A New Method for Calibrating the Kofranyi-Michaelis Respirometer

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A method is described of calibrating the Kofranyi-Michaelis (KM) respirometer under normal laboratory conditions using expired air from a subject exercising in the steady state.

During the calibration procedure the KM is connected to the subject via a valve and respiratory tubing and placed in a large airtight Perspex box from which an outlet tube passes to a Douglas bag. Calibration is made by comparing during a given time the content and volume of expired air in the Douglas bag with that passing through the meter at several different exercise flow rates.

An example of a typical calibration experiment is given.

The reliability of the Kofranyi-Michaelis (KM) respirometer has now been well established but the instrument has always proved difficult to calibrate accurately under normal laboratory conditions. Several workers have suggested simulation techniques incorporating either Douglas bags (Durnin, 1955) or mechanical interrupter mechanisms (Reindeau and Consolazio, 1959) to produce intermittent flow resembling respiration. However these methods are cumbersome and artificial. From the physiological viewpoint a better method, as suggested by the work of Insull (1954), would be to measure energy cost with the KM and standard bag method simultaneously on subjects exercising in the steady state at various different grades of work increasing in severity. Unfortunately, the present design of the KM precludes this. The major portion of the expired air content is allowed to escape through a diffuse network of holes in the top of the instrument casing. We have overcome this problem by simply placing the KM in a specially designed Perspex box with a movable lid (Figure) so enabling the accuracy of the meter and sampling device to be tested simultaneously.

A subject is connected via respiratory tubing to the KM respirometer within the box, and the lid is sealed in position by wing nuts. A little petroleum jelly smeared evenly on the rubber inlay inside the lid ensures an air-tight joint. (This can be tested by immersion in water immediately before use.) Expired air passes freely from the KM to the Douglas bag. A little glycerine spread evenly on the inside of the box opposite the Veeder counter of the KM prevents condensation and ensures that

FIGURE. The KM respirometer calibration box.

volume readings can be taken. Five minutes of exercise should be allowed for the subject to reach a 'steady state' and care must be taken during the calibration procedure to ensure that the Veeder counter readings are recorded so as to coincide with the opening and closing of the Douglas bag taps. Representative samples of expired air are collected from the Douglas bag and KM in the usual way. The volume of the Douglas bag can later be ascertained by passage through a wet or dry gas meter. To arrive at the true volume of expired air, the small volume of air in the KM sampling bag must be added to that of the Douglas bag and the usual corrections made for temperature and pressure.

The results of a typical calibration experiment are shown in the Table. From the ventilatory data a calibration chart can be constructed. Thus if the

TABLE
A TYPICAL CALIBRATION EXPERIMENT

Volume of Expired Air (l./min. S.T.P.D.)			O ₂ Content of Expired Air (%)	
Douglas Bag	KM Respirometer	Correction Factor	Douglas Bag	KM Respirometer
9.58	9.40	1.019	14.41	14.46
19.50	19.19	1.016	14.83	14.80
24.52	24.25	1.011	14.60	14.58
33.17	32.50	1.021	14.36	14.31
45.54	44.36	1.027	14.89	14.88
57.25	55.28	1.036	16.84	16.90

meter registers 225 l. of gas passing through the meter in 5 min. then the true pulmonary ventilation will be $\frac{225}{5} \times 1.027 = 46.22$ l./min. and this can be corrected to S.T.P.D. or B.T.P.S.

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