NOTE ON FLOW RATE MEASUREMENTS MADE ON MAST-BREWER OZONE SENSOR PUMPS

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An ozone sensor developed by A. W. Brewer and manufactured by Mast Development Co., Davenport, Iowa, has found increased usage during recent months as a device for measuring the vertical distribution of atmospheric ozone (see [1] for information about the instrument). In evaluating the performance of the Mast-Brewer sensors, tests were conducted on several sensor air-sampling pumps in an effort to assess their flow characteristics at pressures within the range 150 to 6 mb. Measurements of the rate of airflow were made with a specially developed apparatus which permitted accurate determinations of lengths of time taken by a pump under test to inflate a fixed-volume plastic bag at atmospheric pressure and at another, reduced pressure within a bell jar. The pump's airflow rate at the reduced pressure was computed from the ratio of the two times of inflation. To simulate actual sensor conditions in which air is bubbled through a 2-cm. column of solution, calibrations were performed with the pumps working against a back pressure exerted by a column of Apiezon A oil 2.3 cm. high.

Tests were performed on 4 pumps identified by the numbers 23, 24, 30, and 32. Data plotted in figure 1 indicate not only that the flow rates decreased at air pressures below approximately 100 mb., but, also, that the flow rate factors differed considerably for the pumps tested. The differences in pump performance seemed to stem from the degree of lubrication of the pump pistons and cylinders. It was observed prior to testing, for example, that pumps 24 and 32 were very lightly oiled. Pump 23, with a superior flow characteristic (see curve 23a, fig. 1), appeared to be well oiled and functioned especially smoothly during operation. Pump 30 also seemed well oiled but its mechanical action was considerably less smooth. To test the hypothesis that each pump's performance was influenced by its state of lubrication, pump 23 was operated for 9 hr. after which time it was observed to be considerably drier than initially. A second calibration was then performed, yielding the flow characteristic 23b of figure 1. For a final check, all oil was removed from pump 23 with a solvent, and when an airflow calibration was once again made, considerably inferior flow characteristic 23c of figure 1 was obtained.

The reduction in pump airflow rates at pressures less than approximately 100 mb. is of sufficient magnitude to warrant application of corrections to vertical distribution ozone data used in certain research, for example, in investigations of the photochemical rates of ozone production, vertical ozone transport, etc. Note that failure to apply the corrections may on occasion result in observed ozone amounts that are approximately 25 percent low at 6 mb. pressure. To facilitate the application of corrections to ozone data, an average flow characteristic for the Mast-Brewer air sampling pumps has been drawn in figure 2. After taking into account differences in per-

