

**Antonio ATA Cooled Feed
Feed Reliability History & Solutions
2019-01-31, Minex Engineering, Matt Fleming**

Version	Date	Comment	Initials
Version 0	2019-01-30	Preliminary.	MCF

Contents:

Page 1	Discussion & Problems Identified.
Page 2	Improvements Identified.
Page 3	Summary History and Timeline.
Page 4	Various relevant images.

Discussion:

On page 3 & 4 is a summary history of the Feeds fabricated to date. Of the 16 feeds installed so far, 7 have been performing well since installed about 3 years ago, and 3 have been performing well since installed about 2 years ago. Of the feeds that have failed many have experienced some sort of component failure that may have caused increased vibration and lead to tip Failures. This indicates that the basic design is viable. Some improvements are clearly needed. Below is a list of past feed problems that have occurred over the last 3 years. Following that is a list of proposed solutions. Some have been implemented and some are yet to be pending further consideration.

Problems Identified

1. If the 24 VDC power fails independent of the 48 VDC for an extended period, the vacuum declines and the Cryo Cooler will run away icing up many areas of the dewar. Icing can jam the bellows causing cooler vibration to be extreme.
2. If a vacuum leak occurs, usually due to a bellows failure, once again icing will occur, which can lead to extreme vibration. Bellows failures have occurred in the past because we had the misfortune of receiving bellows with defective welding which often fails after several months of use.
3. If the electrical connection to the Cryo Cooler fails, this can cause an intermittent start stop condition with an associated increase in vibration. The manufacturing defect causing this failure has been found present in some power cords delivered with the Cryo Cooler.
4. If the temperature sensor at the Cryo Cooler cold head is not routed properly it can become worn by vibration and begin sending incorrect temperature information to the Cooler Control. This might in some cases cause improper Cooler cycling.
5. If a cooler damper is not functioning properly it can also eventually cause unacceptable vibration. We have realized that this condition can probably be detected during assembly and corrected.

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Improvements

- A. Modify Feed wiring and program to shutdown the 48 VDC Cryo Cooler when the 24 VDC control voltage fails. This addresses problem 1. (done on units at Minex now, thanks to Jon Richards and Rob Spencer)
- B. Modify Feed program to shutdown the Cryo Cooler when Turbo Pump current exceeds a preset value or when a vacuum error message is detected. This addresses problem 2. (not done yet)
- C. Careful inspection of Cryo Cooler power cable should prevent problems later. This addresses problem 3. (complete, although review of units at HCO is not complete)
- D. Inspect and modify retention of the cable for the cold head temperature sensor. This addresses problem 4. (complete on all feeds at MEC & HCO)
- E. Improve assembly procedure and tune the Cryo Cooler Damper for maximum effectiveness. This relates to problem 5. (more work needed)
- F. Investigate removal of bellows in favor of a rigid mounted Cooler with a high performance Damper. The bellows is a source of complexity and a component with hard to control failures. (more work needed)
- G. Move the existing accelerometer from the Feed Control Board to a location on the Dewar Base plate so that improved software can monitor vibration in the same way on all Feeds. This should allow early warning of vibration damage regardless of why it has become extreme. (done for Feeds at Minex now)
- H. Improve the fit on the rexolite Arm Support nearest the Feed Tip to minimize the amplitude of any shaking that might be present. Or consider another tip circuit connection scheme. This will require careful analysis and testing to guarantee no loss in EM performance has occurred. (can be done)
- I. Improve tip link design to use thinner material that will be even more tolerant of fatigue. The necessity for this can be determined with some stress calculations and assumed displacements and frequency. (can be done if needed)

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Summary History of Feeds at Minex and Hat Creek, 2019-01-31					
	2015	2016	2017	2018	2019
	7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12
5C4-001					Prototype at MEC.
5C4-002					4J 2015-00-00 Build. 2015-08-19 Installed HCO. (2018 site power failure ?) 2018-10-26 Returned to Minex, Major tip damage.
5C4-003					5B 2015-00-00 Build. 2015-08-19 Installed HCO. Operating well.
5C4-004					2E 2015-10-20 Build. 2015-10-23 Installed HCO. Operating well.
5C4-005					2A 2015-10-20 Build. 2015-10-23 Installed HCO. Operating well.
5C4-006					1E 2015-10-20 Build failed due to structure, delayed. 2015-12-17 Installed HCO. Operating well.
5C4-007					1C 2015-10-20 Build. 2017-09-12 Cooler replaced HCO. 2017-10-03 Bellows failure. 2019-01-27 Repaired and waiting.
5C4-008					1G 2015-12-11 Build. 2015-12-17 Installed HCO. Operating well.
5C4-009					2H 2015-12-11 Build. 2015-12-17 Vac Leak during Install, delayed, HCO. 2017-01-15 Power 24V failure iced up, Shutdown. 2017-02-02 replaced Turbo & Diaphragm at HCO, LNAs ? 2018-10-26 Returned to MEC major tip damage.
5C4-010					2B 2015-01-22 Build. 2015-01-24 X pole problem, delayed at MEC. 2016-01-27 Installed HCO. Operating well.
5C4-011					3L 2015-12-11 Build. 2016-12-17 Installed HCO. Operating well.
5C4-012					2017-01-20 Build, X pole problem, delayed. 2017-06-14 Installed HCO. Operating well.
5C4-013					2017-06-10 Build. 2017-06-14 Installed HCO. Operating well.
5C4-014					2017-01-20 Build. 2017-02-02 Installed HCO. Operating well.
5C4-015					2017-01-20 Build. 2017-02-02 Installed HCO. 2017-02-13 Power 24V failed, Iced up?, turned off. 2017-06-14 Replaced bellows, LNAs? 2018-10-26 Returned to MEC major tip damage.
5C4-016					2017-06-10 Build. 2017-06-14 Installed HCO. 2018-07-31 Iced up long time? turned off, Power problem? 2018-10-26 Returned to MEC bellows & major tip damage. 2019-01-27 Repaired.
5C4-017					2017-01-20 Build. 2017-02-02 Installed HCO. 2017-02-13 Power 24V replaced, Iced ? 2018-10-26 Returned to MEC major tip damage.
5C4-018					2018-06-00 Build. 2018-07-00 Waiting, running.
5C4-018					2018-06-00 Build. 2018-07-00 Waiting, running.
5C4-019					2018-08-00 Build. 2018-09-00 Waiting, running.
5C4-020					2018-10-00 Build. 2018-11-00 Waiting, running.

