

NATIONAL RADIO ASTRONOMY OBSERVATORY  
Socorro, New Mexico  
March 2, 1987

To: A. R. Thompson  
From: H. Dill, R. Latasa  
Subject: Recommendations for the Model 22 Refrigerator

We have had three years experience now with the CTI's model 22 refrigerators. The units have basically been installed in the field as received from CTI. The performance of these units has been about 2000 hours before a failure. Two types of failure have been defined. The first, and most common, is a physical temperature above 25 K. The second is mechanical failure that causes excessive grinding and ratcheting.

The standard units when disassembled exhibit the characteristic bushing wear, first stage wear, and gland seal wear. Though small percentage of units have run in this condition for over 10,000 hours, while operating within acceptable bounds, it is clear that the current commercially available model 22's are not acceptable for our use.

Considering our experience the following recommendations are suggested:

1. Discontinue the use of carbon bushings in the cross head.
  - 1.1 Our experience and several studies have shown that carbon and graphite material are not operable as bearing materials in an inert environment.
  - 1.2 The carbon material should be replaced with a polyamide material filled with PTFE or molybdenum disulfide (trade names of these produces are Envex 1228 by Rogers for the PTFE filled, and Vespel SP-3 by DuPont for the molybdenum disulfide filled).
  - 1.3 A molybdenum disulfide and glass filled PTFE could be investigated, but is not worth NRAO's time to investigate.
2. Modify the scotch yoke to eliminate the line contact wear pattern of the bushings.
3. The connection between the drive shaft and the displacer should be loosened to allow for marginal axial and lateral misalignment of the drive shaft axis and the displacer axis. This will eliminate undue stress on the bushings and first stage seal.
4. Maintain clean helium supply gas in supply bottles, supply lines and systems.
  - 4.1 Samples should be tested whenever gas is purchased and in suspect systems.
  - 4.2 Manufactured lines should be carefully cleaned, inspected and purged before installation in a system.