National Radio Astronomy Observatory
VLBA Antenna Memo Series – No. 112

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INSPECTION REPORT – Fort Davis, March 10-12, 2026

1. Trip Summary

A group from the VLA traveled to Fort Davis, Texas VLBA station. One group set out to rebuild the remaining two gearboxes and one group performed an engineering inspection.

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2. Executive Summary

This trip report summarizes engineering inspection activities performed at the FD VLBA antenna from March 10–12, 2026. The primary objective was to perform a broader field assessment of the antenna structure, rail system, drive systems, pintle bearing assembly, platform and vertex rooms, main dish assembly, apex and FRM/subreflector-related components. Great support was received from the site techs. Several observations were documented to support future maintenance planning. The antenna rail and foundation were found to be in general good condition, although localized grout deterioration, variation in rail clip hardware, and one splice joint with a comparatively large gap and visible cracking were noted. A damaged grounding cable connection to the rail was also identified and should be corrected during a future maintenance visit.

Several other observations were made in the azimuth drive, elevation/yoke platform, dish, apex, FRM, and subreflector areas, including grease sampling and visual inspection findings that should be incorporated into future maintenance planning and follow-up evaluation. Inspection of the pintle bearing room porthole confirmed generally good condition, but the absence of a weather seal and superficial rust at the flange interface indicate a need for improved sealing.

Overall, the antenna remains operational and in acceptable condition for continued service, but several localized deficiencies and maintenance items were identified. These findings should be reviewed by Engineering Services and Antenna Mechanics to define priorities, assign follow-up actions, and improve planning for future maintenance and Tiger Team visits.

Figure 1: Fort Davis, TX

3. Rail System

Two different types of rail clips were used on the same track sections. Five of the rail clips that secure the railway along the base plates had different geometry. Having consistent clip types ensures uniform rail behavior and simplifies maintenance. It's possible to replace these clips to the standard size during the upcoming maintenance visit. Both fastening pairs shown opposite of each other can be seen in Figure 4.


Figure 2: Rail Clips (Bolt No. 70)


Figure 3: Rail Clips (Bolt No. 8)


Figure 4: Rail Clips (Bolt No. 3)

It was noted that steel plates were protruding from the grout at bolts 9, 10 and 11. Should the track section require regrouting in the future, extra care should be taken during demolition around this section of rail.


Figure 5: Plates (Bolt No. 3)

The splice joints were all inspected along the rail track. One of the joints had a visibly larger gap compared to the other five intersections. These gaps are necessary to allow for thermal expansion however, excessive joint gaps can potentially lead to surface damage, rail creep or broken components. The gap was measured to be roughly around 0.117 inches and will need to continue to be tracked. The remaining splice joint gaps were considerably smaller however, movement was recorded at these intersections. The splice joint at Bolt 61 shows localized chips (see Figure 7). Regular monitoring at this joint will allow for tracking of any further crack development and/or propagation.

Figure 6: Splice Joint (Bolt No. 41)

Figure 7: Splice Joint (Bolt No. 61)

Various measuring instruments were used to develop geometric characteristics of the rail track. An ultrasonic tester was used on the rail to detect if internal flaws were present, such as cracks or voids. There was a disruption in the signals path between bolt 60 and 61 possibly revealing a hidden defect at one of the splice joints. Splice joints on rail are more prone to failure largely because they are considered to be weakest points. During the next maintenance visit, all splice bars will be replaced, exposing the webbing at these intersections, allowing for further field observations and evaluation.

Figure 8: Ultrasonic Testing

Figure 9: Rail Head Profile

Figure 10: Rail Height

The overall foundation and track of Fort Davis is in acceptable condition. 50% of the grout exhibits high uniformity and integrity (see Figure 11) while the other half of rail across three consecutive 20-foot spans show visual deterioration between edges and around plates (see Figure 12). While functioning well, pushing forward to regrouting sections at a time will ensure longevity and performance of the Fort Davis railway infrastructure.


Figure 11: Older Grout Section of Rail


Figure 12: Newly Poured Grout Section

One of the two grounding cables to the rail had loose and reduced wire connections. It's recommended that it be included as an upcoming maintenance activity during the next scheduled visit to avoid unwanted conductive paths. This can be achieved with wire extensions through a split bolt to a wire mold or lug. The location of this grounding cable is between bolts 36 and 37 shown in Figures 13 and 14.

