Memorandum

To: File

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Subject: Leak Test Procedure for Waveguide Windows

1. Introduction

This abbreviated document is meant to serve as a starting point for detailed procedures to measure leak rates of components installed on the Dewar wall of ALMA receivers.

2. Procedure

Leak tests of waveguide windows and other hermetic components for the Band 6 Cartridge are measured over several hours using a mass spectrometer helium leak detector. This duration is required to account for the diffusion time of the helium through the o-ring seal and through the window proper.

The device under test (*i.e.* the window) is installed in a suitable fixture containing appropriate o-rings and then mounted on the Varian 929 Leak Detector. Nearly constant pressure is applied to the device under test during the test period using a balloon inflated with helium, as shown on the upper right in Figure 1. A strip chart recorder is connected to the leak detector's analog output to facilitate recording the data over a long period of time.

Prior to use, the leak detector is calibrated using its internal calibration standard and automatic switching valves. During the automated calibration sequence, the device under test and standard leak ports are closed with a value, and the background leak rate is recorded. The leak detector then measures the apparent leak rate of the calibration device, which is nominally 1.3×10^{-7} mbar-ltr/sec. Finally, the port to the calibration device is closed and the device under test port is reopened.

Measurements continue until the leak rate stabilizes and falls within the measurement noise of the leak detector. After the readings stabilize, another calibration sequence is executed and the leak rate is again recorded to ensure the system hasn't drifted or become contaminated with helium.

The measured leak rate is for helium (L_{He}), rather than air (L_{air}). A more realistic number is obtained by correcting for the difference in molecular weights of helium (M_{He}, 4 g/mole) and air (M_{air}, 28.7 g/mole) using the following factor[1]:

[1] MIL-STD-883F: "Test Method Standard, Microcircuits," Revision: F, Dated: 2004-06-18

$$L_{air} = \left(\frac{M_{He}}{M_{air}} \right)^{1/2} L_{He}$$
$$= 0.373 L_{He}$$

The helium to air correction factor will not be used until agreed upon by the ALMA project.

3. Results

Figure 2 shows results for a typical (WR-10) waveguide window consisting of a 127 μm (5 mil) thick copper shim with epoxy plug installed in the waveguide opening. The balloon filled with helium covers the atmospheric port of the test fixture.

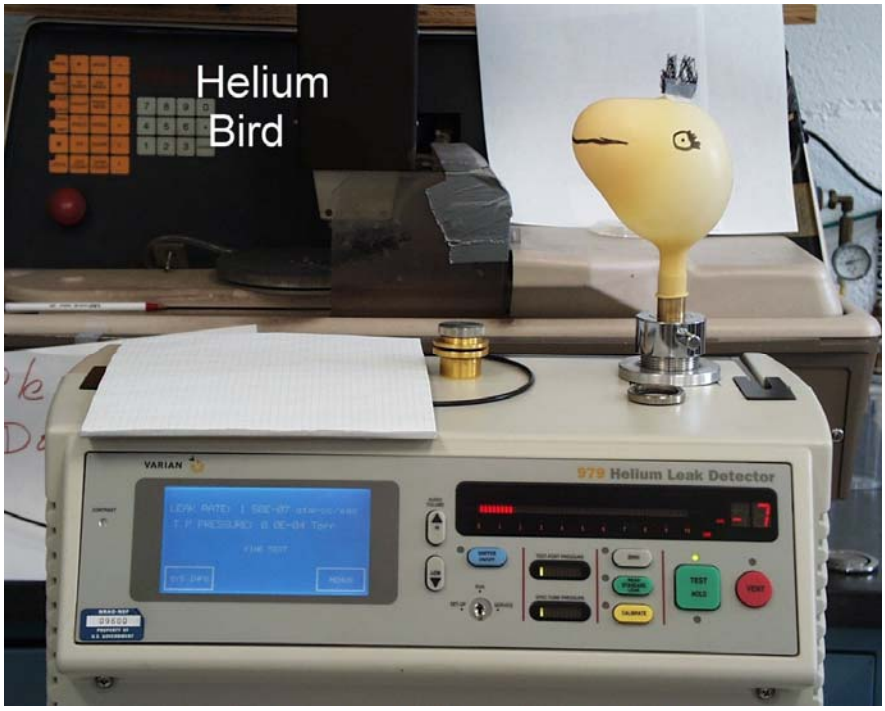

Figure 1: Varian 929 Leak Detector with Balloon Over Device Under Test

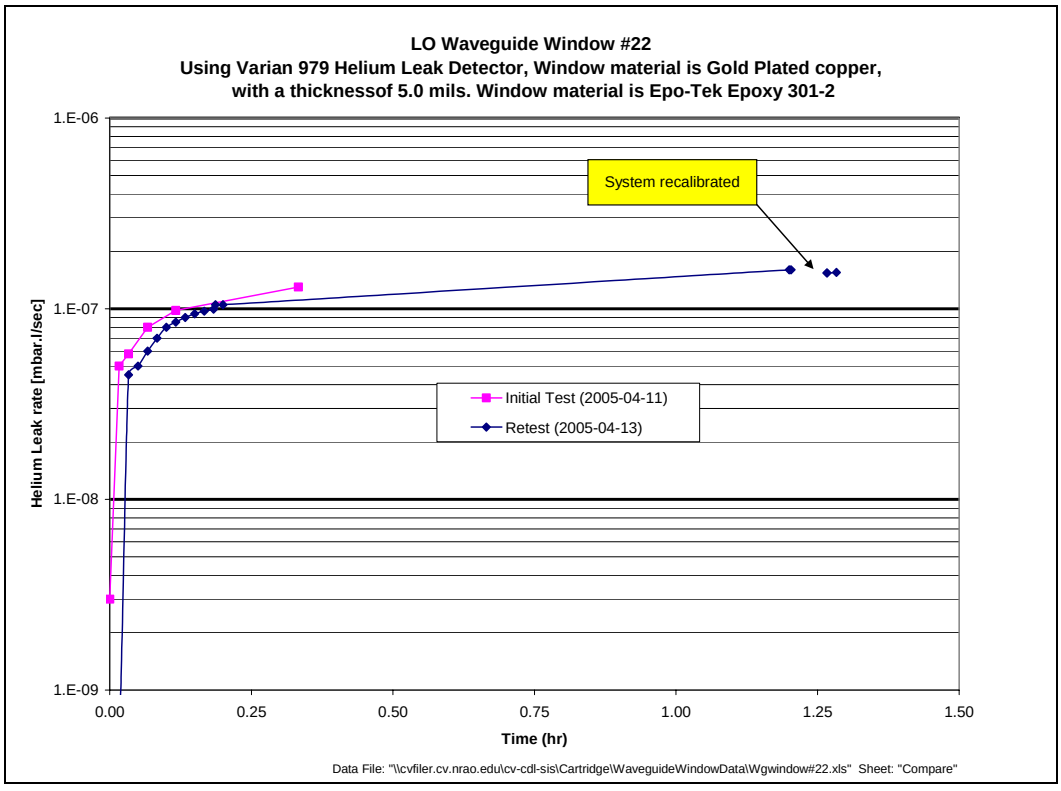

Figure 2: Leak Test Results for a typical LO waveguide windows. The air/helium leak rate correction has not been applied.