

Inspection report 110

VLBA antenna Mauna Kea Dec 2025

Objective

Perform a top to bottom inspection of the antenna, preparatory to a potential tiger team visit to replace bearings in the AZ wheels and gearbox rebuilds.



The Mauna Kea (MK) antenna sits at around 12,500 ft MSL on the flanks of the Mauna Kea volcano, and above a significant percentage of atmospheric water content. Since lower

water vapor improves radiolucency, the MK site is considered the premium site for high frequency data in the whole array c.f. the Saint Croix site, essentially at sea level.

Personnel

Simeon Johnson, Site Technician

Steve Taylor, NRAO-VLA visiting engineer.

Overview of results.

The MK antenna meets VLBA antenna requirements. The site, the buildings and the antenna are free of debris. Tools and materials are stored in assigned, labeled locations, and are in good working order.

The purpose of the visit was to perform a structural inspection of the antenna, with a focus on the bearings, AZ box, and the motors. As part of the inspection, grease samples from all Az bearings were evaluated, but the evaluation process was still in development, while the site was examined.

Two samples were sent over in mid-January and evaluated. No large metal flakes were found in any samples, but several had liberal quantities of sand in the grease. Some samples had particles ~1..2mm in length and 1 mm in diameter, but in every case these were found to be friable and likely some kind of mud.

Other notes of significance:

1. Loss of ~20 PSI of helium every two weeks.
2. Bull gear needs urgent lubrication.
3. AZ2 gearbox is needs a new input shaft seal. This is a standard overhaul item
4. Oil flow on the AZ2 gearbox will need to be evaluated to determine if better flow balance is required.
5. Weather station wiring in the cabinet in the office needs assessment.
6. Air cooling of the "E" rack in the vertex room was measured and it was agreed with Jeff Yarnell that it was likely inadequate. Further investigation at the Pie town antenna revealed a concerning lack of air flow there too.

At this point in time, following inspection of two sets of grease samples, no metallic particles were found, and in conclusion there appears to be no urgent needs for bearing replacements

Photo numbers below relate to the reported issues above

Photo 2



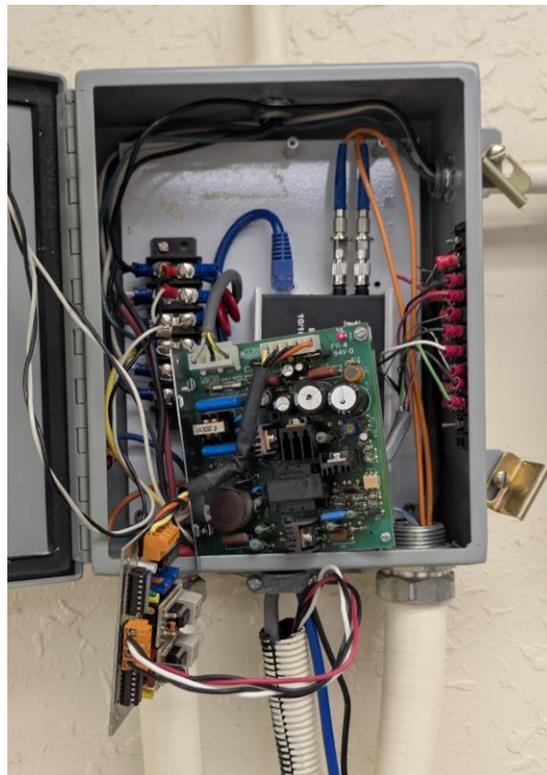
Photo 3



Photo 4



Photo 5



Inspection

Apex

The inspection started at the apex and an examination of the FRM. The FRM is in good condition. A high torque was applied to the barrel of the FRM, but less than a ¼" of backlash was observed at the barrel edge.

Dish

The dish was inspected, together with the Apex legs and their supports through the dish. The recent visit to Saint Croix had been to repair the leg supports but drain holes had been put into at least three of the supports on the MK antenna. No blockages in the drains were observed, even when probed with a wire. One apex support appeared to not have drain holes.

Vertex room

Organized and free of debris.

Inspection of air flow in E rack was performed by Tony Sylvester with our anemometer after this visit, due to technical problems with the instrument.