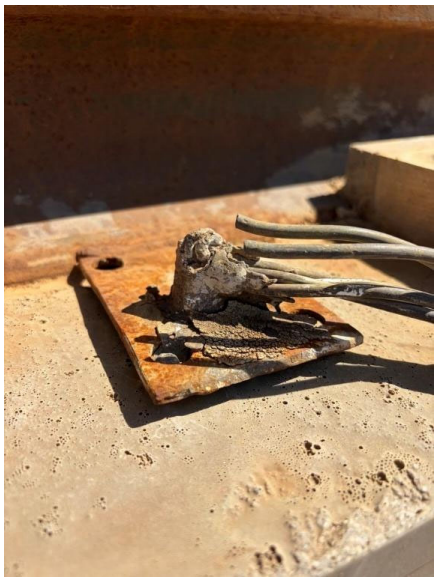
Figure 13: Rail Ground

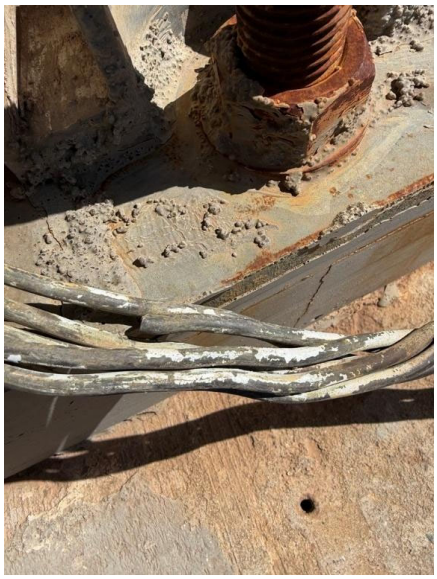
Figure 14: Grounding Wire

4. Pintle Bearing Assembly

The pintle bearing room was found to be in very good condition. Structural elements were free from any water build up, debris and grease collection. Fort Davis has a semi-arid climate with generally lower humidity than found at other sites. Separation around the pintle bearing assembly from the foundational concrete was noted, seen in Figure 16. Implementing a caulking/sealant solution to fill the space around the grout interface between the foundation and the steel structure will help prevent moisture infiltration.

The pintle bearing provides radial and lateral restraint for the pedestal assembly. It also provides axial support for the pedestal base frame. Grease samples were collected from areas inside and outside of the pintle bearing.

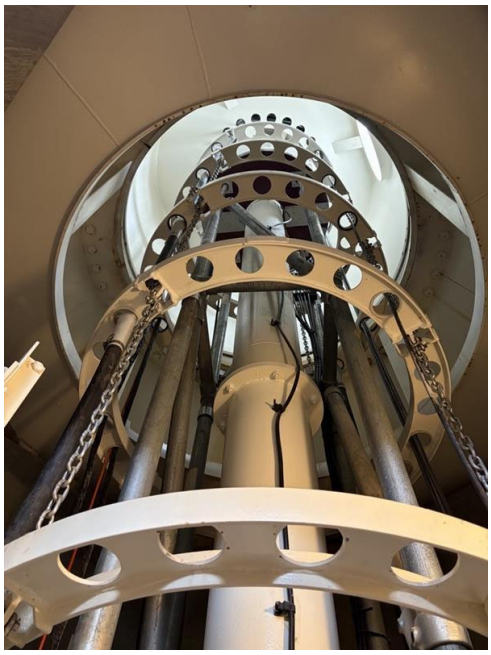

Figure 15: Pintle Cable Wrap

Figure 16: Pintle Bearing Assembly (Exterior)

The porthole to the pintle bearing room was inspected and found to be in good condition. The plexiglass cover does not currently have a weather seal, and some superficial rust was observed at the flange interface, indicating that water may be entering (superficially) through this area.

As part of Safety Corrective Action 3621 (VLBA Pintle Bearing Room Porthole Cover Redesign), a threaded pin will be installed at the upper portion of the mounting flange to support the cover when all fasteners are removed. In addition, a silicone gasket will be applied to the cover to prevent water infiltration. This solution will be initially applied in PT and then to FD during the upcoming Tiger Team.

Figure 17: Port Cover

Figure 18: Pintle Bearing Room Port Hole

5. Azimuth Drive

The AZ #1 gearbox was rebuilt in 2023, and the EL #2 gearbox in 2025. The remaining two gearboxes were rebuilt during this trip, refer to VLBA Antenna Memo 111. It was observed that Drive #1 wheel has an inner solid pillow block and split outer pillow block. The Drive #2 wheel has solid pillow blocks. Both Idlers wheels have all split pillow blocks. These pillow blocks bolt to the antenna structure holding the shafts and bearing components in place. Solid pillow blocks are made of one solid piece while split pillow blocks are made of two pieces. These different housing units can be seen in both Figures 19 and 20. The solid pillow blocks can be replaced with splits during scheduled bearing changes for those wheels.

Figure 19: Solid Pillow Block

Figure 20: Split Pillow Block

The drive bearings incorporate an automatic lubricator (SKF SYSTEM 24) on the pillow blocks as shown in Figure 19. The idler bearings require manual greasing using an extreme pressure (EP) grade 2 grease. Grease sampling helps to analyze the wear debris for predictive maintenance of these bearings. A “Grease Thief” kit was used to sample and capture the system's grease. The collected grease will be sent out to a lab for basic ferrous grease testing to identify iron-based particles.

