GBT MEMO 138

SUMMARY OF LIFE TESTS OF GBT PANEL ACTUATORS

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Introduction

In an attempt to identify failure points in the production GBT Panel Actuators, life tests were conducted. This document summarizes the test set up, the tests and conclusions.

Test Configuration

The same equipment that was used to conduct field tests of prototype actuators was used for this test. The equipment consists of I-beams and adaptors on which actuators are mounted horizontally. An AC motor and spring provide a cyclic side load for the actuators. Electronics cause the actuator to extend and retract, with a few second wait between direction changes. Initially, the actuators were coupled together with a box beam. This was cut part way through the test so that mis-alignments would not place excess loads on the actuators.

Life Tests

Three motors and three actuators were involved in the life tests. This section summarizes the effects of the testing on each of these components.

Actuator S/N 1516: This actuator was installed in the test stand after the questionable performance of Actuator S/N 1529 (see below). It ran with Motor S/N 0635 for 5565.1 hours (see below). Motor S/N 0635 was replaced by Motor S/N 1656. It ran with this motor for 4989.8 hours for a total of 10554.9 hours, with a total distance traveled of approximately 380,000 in. or 9,651,000 mm. At this time backlash on the actuator was measured to be .0035 in p-p; initially, this actuator had 0.00035" backlash. Also, the anti-rotation device was noted to have quite a bit of slop in it. The actuator was disassembled and inspected. One component, the the bearing which takes the axial load, had rusted and disintegrated. Signs of water in the grease were apparent. The anti-rotation device appeared intact; its is not known why it showed slop in the field. This actuator was on the test stand from 9/28/93 to 7/95.

Actuator S/N 1525: This actuator was installed on the test jig on 9/3/93. It ran with Motor S/N 1599 for 11060 hours. At this point its backlash was 0.006"; its initial backlash was 0.00044". Also, the anti-rotation device was noted to have quite a bit of slop in it. At this point, Motor S/N 1599 failed. It was refurbished and run for an additional 1181.1 hours until it failed again. The actuator is presently still on the test

stand, but not running. It has accumulated 12241.7 hours of run time; is is equivalent to approximately 440,000 inches or 11,194,000mm of travel.

Actuator S/N 1529: This actuator was installed on the test stand on 9/3/93. After almost 400 hours of run time, the actuator exhibited loud popping noises as it extended and retracted. These noises were similar to the ones emitted by the Inland prototype actuator. The actuator was video taped and then sent to IDC for evaluation. IDC was not able to reproduce the noise during 500 hours of tests under various conditions. The hypothesis is that the NRAO test jig put excessive torque on the actuator shaft, causing the noise. The actuator has not been tested again.

Motor S/N 0635: This motor was incorrectly labeled by Sierracin; it should have been labeled 1635. It ran for 5565.1 hours on Actuator S/N 1516 before wearing out. When disassembled, it had three brushes completely worn and one that had gotten stuck in the cartridge and was only worn about half way. The commutator wore about .015". The motor powered the actuator for the equivalent of 200,000" or 5,100,000 mm of travel.

Motor S/N 1599: Ran for 11060 hours on Actuator S/N 1525 before failing. When disassembled, it was found that failure was caused by worn brushes. At this point it was responsible for 398,000" or 10,113,000mm of actuator travel. Brushes were replaced, the gear end bearing replaced, and the commutator turned down about .015 to make it uniform. Torque constant was then measured to be about 42 oz-in/amp. Spec is 51.75 to 63.25. It was put back on Actuator S/N 1525 and ran for only 1181.1 hours before failing due to worn brushes.

Motor S/N 1656: Ran for 505.7 hours in Actuator S/N 1529. The actuator failed, and was sent off for evaluation. When the actuator was returned, the motor was removed to be used in Actuator S/N 1516. It ran for 4989.8 hours in this actuator, for a total of 5495.5 hours plus about 500 hours during tests at IDC. It failed due to worn brushes, and was resposible for approximately 216,000" or 5,486,000 mm of travel.

Conclusions

Early in the project John Payne estimated that the required actuator hours for 20 years of service was about 2000. At the design actuator speed, this is equivalent to 1,800,000 mm. Later, Lockman (GBT Memo 120) estimated the requirement to be 1,200,000 mm. The tests described above admitedly involve few actuators. However, they did show that the actuators involved were capable of comfortably exceeding this requirement. Also, the failure mechanism, worn brushes was the expected one. The backlash on the actuators had also reached a point where it was a factor in the surface accuracy; this was not unexpected. It is not known if the increase in backlash is a linear function of time.

The additional hours achieved on the motor that was refurbished were surprisingly little. There may be some subtle techniques, of which we are not aware, involved in the rufurbishing process. This may bear more looking into as time allows.