Below are the airflow rates from each of the three racks in the vertex room. Both inflow and outflow were taken.

Rack (A) bottom 5.4 m/s

Rack (A) top zero airflow

Rack (B) bottom 6.7 m/s

Rack (B) top 2.0 m/s

Rack (E) bottom 5.2 m/s

Rack (E) top 1.1 m/s

Vertex room temperature is 59-60 F (15.5 °C) using the anemometers internal thermometer.

These are higher than the flows measured at Pietown, but below specification.

Elevation motors and platform

Both elevation motor/gearboxes were inspected and no leaks were found.

The bull gear for driving the elevation axis was observed to be very dry and lubrication needs to be added at the earliest opportunity.

The elevation axis platforms showed no issues.

General superstructure

The general superstructure was viewed over the course of the inspection, and several high-quality pictures of the antenna taken from the ground for future reference. Where closed sections could be observed, drain holes seemed to have been placed in all of them, no bulging of them was visible.

Foundation

A walk-around of the rail and foundation did not find any defects in the grout, and no loose splice bars. The current splice bars are of the older type and will be replaced in an antenna tiger team servicing the gear boxes. Rail was free of defects in both visible inspection and sonic inspection. No broken concrete (repaired at Hancock in Sept 2025) was visible.

Pintle room

The pintle room of VLBA antennas has become of interest because of humidity problems recently observed at Owens Valley. The pintle room/snakepit at MK was clean and dry; no cable wear problems were seen around the maypole during the survey.

Azimuth motors and gearboxes.

Idlers and drive wheels were inspected. No defects were observed. A leak was seen on the AZ 2 input shaft that would be resolved on a tiger team visit. Also, on the AZ2 box, a slight flow imbalance on the oil flows to sites on the box was seen.

Rail

The rail surface appeared very flat, and there were no really palpable steps between the rails at joints. Our new ultrasonic tester was employed to look for cracking at the rail splices, but, due to the limited practical experience of the inspector, the fact that no cracks were observed should not be regarded as *definitive*, but *indicative*.

Control building

The control building is in good condition. The offices were clean and organized.

Weather station control box

One remaining area of concern was observed with the control cabinet for the weather station. Wiring was of poor quality and the SMPSU driving the fibre interfaces, was not secured in the cabinet – no means TO secure the PSU was found.

Concluding remarks.

The visit was a success, despite some problems with illness at the site. The site is in good condition, a site in poorer condition would have taken longer to inspect.

The basic toolkit taken for this inspection was little more than a good phone camera, the new and unused ultrasonic tester and a voltmeter. All the usual safety equipment for working at height is needed too.

Engineers performing an inspection really need familiarity with ultrasonic inspection – ideally from having worked on test samples.

Appendix 1

Grease analysis.

It is impossible to determine the presence of ferrous particles in the solid greases used in bearings. A simple procedure was created to dilute the grease, settle out any particles, and allow for simple inspection, either with the aided or unaided eye

Grease is composed of an oil phase and a soap phase which suspends the oil to make it lubricate and seal over the long term. Breaking down the grease with solvents is required to destroy the structure and create a low viscosity fluid with no yield stress to support the particles in suspension.

Each grease samples was scraped from the “sample bowl” and placed in a screw top glass jar.



The jar was partially filled with a *heptane*-based brake cleaner. Mineral spirits, a more benign solvent completely failed to break down the greases employed at VLBA !

The sealed jar was shaken vigorously for five minutes, and a low viscosity liquid created. The liquid was allowed to settle for a couple of hours, and then the top 75% of the jar decanted through a filter paper to a waste container. The filter paper was checked for particles, but any remaining settle to the bottom of the jar.

In a spirit of experimentation the samples were then prepared slightly differently

One sample “pink” AZ2 inner was poured into a 4” Petri dish, covered and the solvent allowed to evaporate



One sample “blue” AZ2 outer was poured through a folded coffee filter into the waste container, and the filter allowed to dry.



Results.

A close examination of both samples with a magnifying glass reveals only one or two large particles.



This particle was originally one, then prodded with a pencil tip, whereupon it broke into two. It was probably sandy grit.



This is the “pink” sample. This large particle was tested with a magnet, but wasn’t attracted to it.