Figure 21: Drive Wheel

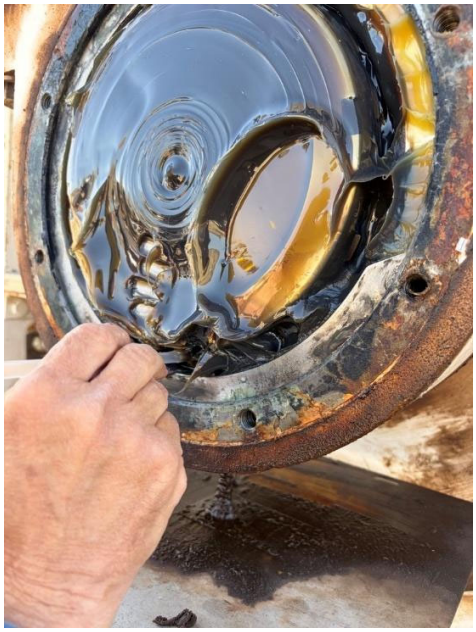

Figure 22: Grease Sampling

The bypass filtration system for all four gearboxes was installed at the end of 2023. The nitrile/neoprene hose lines were recently replaced with 3/8 copper tubing and reported to have improved performance due to previous hose cracking. This solution can be pursued for sites experiencing frequent hose replacement. One of the sight glasses was reported by the site tech with a loss of flow. Flow monitoring at this sight glass has been requested.

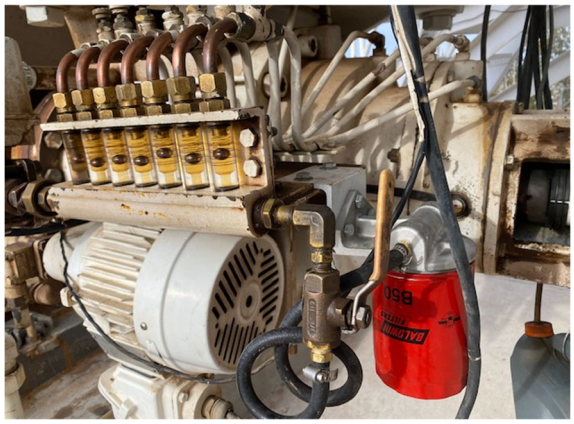
Figure 23: Bypass Filter Nitrile Hose Lines

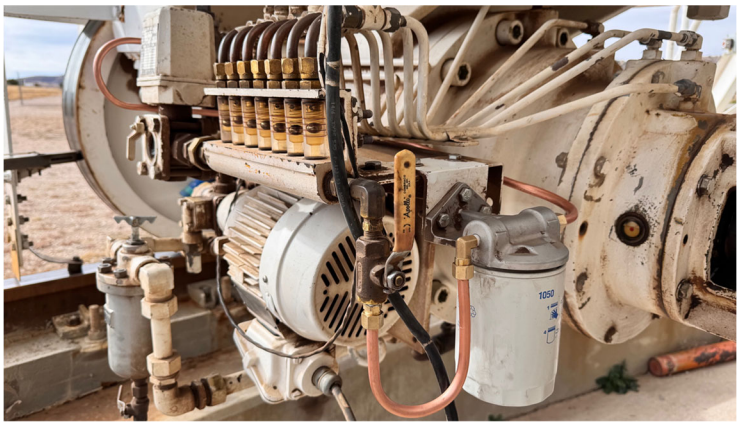
Figure 24: Bypass Filter Copper Lines

6. Elevation Drive

Open gear grease is used on the sector (bull gear) and pinion gears. It's tackier than our semifluid greases used on azimuth and elevation bearing, sticking to our open gears without running off. Further open gear applications are to be investigated against current operating conditions for improved wear protection. Noises from gearbox drives have been reported after rebuilds and are being investigated. Acoustic imaging, axial clearance determinations along with motor and meshing points within stages will be evaluated in the coming weeks.

Figure 25: Pinion Gear and Bull Gear

Figure 26: Elevation Drive

7. Elevation/Yoke Platform

Except for very minor areas of surface rust, structural components associated with the elevation and yoke platforms were found to be in good condition. This includes platforms and gratings, stairways, decks, catwalks, counterweight structure, backup structure, and associated fasteners. No significant signs of structural deformation, cracking, loose members, or advanced corrosion were observed during the visual inspection.

A number of small inspection holes that had been torched open into some elevation structural members were re-used for internal assessment. These locations were inspected using a fiber-optic camera probe to examine otherwise inaccessible internal surfaces. The internal surfaces of the inspected structural members appeared to be in good condition, with no apparent internal rust or other visible signs of significant internal deterioration.

