National Radio Astronomy Observatory
VLBA Antenna Memo Series – No. 105

David Paul

TRIP REPORT – FORT DAVIS, April 19-24, 2023
RAIL SECTION REPLACEMENT

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1. Trip Summary

A group from the VLA traveled to the Fort Davis, TX VLBA station (FD) to replace a 60 degree section of azimuth rail (bolts 1-20). Piece of rail removed had a low spot where it had been welded up originally.

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Sean Tracy
Lorenzo Benavidez
Scottin Platero
Rob Simpson

Along with the VLA staff, there were the FD VLBA site techs on site to help.

Juan De Guia
Julian Wheat

Figure 1: The Fort Davis VLBA station antenna.

2. Plan Summary

Shoot existing rail elevations, remove bad section of rail, remove grout under rail and support plates, cut, fit and install new rail section, set elevations and re-grout with epoxy grout. Re-shoot rail elevations after grout is set.

3. Trip Details

Tuesday, April 18, 2023

Several vehicles were driven from Socorro, NM to Ft Davis, TX site:

- Semi truck and flat trailer hauling: new rail, grout, compressor and job box.
- Manitex boom truck hauling: job box, band saw and skid steer bucket.
- Pickup hauling: skid steer jack hammer, rail drill and misc.
- Pickup with car trailer hauling: skid steer with cement mixer, empty 55 gallon drums and misc.

<u>Wednesday-Monday, April 19-24, 2023</u>

Unloaded trucks and started shooting existing rail elevations. Measurements were taken with the Hamar laser on the idler wheel and on the rail. Several issues were found using the Hamar system. All of the existing instrument mounts are setup for the Wilde and are too tall for the Hamar. (see Figure 2) Measurement readings jump around a lot due to distance and bright sunlight. Even when using the prism filter on the reader. The on-rail target doesn't remain still during windy conditions and the magnetic base doesn't set flat on the warn rail (rail isn't perfectly flat). New rail was unloaded and one end cut for the angled splice interface. The rail elevations were re-shot with the Wilde due to Hamar issues detailed above.

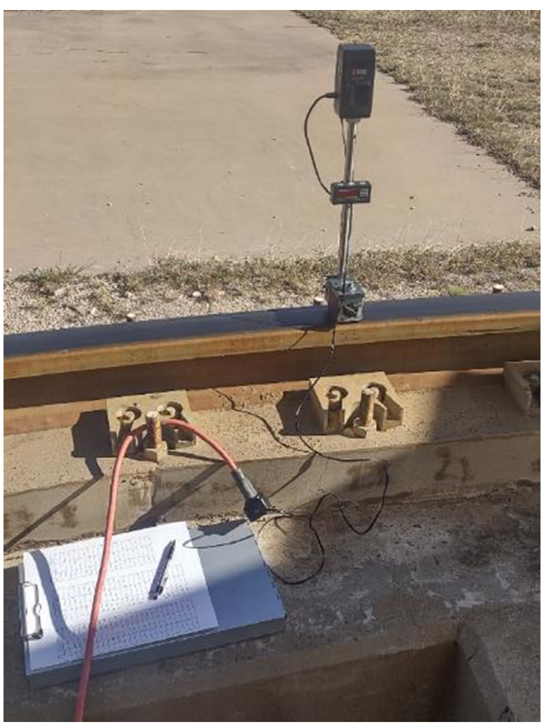

Figure 2: Hamar Height Setup

Cutting the rail with a carbide bandsaw blade and coolant takes about 1.5+ hours. The time required depends on the hardness of the rail in the cut location. We setup the saw and support stands on the site's concrete pad to have a solid planar surface to work. (see Figure 3) It does take some additional time due to moving, setting up and taking down the boom truck for each rail lift.

Figure 3: Saw cutting on concrete slab

The band saw electrical cord had a different connector put on it to allow for antenna power access.

