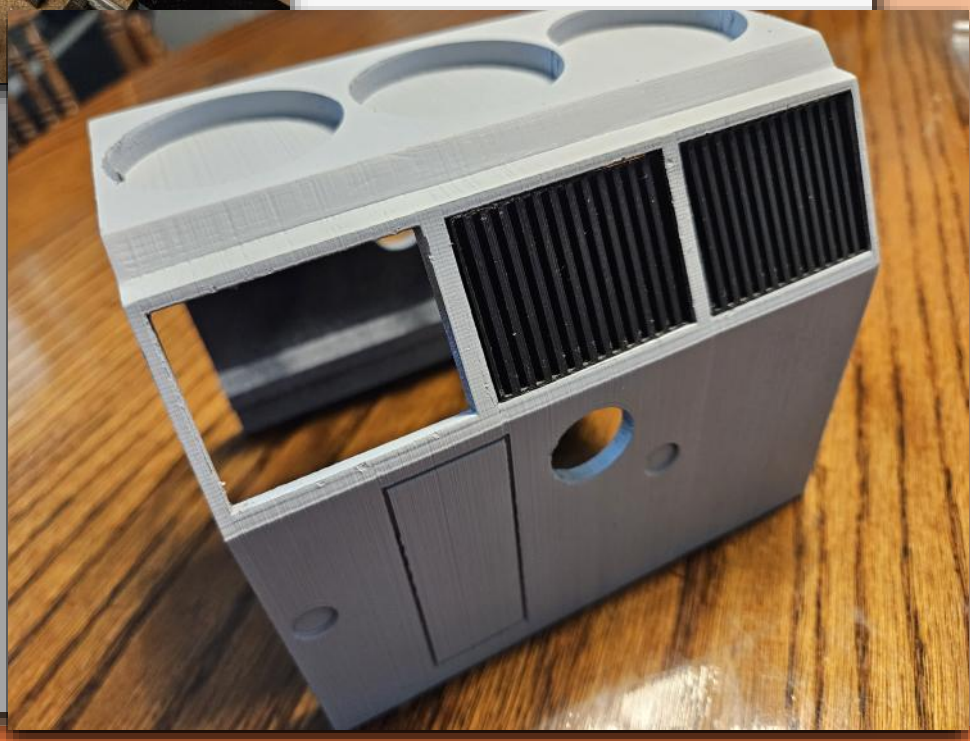


As I mentioned in Part 1, it was necessary to trim about a quarter of an inch off the edges of my base in order to allow the body panels to overlap. You can see the cut edges in the photo to the right. This modification to the base has been incorporated into the design, so the next base that I build will have smooth edges.

I use grey automotive primer to paint the body panels. This will give the paint a good surface to adhere to when I reach that step.

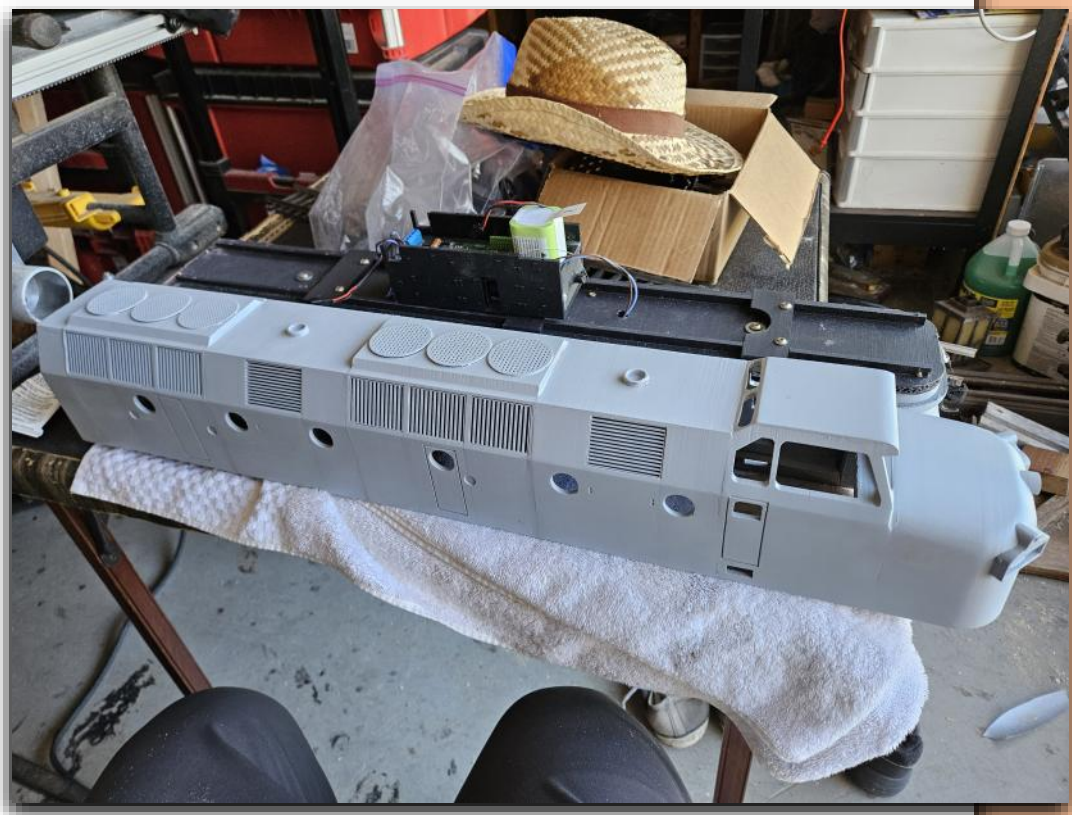
I continued to print each body section, working from the back to the front of the locomotive.