Similarly to the structural inspection in Mauna Kea (VLBA Antenna Memo 106), a half inch hole was drilled in the center of the bottom plate (as seen in Figure 27) as preventative maintenance against structural damage due to moisture buildup. Insulation repair will need to be performed along the two quadrapod configurations on the pedestal assembly shown in Figures 28 and 29.

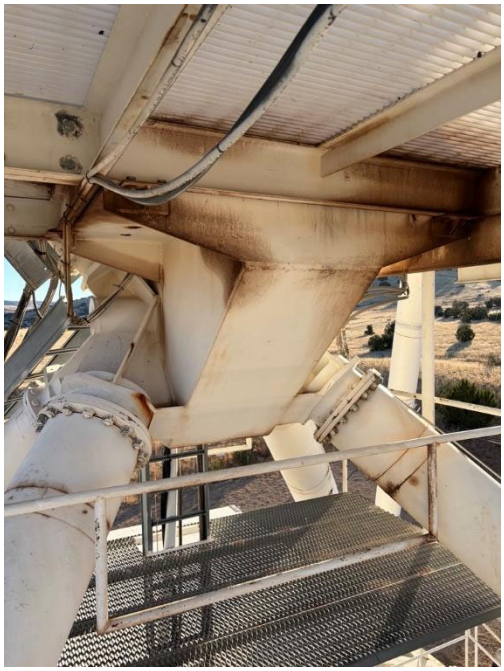

Figure 27: Knuckle

Figure 28: Quadrapod Support (Synchro)

Figure 29: Quadrapod Support Insulation

Grease sampling was additionally performed at both elevation bearing locations. Both the synchro plate and encoder cover prevented sampling from active areas within the pillow block. Purged grease closely around the axle and pillow block cover still enabled representative grease samples to be taken without the disassembly of these components.

Figure 30: Synchro Pillow Block

Figure 31: Encoder Pillow Block

8. Vertex Room

The vertex room has been well-maintained with only minor concerns identified. The 3mm (W-Band) receivers control card enclosure does not include a bottom panel (see Figure 33). The desiccant located on the C-Band receiver needs further securement to the mounting plate seen in Figure 34. It has the potential to shift during EL movement. Air velocities were measured at the inlets and outlets of racks A, B and E. Air flow continues to be evaluated within these racks.

