# Radon Filtration From SF$_6$ Gas Using Molecular Sieves

## Procedure for Testing Radon Filtration

The system in Figure 1 is first evacuated using a vacuum scroll pump for an hour. Then the whole system is filled to 1.1 bar with SF6 via the desiccant. With the valves connecting the system to the filter closed, the internal air pump in the RAD7 is switched on to create a gas current through the radon source therefore contaminating the gas. This process is done for an hour. After the contamination of the gas, the RAD7 is set to test for a total of 48 hours with a measurement every hour. The first 24 hours is done to measure the initial concentration of radon. The filter is then engaged for the remaining 24 hours, to measure the effect of the filter on the concentration of radon.
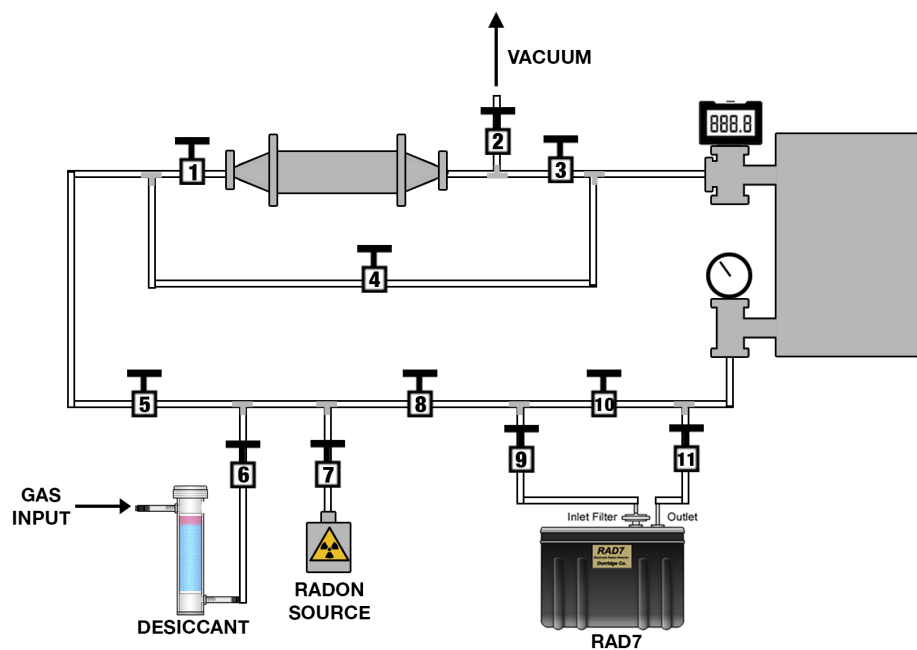


Figure 1: Going anti-clockwise ,the components connected via swagelok are as follows; a vacuum scroll pump for evacuating the gas currently inside the system, a *Drierite* desiccant to remove any moisture from the SF$_6$ when filling the system, a 5.367 kBq radon source to contaminate the SF$_6$ and a Durrige RAD7 to create a gas current and measure the concentration of radon as a function of time.

## Radon Filtration Results

The decay equation is used as a model to create a non linear regression fit to the data. Where the radon decay constant $\lambda$, calculated from its half-life, is locked as a parameter in the fit in Figure 2.

$$N(t) = N_0 e^{-\lambda t}$$

The data before and after the filter is engaged are considered separately. The sample size for the non linear regression fit to the *Filter On* data is adjusted until the discrepancy between the data and the decay equation is minimised. It is found that to provide the best fit for the *Filter On* data, the first 8 hours of data after the filter is engaged is not included. This suggest that once the gas is passed through the filter, it took 8 hours to reach a new equilibrium.
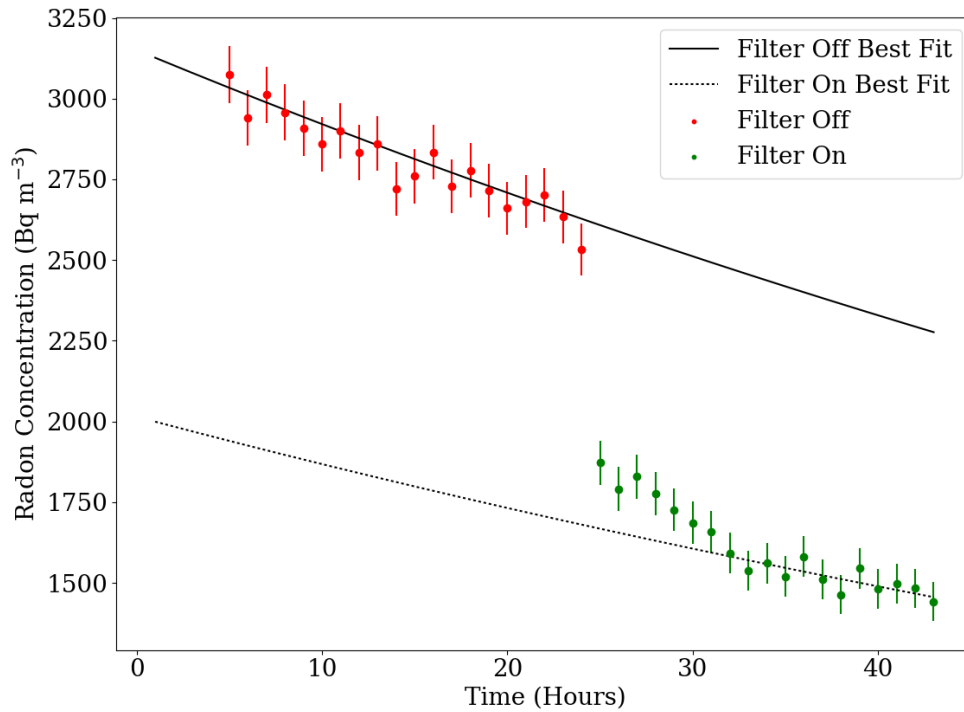


Figure 2: Plot for the radon concentration against time, where the 5A molecular sieve filter is engaged after 24 hours. Note that the Filter Off best fit is determined by the data after 32 hours.

The *Filter Off* data provides a solution for the initial radon concentration of 3150$\pm$ 28 Bq m$^{-3}$. Whereas, the *Filter On* data provides an extrapolated value for the initial radon concentration of 2014$\pm$11 Bq m$^{-3}$.

In summary, the radon concentration of the 35L contaminated SF$_6$ was reduced by 1136$\pm$30 Bq m$^{-3}$ by a filter containing 90g of 5A molecular sieve beads.