Discussion, Antonio ATA Cooled Feed
Feed Tip Vibration Test Plan
2015-08-03, Minex Engineering, Matt Fleming, Ver 1

Version	Date	Comment	Initials
Version 0	2015-08-03	Preliminary.	MCF

Contents:

None at this time

Summary:
This document will outline the testing intended to measure the amplitude and frequency of motion between the tip of the center Pyramid and the ends of the adjacent Feed Arms. The Antonio ATA Cooled Feed has been experiencing problems with failure of the very fine copper Link between the end of the Feed Arm and the Tip Circuit Board. The link may have been stretched during the cooldown process as the feed goes from ambient at 293 Kelvin to 68 Kelvin or during the warmup process when cooling is stopped. Monitoring temperatures on the pyramid and arms and some extrapolation revealed the center pyramid definitely shrinks in length relative to the arms. This is probably worst during warmup, however the calculated distance can be accommodated by the link geometry. The other source of trouble could be vibration at the tip of the Feed Arms relative to the center circuit area attached to the Pyramid. Vibration of these parts would cause rapid fatigue failure of the fine copper link. The cryocooler is the largest source of vibration so a spring suspension system was installed to significantly reduce the vibration transferred into the feed structures from the cooler. Additional support was also added at the tip of the Feed Arms. The actual vibration motion at the tip link is unknown, so we will pursue the test program outlined below.

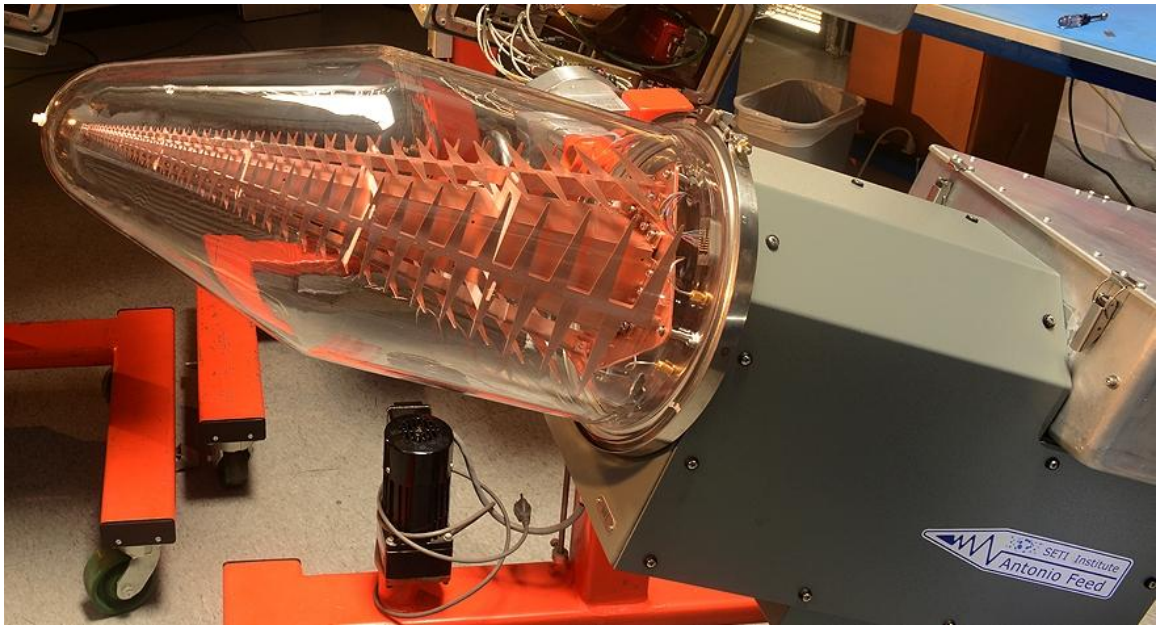


Figure 1 Typical Antonio Feed Production unit.