Figure 32: W-Band Receiver

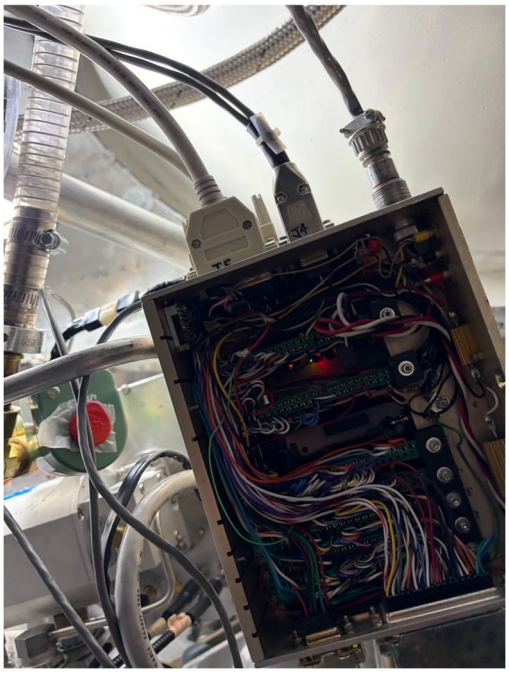
Figure 33: Control Card Enclosure


Figure 34: Desiccant

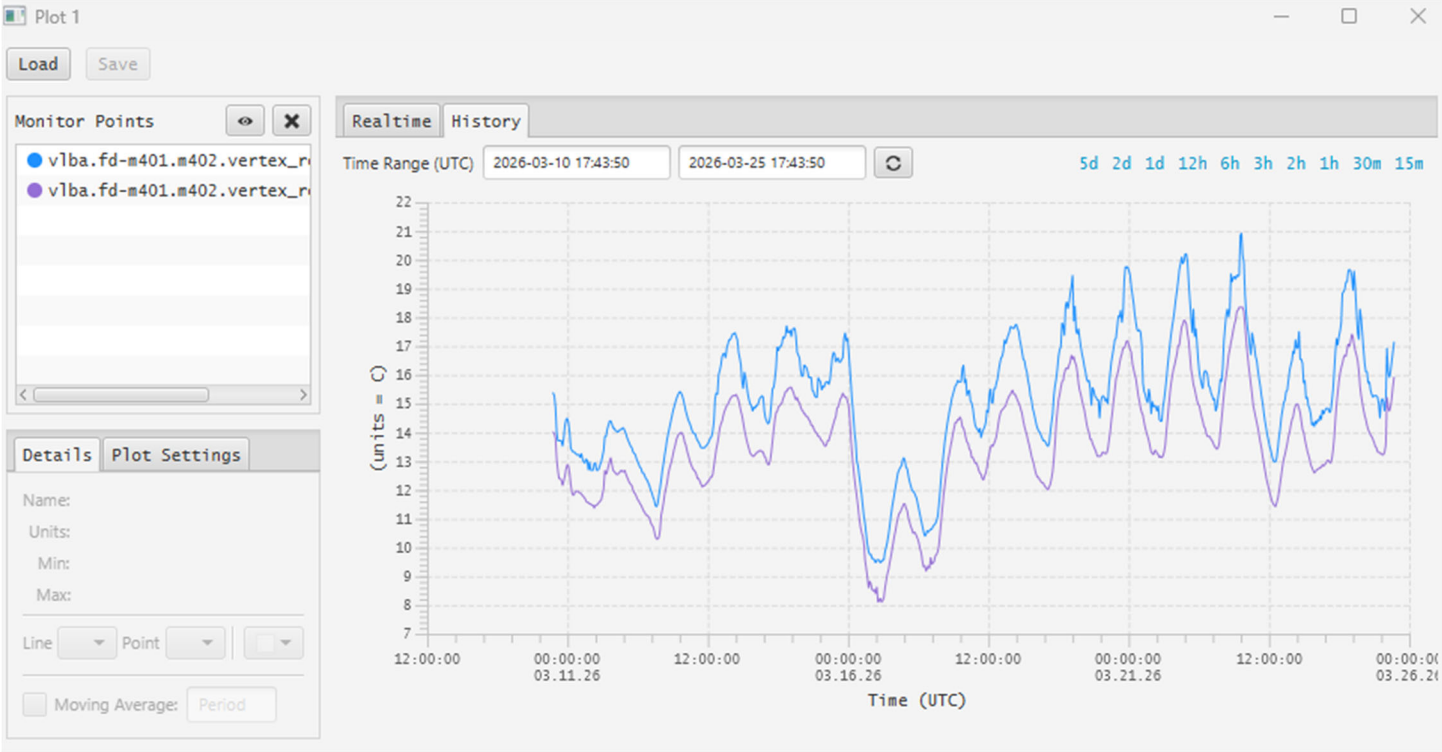

Figure 35: Temperature Readings (Vertex Room)

The above figure shows temperature readings for the upper and lower vertex room. The line color for the upper vertex room is blue and the lower vertex room is purple. Cooling for FD is set around 16.19°C . The difference between the two levels can vary anywhere from two to four degrees. Extreme outdoor conditions can contribute to larger temperature differences due to the location of the air handler with respect to the dish and the two room levels.

9. Truss Structure, Dish and Feed Cone

The backup structure is a trussed network supporting the reflector panels, subreflector support structure, elevation bearings and sector gear/counterweight structure. One of the web runners along the circumferential truss revealed surface level rust shown in Figure 37 and at one of the hard joints in Figure 36. It is recommended that during the upcoming repainting of the subreflector that protective paint layers be applied to these areas. This will prevent these support members from worsening if left unprotective.

Figure 36: Truss Joint

Figure 37: Truss members

Slightly northeast of the vertex room hatch door, several panels were stained with a hardened black residue seen in Figures 39 and 46. Some components of the feed cone were also found with similar spotting. It was later detected that the FRM bumper material had degraded and leached onto the lower-level structures. Despite minimal staining, the feedcone is well maintained. Though the feed cone is minimally insulated, walls showed no visible problems. Though the feed cone is minimally insulated, walls showed no visible problems, such as cracks and insulation delamination. No actions required

Figure 38: Feed Cone

Figure 39: Dish Panels

The torsional rod assemblies (eight total) provide stiff load paths. For each guy wire, no significant droop was present. Any unequal guys could shift the demand on any one wire seen in Figures 38, 40 and 41. The subreflector quad legs (four total) are located outboard to the apex ring terminating at the primary reflector (see figure 40). The surface condition was generally good, with no distinct issues affecting the structural integrity of these quad legs. No weep holes were found along the joints of these members. These are generally small openings to allow for water to escape. Some sites prone to water intrusion include weep holes. This ensures that trapped moisture can exit.

Figure 40: Apex Quad Leg

Figure 41: Torsional Rod Assemblies (Guys)

The dichroic panel has sustained better paint adhesion and longevity of the two components of the SX system as shown in Figures 42 and 43. Mounting attachments for each of these structures were securely connected. During the upcoming scheduled maintenance of the subreflector, it will be recommended for both the ellipsoidal reflector and dichroic panel to be painted (Goldstone #7 High Infrared Reflectance Water Based White Topcoat).