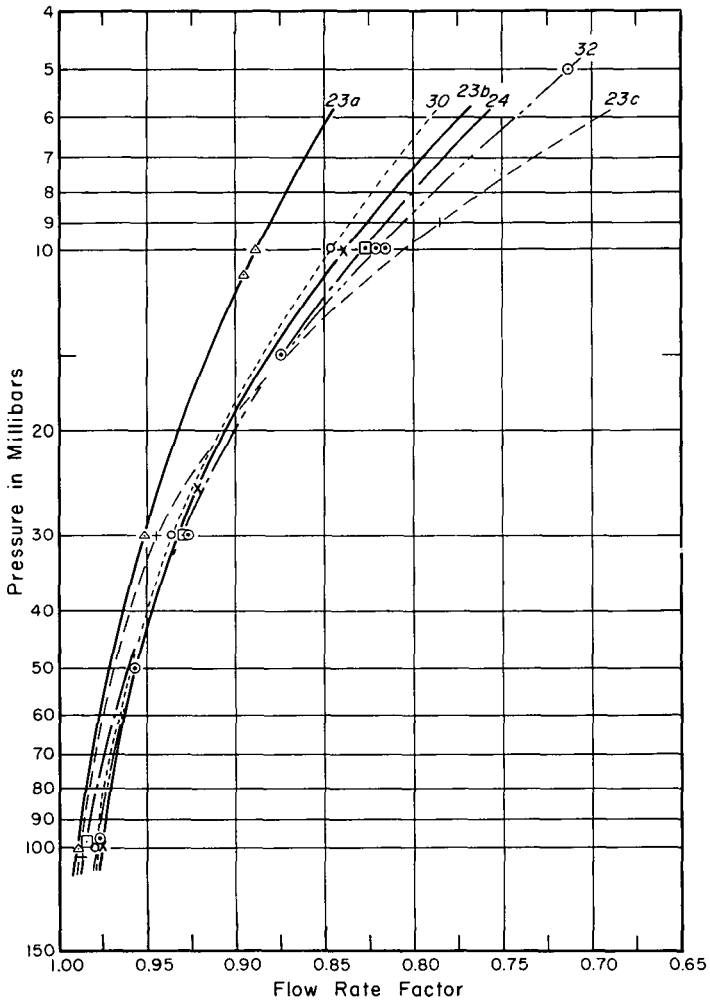

FIGURE 1.—Flow-rate factors (ratio of flow rate at indicated reduced pressure to flow rate at atmospheric pressure) for Mast-Brewer ozone sensor pumps. (See text for identification of different curves.)

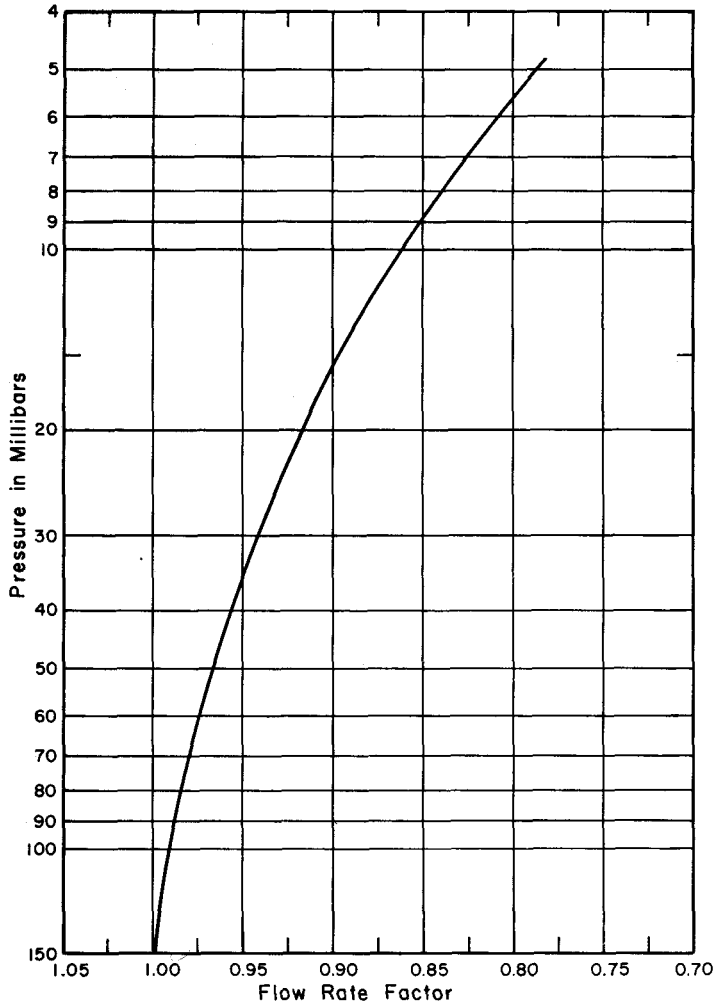

FIGURE 2.—Average flow-rate factors for Mast-Brewer ozone sensor pumps.

formance of various pumps as well as a calibration error of ±2 percent due principally to uncertainties in pressure measurements made at the time of calibration, we estimate that the flow-rate factor determined for a particular pump from the average flow characteristic (fig. 2) may be in error by ±8 percent at 6 mb. pressure. A corresponding maximum error at 100 mb. pressure is probably ±2 percent.

REFERENCE

1. M. Griggs, "Studies in Atmospheric Ozone," a thesis submitted for the degree of Doctor of Philosophy in the University of Oxford, Clarendon Laboratory, Oxford, England, May 1961.

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CORRECTION

Vol. 93, No. 2, February 1965, p. 98, figures 7 and 8: The two illustrations should be interchanged. The smaller one is described by the caption designated figure 7, the larger by the caption designated figure 8.