

New Folder Name Box Leaks

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Rai's comments on allowable vacuum box leaks/ pressure achieved.

From weiss@tristan.mit.edu Mon Sep 12 19:44:12 1994
To: ljones@ligo.caltech.edu
Subject: chuck strikes again

file:rwljones091294.txt
to: Larry Jones
from: R. Weiss September 12, 1994
concerning: Leaks in external vacuum box

Larry,
Finally have a moment to answer one of the simpler questions you posed last week, "Can CBI get away with a leak in the external vacuum box that maintains 22 millitorr against the leak hunter pumping speed of 8 liters/sec" The answer is no if they want to meet our component leak requirement of 10^{-10} torr liters/sec.

One simple way to see this (I showed this to John last Friday) is to look at the implied flow through the leaking box.

$$Q(\text{air}) = 22 \times 10^{-3} \times 8 = 1.8 \times 10^{-1} \text{ torr liters/sec}$$

The fraction of the atmosphere that is helium is about 5×10^{-6} .

This says there must be a signal on the leak hunter that corresponds to a leak of

$$Q(\text{implied leak}) = 9 \times 10^{-7} \text{ torr liters/sec}$$

The background then in the leak detector is about 10^4 times bigger than the signal that would be produced by our leak requirement. It is not possible that the system is stable enough to suppress this much signal to look for small changes. Our friend Chuck is pulling the chain again.

From weiss@tristan.mit.edu Tue Sep 13 08:59:18 1994
 To: ljones@ligo.caltech.edu
 Subject: box leaks

file:rwljones091394.txt
 to: Larry Jones
 from: R. Weiss September 13, 1994
 concerning: Leak in external box

Larry,

The leak between the outside world and the inside of the leak detecting box should be no larger than 2×10^{-5} torr liters/sec if the requirement is that we test for leaks at 10^{-10} torr liters/sec on the weld. This leak rate into the box from the outside would give the same signal as the maximum leak we are looking for.

Again assume that the fraction of air that is helium is $R = 5 \times 10^{-6}$ and that the pressure of helium in the box, when looking for a leak on the tube is, is 1 atmosphere. The condition that the signal for the minimum leak in the weld and the leak from the box to the outside are equal becomes

$$F(\text{box to outside}) = \frac{F(\text{on tube})}{R} = \frac{1 \times 10^{-10}}{5 \times 10^{-6}} = 2 \times 10^{-5}$$

Depending on the leak detector and the stability of the box leak to the outside one could hazard that they could suppress the bias in the leak detector by a factor of 10 so that the box could leak to the outside by 10 times higher. This is risky but not out of the question.

What CBI should do is not give you the pressure in the box when evacuated but they should bag the box and tell you the equivalent leak rate of the box to the outside world. The pressure is always a combination of leak plus outgassing and if they hit 10^{-3} torr in the box, it may really be limited by the outgassing. The helium permeability of the box should be small enough to allow this.

RW