Figure 42: Ellipsoid

Figure 43: Dichroic Panel

10. Apex, FRM and Subreflector

All four FRM rubber bumpers were found to have deteriorated most likely due to excessive heat exposure. The bumper material had melted, and a significant amount of rubber residue had leaked onto portions of the apex structure, cable wraps and onto adjacent main dish panels and feedcone as the antenna moved in elevation. All affected areas should be carefully cleaned. The bulk of the leaked material should first be mechanically removed using non-marring scraping tools, followed by cleanup with a mild solvent confirmed to be compatible with the affected painted and metallic surfaces.

The apex structural assembly was thoroughly inspected and was found to be in good condition. No significant corrosion, distortion, cracking, or other signs of structural degradation were observed. Surface condition was generally good, with no visible issues affecting the integrity of the assembly.

Because the four rubber bumpers failed in service, replacement took place during the visit, using new bumpers requested by the site techs. Regular inspection during future visits is highly recommended to avoid deterioration of the new bumpers beyond their structural integrity, avoiding another leakage event.

Figure 44: FRM Bumpers

Figure 45: Apex Ring and Cable Track

Figure 46: Panels

All four bellows of the FRM linear shafts were opened to allow visual inspection of the shaft surfaces. The shafts were found to be in good condition, with no significant dents, scratches, scoring, or other visible damage. Lubrication appeared adequate on all four shafts. The flex drive and pinion gear were also inspected and found to be in good condition, with no visible signs of wear.

The FRM leadscrews were visually inspected and were found to be in good condition, with no visible scratches, damage, or abnormal wear. In addition, all dust-cover bellows examined during the inspection were found to be intact and in good condition, with no obvious tears or deterioration noted.

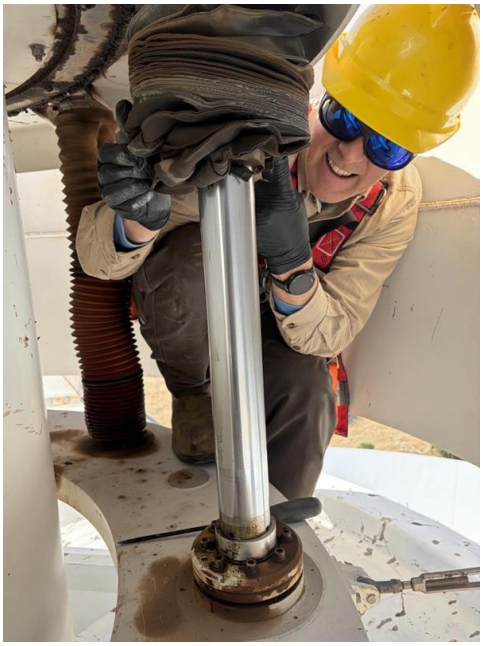

Figure 47: Linear Shaft #1

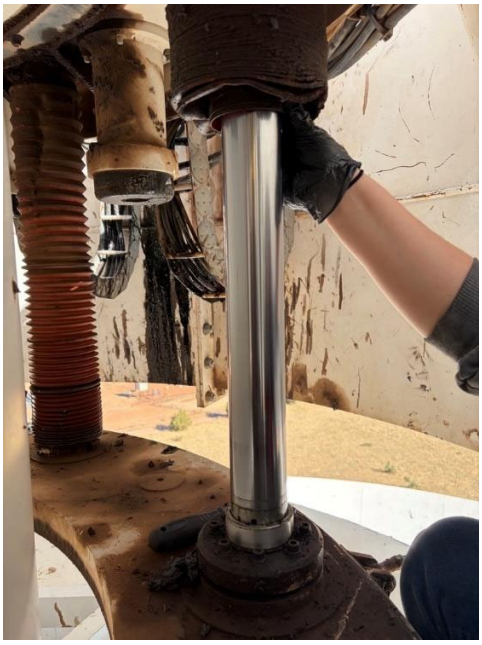

Figure 48: Linear Shaft #2

Fading of paint was visible at the subreflector (see Figures 49 and 50). There were moderate amounts of delamination of the topcoat. The subreflector appearance is one of the least affected surfaces with more surface uniformity by comparison to other sites. Preventative measures for the subreflector will include sanding, filling and painting during the next scheduled tiger team. Indexing for the future XKa feed will require retroreflective targets to be placed at the edge of the subreflector (shorter lobe side) and center of the dipole.

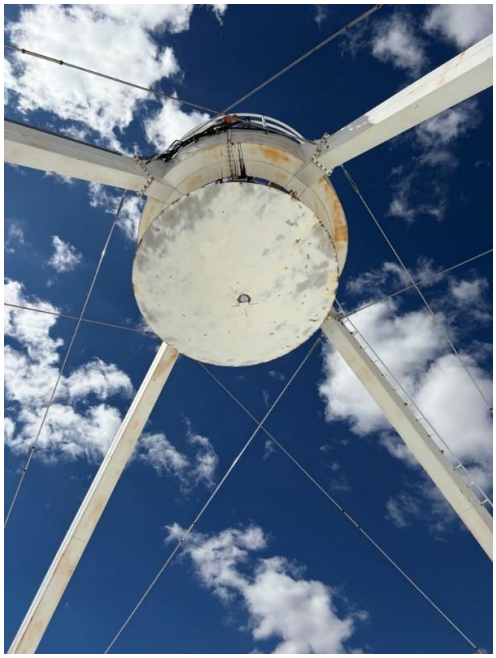

Figure 49: Subreflector

Figure 50: Subreflector

11. Transformer

Fort Davis is one of three VLBA sites awaiting a new generator installation. The original propane generator can be seen below in Figure 51.