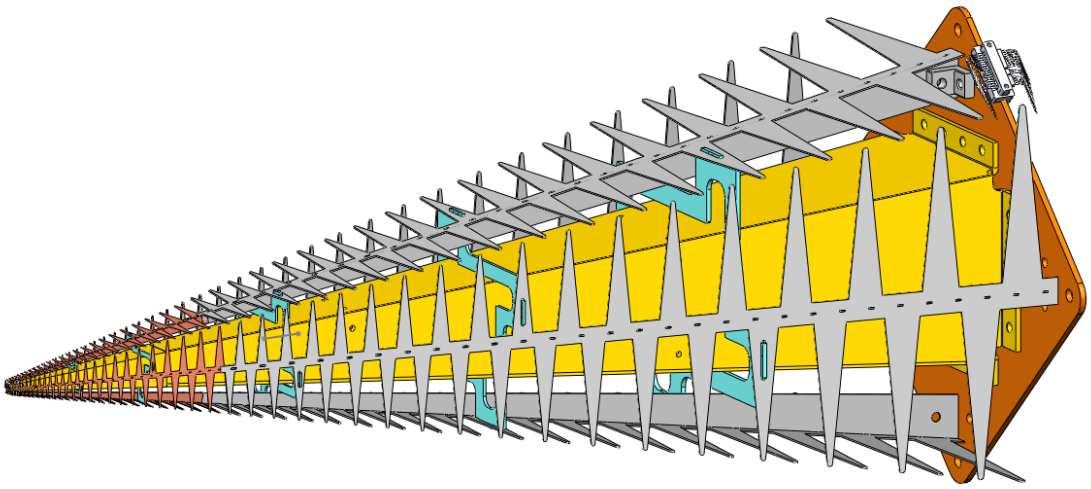


Figure 2 Feed structure with sheet copper base, pyramid and arms

Discussion:

We need to measure the vibration of the components attached to the fine wire link between the tip of the Feed Arm and the center Circuit Board at the tip of the Pyramid. We have chosen to use a Laser Vibrometer tool to measure the amplitude and frequency of motion for parts at the tip of the feed. We will mount the feed on the existing assembly stand. Although some useful information can be gained at ambient temperature and atmospheric pressure, results will be much more accurate if we cool the feed as we would in normal operation with the glass vacuum dome over the tip area. This is important because the modulus of elasticity for copper materials will change by as much as 14% when cooled to 68 Kelvin. This will affect vibration frequency. Also the absence of air will greatly reduce damping causing vibrations to be more severe. The Laser Vibrometer we have chosen to use is a Polytec OFV-505 sensor head with an OFV-5000 Controller. It should be able to measure motion on an area 0.5mm square from about 150mm away. We are told it will work even through the beam must pass through 1mm of glass.

We plan to perform the following tests:

1. Measure vibration of arms & pyramid at 0° (horizontal), 30°, 60°, 90°, (ambient no glass dome)
2. Measure vibration of arms & pyramid at 0° (horizontal), 30°, 60°, 90°, (cooled in glass dome)
3. Modify arm retention scheme and repeat test 2 above.

This series of testing only explores vibration and resonances caused by the 60 Hz cryo cooler. A more complete method would be to place the feed on a vibration table and explore what portions of the feed are excited to resonance by various inputs. Unfortunately for proper analysis the feed arms and pyramid would require cooling and a full vacuum. That means the entire Feed copper structure and housing with support equipment would need to go on the vibration table. That would be quite a bit of equipment and after attaching it to the table it is not clear exactly what accelerations will be seen at the bottom of the copper feed structure. We are hopeful the Cooler will provide enough 60 Hz excitation to reveal the problems we need to solve.

We have arranged for one week of Vibrometer rental and will receive training on setup and use of the instrument.

The new Beryllium Copper Arm to Coax Links that will replace the copper flex circuit are shown below. The parts will arrive on Wednesday, Aug 5th, allowing us time to get them installed and tested in the two feed headed up to Hat Creek on August 18th. The new BeCu link has a larger cross-section than the old design and the yield strength at about 165,000 to 200,000 psi is much higher than copper at 10,000 to 45,000 psi.

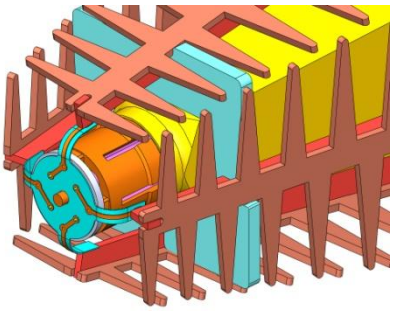
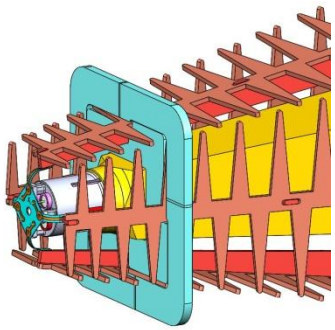
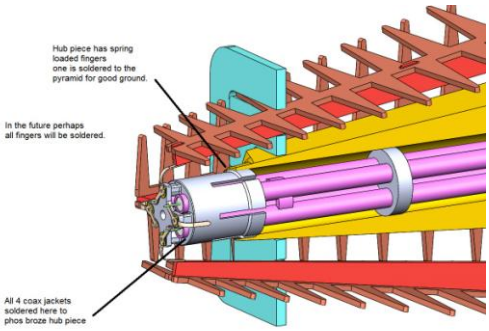
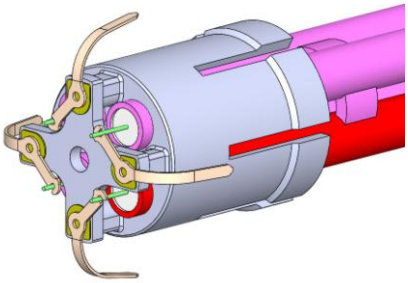


Fig 19 Older unrestrained arms, free.



New proposed additional arm retention scheme.





New proposed BeCu Arm to Coax Links