The old rail section was used as a template to mark the new rail section cuts. After both ends were cut the new rail piece was fit and the splices pulled together. It was found, however, that the center of the section's radius wouldn't fit within the hold-down clamps by about 3/4 inch. The rail had to have about 3/16-1/4 inch cut off to fit properly. Some new rail crane lifting plates were made for this trip that clamp the rail more securely. The plates have a hole near the bottom for the attachment of tag lines while lifting. These holes are useful for attaching a shackle and lever type chain puller to pull the rail into place. (see Figure 4)

The old grout was removed using electric jack hammers and a hydraulic jack hammer on the skid steer. The grout has to be removed under the support plates so the nuts under the plates are accessible for adjusting the rail height.

Figure 4: Rail Lifting Plates and Lever Puller Attachment

While fitting the new section of rail a “gouge” was noticed in the cut face of the old rail. Upon further investigation it was found that the inner surface of the rail has a horizontal crack that tied into the crack on the cut face. We inspected all of the rail for these horizontal cracks on the inside and found that only the two sections of rail that were replaced in 2018 have these cracks present. It appears that when that batch of rail was manufactured there was a lamination or imperfection in the material. (see Figure 5 & 6) (See Isaiah Acevedo report for subsequent visit for more details)

Engineering created an inspection sheet for the site techs and has asked that they inspect the rail monthly for any crack growth and keep the forms locally. Engineering is to be informed if either crack growth or any other changes occur.

Figure 5: Delamination Cracks in Existing Rail

Figure 6: Delamination Crack Examples

Using the old rail elevation measurements, a new set of values were iteratively determined using the spreadsheet where the residual values are very close to zero. The new section of rail was clamped down and the splice bars were installed. With one technician on the outside and one on the inside the rail was moved to match the new elevation values. This is achieved by adjusting the nuts on the underside of the support plates. (see Figure 7)

Figure 7: Old Grout Removed and Support Plates Exposed

While fitting the new rail and tightening the clamps and splice bars it was discovered that the new piece of rail differed in height as compared to the replaced rail and the original rail. We spent several hours loosening the bolts on the clamps and splice bars then shimming under the "short" new rail with brass shim stock to make up for the difference in height. The difference is approximately 0.055 inch. (see Figure 8) When the splice bars were installed again the difference in height re-appeared due to the bars sandwiching on the taper of the rail flanges. Everything was tightened down and the mismatched height was blended using an angle grinder.

It should be noted that after the antenna was put back into service for a few days one of these splices (bolt 21) appears to have come loose and the height difference has reappeared. A follow-up visit is required to investigate and correct the problem.

Figure 8: Rail Height Difference

Grout forms were made of Masonite with triangular outside supports. The inside of the forms is lined with clear packing tape for easy release when the grout is setup. The for supports are Tapcon screwed to the concrete. Any gaps were filled with NeatStuff foam and/or caulking. Several hours set time were required before the grout could be poured. (see Figure 9)

Ambient temperature has to be watched closely as the cure time for the grout is very temperature depended. Our temperatures were low so we waited over 24 hrs before doing the final elevation measurements.

Figure 9: Pouring Epoxy Grout and Grout Forms

The eCHEM EP-15 grout has very specific instructions on mixing equipment and mixing time. These were followed but there are some areas for improvement. Not a cement mixer but a stucco mixer is specified by eCHEM to reduce the amount of air entrainment in the mix. Our cold temperature (~40F) could likely have exacerbated the air problem. It was noted by the crew that the grout usually flows a lot more easily than we saw during our pour which was attributed to the low temperature. After pouring and some time passed it was observed that air was working its way out of the grout. (see Figure 10)

Figure 10: Cure Grout and Air Entrainment

4. Trip Conclusion

The job went pretty smoothly and was completed a couple days early. The problems encountered during the work are noted above. Engineering is going to work on improvements for some of the measuring equipment. The existing grout was is good condition and the splices were tight with only a 3 degree radial low spot where it had been welded originally, and there was no cracking in the welded area, we probably could have welded up this spot again. Better matching of the weld filler to the rail hardness and proper preheating and welding procedures could have provided a good repair. This is based on hindsight and learning more about the rail conditions at different VLBA sites.