Although I could have incorporated the louver detail into the print of the body sections, I chose to print them separately and then glue them in. This allowed me to print the louvers flat on the printer bed and preserve clean openings between the “blades.” Printing them vertically as part of the body section would have resulted in a lot of unwanted support structure that I would have had to then remove manually.



The cab took about 30 hours to print. I realized later that I needed to redesign the overhang over the windshield, which is supposed to be rounded off. I eventually rounded it using a file and auto body filler on my prototype, but the rounded overhang is now part of the design and the next one printed will be correct.

The nose was the last body section to be printed. The nose was more challenging to design because of all of the different complex curves. I went through three different iterations of the nose design before I got one that I liked and finally decided to print.

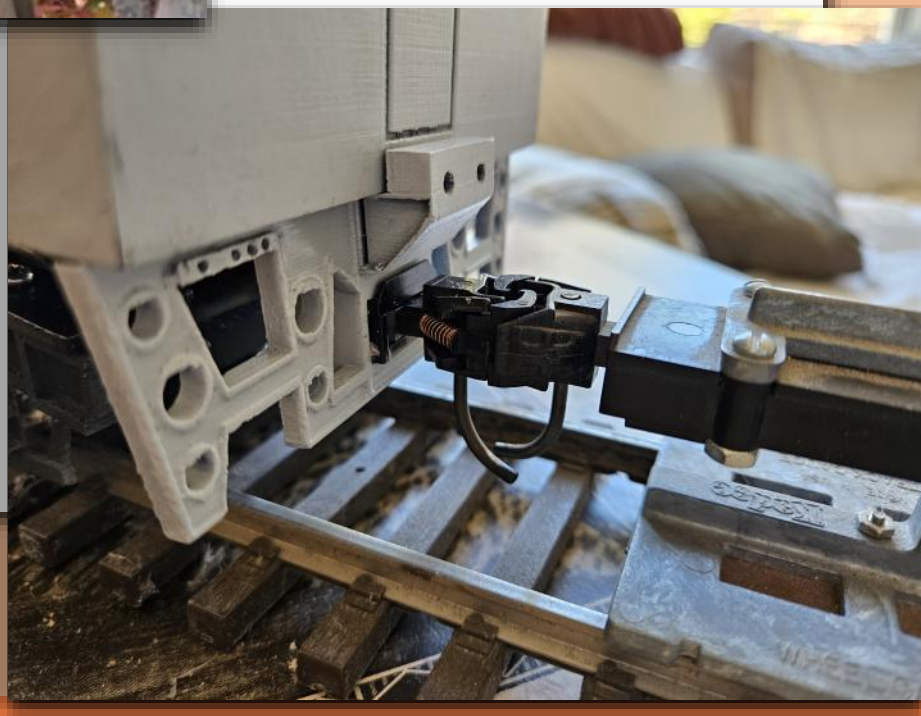


I connected the sections of the body together by drilling four guide holes in each face. I then clipped the ends off stainless steel brads and inserted them as pins. The purpose of the brads is to guide each of the sections together and prevent lateral shifting of the body sections relative to one another. I connected the body sections together using a two-part epoxy. I also reinforced the inner edges between body panel joints by gluing in reinforcing blocks of 3-D printed scrap plastic. The reinforcing blocks will be incorporated into the final design.

The fuel tank provides some structural rigidity to the base to keep it from flexing. I decided to make the fuel tank hollow in order to provide the option to add weight to it. After running some tests on the track, I decided to add one pound of lead weight to the bottom of the fuel tank.

I found that I needed to make changes to the design of the pilot to allow the front truck to rotate fully on my curves. After manually trimming the pilot and verifying that it now cleared the front truck, I also design a Kadee coupler mount and integrated the Kadee mount into the pilot design. After printing a new pilot, I had a working pilot and Kadee coupler unit.

The rear coupler was a bit more challenging. I studied the *very* few photos that I could find of the rear of the KM, and designed a support structure for the rear Kadee coupler. After three print and design iterations, I was able to produce a coupler mount that worked.



Now that I had a complete body and fuel tank, along with a working set of couplers, I decided that it was time for a “road test.” I added a temporary AirWire receiver and Li-ion battery pack and ran the locomotive in order to check mechanical function and clearances. I hooked up my “tourist train” and set off around the layout to spot any problems. I was pleased to see that the locomotive negotiated every single curve and turnout on my layout without any problems.

So far, so good! In the next installment, I get tired of the grey, so we add details, install RailPro, and do some painting! ■