Memorandum

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From: J. Effland

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Subject: Reliability of Nanonics Dualobe Connectors

1. Summary

Connectors manufactured by Nanonics Corporation (http://www.nanonics.com/dualobe.html) are being used on ALMA mixers presently under development at NRAO's Central Development Lab. These connectors have proved sufficiently reliable for use on a number of spacecraft programs and are also compact, with contact spacings of just 0.63 mm (0.025"). Their design includes two protruding lobes at each end of the mating connectors to prevent misalignment during connection. Connector misalignment has caused pin damage on previous NRAO mixer bias connectors.

This report summarizes reliability information for this connector obtained from Nanonics and the specifications they reference.

2. Programs Presently Using Nanonics Connectors

The Nanonics Dualobe connectors are being used on a number of large spacecraft, such as the:

- Hubble Space Telescope,
- Space Infrared Telescope Facility (SIRTF),
- Mu Space Engineering Spacecraft (Muses-CN), and
- Gamma Ray Large Area Space Telescope (GLAST).

These connectors are also installed on a number of US military aircraft (F-22, F-18) and according to the manufacturer "many other classified space programs".

One of the most demanding applications of this connector occurs on NASA's SIRTF spacecraft, because that spacecraft's cryostat operates at 1.4K and 5.5K, and of course reliability is paramount.

3. Reliability Specifications

Nanonics claims their connectors comply with the following specifications:

- US military specification MIL-C-85327 (*Performance Specification: Connectors, Electrical, Rectangular, Microminiature, Polarized Shell, General Specification For*).
- NASA SP-R-0022 (*General Specification, Vacuum Stability Requirements of Polymeric Material for Spacecraft Application)*
- US Defense Supply Center (Columbus, OH, USA) DSCC 94031 to 94046
- NASA Workmanship Standards NHB-5300.4

The US MIL standard extensively covers most connector characteristics that are relevant to ALMA, but that standard's temperature ranges between –55C and 125C, which does not address cryogenic temperatures. Nanonics contracted with the commercial testing firm Trace Laboratories to perform cryogenic thermal shock tests of the connector by dipping it in liquid nitrogen. Trace Laboratories continuously monitored the relative contact resistance with a data logger and there was no evidence of open circuits or resistance increases during thermal shock testing of three connectors.

The following table summarizes the significant reliability characteristics and provides references for Nanonics' Dualobe connectors.

Characteristic	Reference	Details
Durability	MIL-PRF-83513D Para 3.5.14	500 mating/unmating cycles while maintaining contact resistance specs and mating/unmating force specs.
Contact Resistance	MIL-PRF-83513D Para 3.5.6	30 mΩ
Low-Signal Level Contact Resistance	MIL-PRF-83513D Para 3.5.19	32 mΩ
Temperature Cycling (Thermal Shock)	Trace Laboratories' report "Formal Test Report for Cryogenic Testing of LCP Vectra Molded Connectors" dated 1999-02-12	Dip testing in liquid nitrogen while monitoring contact resistance.
Vacuum Outgassing	NASA SP-R-0022A	Max volatile condensable material content < 0.1% Total mass loss < 1%