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Interactive comment on "The density–salinity relation of standard seawater" *by* Hannes Schmidt et al.

Anonymous Referee #2

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Hannes Schmidt et al. present a very well documented paper about a subject which realization was waited for a few years: the measurement of the density of standard seawater bottles. This subject is of a great importance in the way to unsure a traceability on long time scales of the standard seawater used to calibrate laboratory salinometers.

The presentation and the explanations are clear and easy to follow. In each paragraph, numerous and useful details are given, but the essential of the method used is described in another publication of Metrologia 53 (2016). This work shows what metrology and metrologists can bring to chemical and physical oceanography.

I recommend the publication of this paper after the authors will have answered the few following questions or remarks:

-1- The DMA 5000 is calibrated with two points at atmospheric pressure: air and water. Nothing is said about the relation and the conditions used to calibrate with the air. Does the BIPM relation (A Picard, RS Davis, M Glaser and K. Fujii, 2008, 'Revised formula for the density of moist air (CIPM-2007)', Metrologia. 45, 149-155.) was used? This point is of a great importance as it determines the offset of the instrument and it is in relation with the accuracy of measurements made beyond the density of fresh water. If the manufacturer's relation was used, could you assess the impact on the accuracy of the measurements of seawater with the DMA 5000?

2.1- About the substitution method: it allows the compensation of the drifts of the instrument, but it can't warrant its linearity for measurements made beyond the density of fresh water. This element was checked in the Metrologia's publication, by comparing to an hydrostatic weighting apparatus at atmospheric pressure. Could you remember this point in this publication, as it is of a great importance to validate your data compared to Millero results?

2.2 - At high pressure, the linearity was checked and corrected with 4 substances, the less precise having the higher densities. In this publication, their standard uncertainty is given to be 25 g/m3 and you give a standard uncertainty adjustment of 19 g/m3 at 65 MPa. In this case, how can you unsure an uncertainty of 0.008 (including the linearity in the budget) in salinity at high pressure and the deviations you give in figure 12?

3.1 - About the apparatus: tubes are clamped between the VTD, the peristaltic pump and the valve. B. Laky, of the research lab of the manufacturer Anton Paar, has made a remark about the influence of tubes on the damping frequency of the DMA. Any modification of the in/output assembly of the cell, even a small movement of attached tubes, can alter the DMA's results. The oscillation frequency can be altered with any modification of the mechanical forcing by attachments. How have you taken into account this remark?

3.2 - The DMA 5000 is quite sensitive to the inclination of its support. Apart from a

low vibration stand, a level surface is mandatory for a best accuracy. It seems that an inclination of a few degrees can affect the measurements by about 2 ppm/degree. Could you say what cares have been taken to prevent this error?

3.3 - In the pressure experiments, how can you unsure that the tube is sufficiently long to avoid diffusion of the oil in the U-tube of the DMA during measurements at high pressure?

4 - Paragraph 3.2.3, line 15: replace 'to store the of seawater' by 'to store the seawater'.

5 - in the summary, line 26, you speak of a 'linear dependence' on salinity. With the deviations given in figure 11 b), it seems that a parabolic equation could fit the data as well. Could you calculate the best polynomial, give its correlation coefficient and display it on the figure 11 b), in order to prove your assumption of a linear dependence?

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