NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

VLBA Antenna Memo Series No. 70

Fort Davis Elevation Bearing Replacement - Trip Report

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Metal particles were found in the grease on the encoder side elevation bearing on the Fort Davis VLBA antenna. A maintenance team consisting of Steve Aragon, Ramon Gutierrez, Martin Lopez, Phillip Sanchez, Jon Thunborg and John Wall traveled to Fort Davis to replace the bearing. The site technicians John Jordan and John Smith also helped with the bearing replacement.

Steel beams, struts and stiffeners were bolted or welded to the antenna to support the lifting jacks and reinforce the structure.

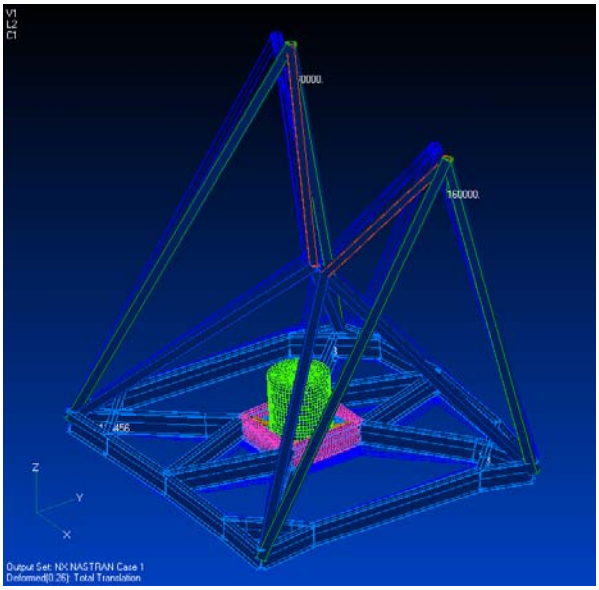
During previous bearing changes, one side of the dish was lifted and the entire pillow block was removed from the antenna. The old bearing was then pressed out and a new bearing pressed into the pillow block before it was reinstalled on the antenna. This was a time consuming procedure that required torch cutting of the large bolts and welded stiffeners that attached the pillow block to the antenna. This procedure also required that the dish be lifted high enough for the pillow block to clear the structure. In order to increase efficiency and keep from lifting the dish as high, the maintenance team decided to remove and replace the Fort Davis bearing without removing the pillow block. Using this method, the dish was lifted approximately 0.005 inches until a feeler gage could be inserted under the bearing rollers. A prefabricated press was then welded to the pillow block and used to force the tapered sleeve inward until it released its grip on the axle.

The next step, removing the old bearing from the pillow block proved to be problematic. Threaded rod studs were welded to the bearing and a prefabricated pulling fixture with a 100 ton jack were used to try and pull the bearing from the pillow block. This method proved unsuccessful because the welds to the hardened steel bearing race did not have adequate strength to withstand the pulling force. A torch was then used to cut the rollers from opposing sides of the bearing. This allowed the threaded rod to be inserted through the bearing. Nuts were then screwed onto the threaded rod on the back side of the bearing enabling a robust attachment to the pulling fixture. This method proved successful, but the force required to remove the bearing was substantial causing both the inner and outer bearing races to shatter.

A new bearing was then inserted into the pillow block using the prefabricated press shown in the adjacent photograph. The taper coupling nut was then tightened until the bearing clearance was reduced to the manufacturer's recommendation. This reduction in clearance was insufficient because after the maintenance team left Fort Davis, the taper coupling slipped on the axle causing the pillow block to move relative to the axle. The maintenance team subsequently returned to Fort Davis and increased the taper coupling tension.

The movement of the bearing relative to the axle indicated that the bearing was installed in such a way that it was axially loaded. This axial loading would have caused premature bearing failure had it not been relieved by the bearing slipping on the axle. In order to have the bearing axially loaded we must have locked the bearing onto the axle while the antenna was in a deflected position due to the off center loading of the jacks on the bearing platform. We should account for this deflection on subsequent bearing changes by installing the bearing loosely initially allowing it to slip into the correct position before it is rigidly locked into place.

The original bearing's inner ring center guide flange was fractured. According to engineers at Torrington Bearing, this kind of fracture is due to excessive axial load on the bearing. This is the same type of failure that we have seen on both elevation bearings that have been previously replaced. Therefore, the author feels that it is safe to assume that all of the VLBA antennas were assembled in such a way that the elevation bearings are subjected to thrust loads.



The VLBA antennas were assembled by installing the elevation axle and then adding the backup structure, quad legs and dish panels. This additional weight was added after the elevation bearings were locked in place. A finite element model of the VLBA antenna base shows that the elevation platforms deflect away from each other as weight is applied to the structure. The axle constrains this movement resulting in a thrust load in the elevation bearings. From the FEA model, the thrust load is estimated to be approximately 10,000 lbs. Bearing life calculations show that a 10,000 lb thrust load would decrease the bearing life by approximately 60%.

While on location, the maintenance team also installed the HVAC platform extension.