

## ***Interactive comment on “An unheated permeation device for calibrating atmospheric VOC measurements” by J. Brito and A. Zahn***

**Anonymous Referee #1**

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Permeation tubes are used as calibration sources with many laboratory and field applications. Their advantages include simplicity, size, and weight. One disadvantage is that permeation rates depend strongly on temperature.

This paper describes an unpowered permeation device, consisting of a water bath, analyte reservoir, and thin polytetrafluoroethylene (PTFE) membrane. The novel aspect of this design is the thin PTFE membrane, which allows the permeation rate to rapidly equilibrate with temperature, and a large, well-insulated thermal mass.

Overall, the manuscript is well-written and describes a useful improvement to existing permeation calibration methods. It addresses a relevant scientific question within the scope of AMT.

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### Major comments:

1. The purpose of the paper is to describe a new calibration source and demonstrate its performance. However, it contains several sections which aren't relevant to the main purpose of the manuscript. This makes the manuscript longer and more difficult to read. In particular, I recommend the following changes:

1a. The importance of accurate and reliable calibrations is described well in the introduction. I recommend removing the first paragraph of Section 2 (Pp. 2934 lines 19 - 26).

1b. Likewise, static calibration methods are also described with good detail in the introduction and these are not the focus of the paper. I recommend eliminating Section 2.1 (Pp. 2935 lines 1 - 16). If necessary, the sentence about uncertainty of gas cylinders (Pp. 2935 lines 11 - 14) could be included in the introduction (Pp. 2933 section a).

1c. Following these two changes, Section 2 can be renamed "Theoretical description of permeation devices."

1d. I recommend removing Section 3.1, which describes the theory and details of PTRMS. PTRMS is a well-established technique and is not the focus of this paper. The section could be replaced with a statement like "The output of the permeation device was measured using proton-transfer-reaction mass-spectrometry (PTRMS) [reference describing the particular instrument used in these experiments]. The precision and accuracy of the PTRMS instrument are xxx pptv min<sup>-1</sup> and xxx pptv."

2. Has the thermal stability of the permeation device been measured? This would seem like a straightforward test, and perhaps I missed finding it in the paper. In Section 3.4, the authors calculate a maximum temperature drive of 0.5 K/h for a temperature differential of 30 K. Is this theoretical result achieved experimentally?

3. The description of the permeation device (Section 3.3) and the diagram (Fig. 3) do not indicate that there is a temperature measurement of the system. Although it is

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a large, well-insulated, thermal mass, it will drift in temperature and ultimately reach equilibrium with its surroundings. As reported by the authors, the permeation rate of acetone depends strongly on temperature (6.6 %/K). Is the temperature of the system measured? If the temperature isn't measured, how is it possible to know what the permeation rate is?

4. Please expand on some details in the description of the device in Section 3.3:

- What is the thickness of the PTFE membrane? (Given in Fig. 3, but not in the text.)
- What is the area of the PTFE membrane?
- What is the typical thickness of PTFE for commercially-available (Kin-Tek, Vici) permeation tubes, for comparison?
- What is the volume of analyte immersed in the water bath?

5. Please provide a list of variables and their definitions for the equations. Some variables are defined multiple times in the text and this should be simplified (example: gas constant, pressure). Check that the equations and variables are used consistently.

Minor comments:

- Pp. 2932 line 21 Remove "inter alia".
- Pp. 2934 line 5 Change "easiness to meet safety clearance" to "ability to meet safety clearance"
- Pp. 2939 line 9 Change "independent on" to "independent of"
- Pp. 2943 line 21 Change "loosing" to "losing"

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