Figure 51: Site Generator

12. Report Conclusions

This report provides an overview of the general findings for the Fort Davis VLBA site including the maintenance and repair activities performed. Observations and issues identified during the inspection will be strategically deferred to upcoming scheduled tiger teams. The Facilities Condition Assessment Report (FCAR) inspection grading scale was used to assign an overall score to the antenna based on criteria for each antenna system (within engineering services). It is the recommendation of this document that all site findings be addressed.

General Inspection Findings (priority level highlighted below)

Rail Assembly
Grounding cable repair
High
Splice bar replacement
Medium

Pintle Bearing Assembly
Exterior sealing
Low
Update porthole cover (Safety Corrective Action 3621)
Low

Vertex Room
Desiccant securement (C-Band)
Low
Enclosure cover (W-Band)
Low

Dish
Clean stained panels
Low

Feed Cone
Repaint ellipsoid and dichroic panel (S-X)
Low

Apex
Clean stained apex structure

Low

FRM
Clean stained rings

Low

Subreflector
Repainting of subreflector

Medium

Place targets on subreflector/dipole (indexing)

Low

Antenna Structure
Prime/Paint web runner (truss)

Medium

Lower level quadrapod insulation repairs

Medium

Performance Findings

Azimuth/Elevation Drive System
Address unusual sounds associated with gearboxes

High

Overall Rating: **Grade:**

Fort Davis	**2**
Antenna shows minor wear and tear from normal use with minor maintenance needed. Refer to the Facilities Condition Assessment Report (FCAR) inspection grading scale.	

FCAR inspection grading scale

Grade 1

- New system or new construction.
- Meets design goals and demands of facility or instrument.
- Full safety systems are in place and functioning as designed
- Components of system (steel, piping, fittings, pavement concrete, masonry, etc.) show no leaks, cracks or other imperfections
- Electrical components (enclosure, wires, connectors, raceways, batteries, etc.) show no obvious physical damage, exposed conductors, leaks, or other imperfections.
- Electronics such as displays, LED indicators function as expected, are clearly visible, and are free of cracks, discoloring, and errors.
- Cooling pathways have no visible signs of damage at inlet/exhaust vents and have no obstructions that could diminish air volume.

Grade 2

- System, part, or facility shows minor wear and tear from normal use.
- May be slightly outdated in design or esthetics without functional impact, minor improvements needed.
- Full safety systems are in place and functioning as designed however they may show aesthetic wear from the elements (ex: sun bleaching, or cracking of plastic handle covers, etc.)
- Fluid based systems (water, oil, hydraulic fluid, etc.) have no visible corrosion or deterioration however there is a history of small repairable leaks either documented or shown in stains and dried puddles near the fitting or fixture.
- Components or sub-components of structural systems (steel, piping, fittings, pavement concrete, masonry, etc.) show minor cosmetic cracks or misalignment or signs of superficial damage and/or the beginnings of oxidation or light rust.
- Structural components of electrical/electronic systems are present but may show minor visible damage such as dings or paint smudges from normal use and all mechanical components like hinges and latches are fully operational.
- Electrical components such as connectors, wiring, and switches present no damaged insulators or exposed conductors.
- Electronics such as displays, LED indicators function as expected, are clearly visible, and are free of cracks, discoloring, and errors.
- Batteries are within their expected life and show no leaks or damage.
- Cooling pathways have no visible signs of damage at inlet/exhaust vents and have no obstructions that could diminish air volume.

Grade 3

- System, part, or facility still meets its needs and is considered within its useful life. However, some deterioration exists, repairs are needed and maintenance needs are significant.
- Paint or finishes are showing more than the normal wear and tear and peeling or coming loose and will require significant remediation to correct.

- Full safety systems are in place but concerns are beginning to arise and become evident (ex: workarounds or temporary repairs).
- Fluid based systems (water, oil, hydraulic fluid, etc.) leak intermittently and have early signs or documentation showing deterioration in piping, fittings, or fixtures.
- Components or sub-components of system (piping, fittings, pavement, concrete, masonry, etc.) have minor sagging, noticeable cracks and/or rot that needs to be repaired with the possibility of small areas that need to be removed and replaced (ex: several bricks/CMU, areas of wood rot, or pot holes that can be filled or repaired without a large removal).
- Steel components are showing moderate misalignment. Freckled rust and corrosion have been initiated in broad areas and cracks that have self-arrested or been arrested by drilling holes or applying additional plating.
- Structural components of electrical/electronic systems are present but may show minor visible damage such as dings or paint smudges and some mechanical components like hinges and latches show minor misalignments that do not significantly inhibit operation. Rubber bumper stops may show signs of deterioration but are still in place and functional.
- Electrical components such as connectors, wiring, and switches present no damaged insulators or exposed conductors.
- Electronics such as displays, LED indicators function as expected are beginning to show early signs of wear, however they continue to be clearly visible, and are free of cracks, discoloring, and errors.
- Batteries are nearing the end of their expected life but show no leaks or damage.
- Cooling pathways may present minor cosmetic issues like faded paint or dings, but inlet/exhaust vents have minor obstructions caused by light dust and debris that could diminish air volume.

Grade 4

- System, part, or facility has reached the end of its useful life deterioration is clear and present and repairs are significant and replacement is immediate.
- Paint or finishes are peeling off or missing in aggregated patches that are coming loose and will require significant remediation to correct.
- Safety systems are in place however they are beginning to show safety issues and damage or missing components has become evident and repairs are absent or inconsistent with manufacturer recommendations.
- Fluid based systems (water, oil, hydraulic fluid, etc.) leak continually and requiring constant maintenance along with documented deterioration in piping, fittings, or fixtures.
- Components or sub-components of system (piping, fittings, pavement, concrete, masonry, etc.) show significant sagging, obvious open cracks and/or rot that penetrates through or extends further than twice the cross-section of the member. Repair is not an option and complete replacement of the part(s) or member(s) is required. Large pieces of pavement or concrete/masonry structures need to have large sections removed and replacement.
- Steel components are showing serious separation and misalignment. Section loss or pack rust is present but does not necessarily require structural review for repairs to be developed by in-house repair personnel.

- Structural components of electrical/electronic systems may be missing or needing replacement and may inhibit operation. Shows visible damage such as dings or paint smudges from that require repair and some mechanical components like hinges and latches have misalignments that hinder or prevent operation. Rubber bumper stops may show signs of deterioration and/or are missing preventing their function which can lead to additional damages.
- Electrical components such as connectors, wiring, and switches may show minor damage such as fading, rubbing, or discoloration but have no exposed conductors. These components will require replacement if these conditions exist.
- Electronics such as displays, LED indicators function as expected, are clearly visible, but may show minor cracks, discoloring, and errors. Repairs or replacement are required.
- Batteries are at the end of their expected life and may show leaks or damage. Replacement is required.
- Cooling pathways may present damage or significant dust and debris that may diminish airflow. Inlet/exhaust vents have minor physical obstructions that require repair or replacement.

Grade 5

- System, part, or facility is past its useful life and has critical defects affecting its functioning. Excessive repairs required to prop up the item or system. Beyond repair and in need of immediate replacement.
- Paint or finishes are peeling off or missing in aggregated patches that are coming loose and will require significant remediation to the base material to correct.
- Safety systems are failed, removed, nonexistent, nonfunctioning, or bypassed making the environment, part, or facility is a safety concern for human, facility, or operations.
- Fluid based systems (water, oil, hydraulic fluid, etc.) have leaked dry and/or there is full deterioration in piping, fittings, or fixtures causing multiple blowouts or leaks within the part, system, or infrastructure. Leaks could also be widespread causing collateral damage to other systems, parts, or areas not directly connected with the leaking system.
- Components or sub-components of system (piping, fittings, pavement, concrete, masonry, etc.) show significant sagging, obvious cracks and/or rot that penetrates through or extends further than twice the cross-section of the member. Repair is not an option and complete replacement of the part(s) or member(s) is required.
- Pavement or concrete structure is cracked and spalling in a manner that effects its functioning and operation. Emergency support may need to be installed to create a safe environment until repairs are complete.
- Steel components show complete separation and misalignment, fasteners have failed and members are rusted through. Degradation requires structural review to confirm repair and current or future safety of operation.
- Structural components of electrical/electronic systems such as panels, rails, screws, air dampers, rubber components are missing or damaged and inhibit operation. Parts to repair the system are no longer available and replacement of that system is required.
- Electrical components such as connectors, wiring, and switches may show damage such as melting insulators, frayed wires, exposed conductors that pose a safety threat to human, facility, and/or operations. Parts to repair the system are no longer available so replacement of that system is required.

- Electronics such as displays, LED indicators do not function as expected, are not clearly visible, shows cracks, discoloring, and errors replacement is required.
- Batteries are past the end of their expected life and show leaks or damage. Removal and replacement of components is required and system may need to taken offline for health and human safety.
- Cooling pathways are damaged and are impacting airflow. Inlet/exhaust vents have obstructions that cannot be repaired. Replacement of that system is required.