

A nomogram for B.T.P.S.-volume corrections in pulmonary ventilation tests

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The conversion of a spirometer tracing into a volume of gas corrected to body temperature and pressure saturated with water vapour (B.T.P.S.-volume) involves: (a) a factor to convert centimetres of tracing height to millilitres of gas at the existing (or 'ambient') temperature and pressure saturated with water vapour (A.T.P.S.-volume), this factor being 300 for the Godart apparatus in use in this Unit, since 1 cm. is equivalent to 300 ml. of gas; (b) conversion of A.T.P.S.-volume to B.T.P.S.-volume by the application of Boyle's and Charles' laws and the known values of water vapour partial pressure at different temperatures.

Detailed investigation of a single patient requires that these steps should be repeated many times. Hence a welcome contribution was the provision of a set of factors for the second calculation in the range 20–37°C. (Comroe, Forster, Dubois, Briscoe, and Carlsen, 1962), barometric pressure changes between 750 and 770 mm. Hg having been shown to be insignificant. These factors are therefore primarily dependent upon laboratory temperature.

This paper extends the range of the Comroe factors to 15–40°C., as these extremes have occasionally been required, and presents an easily constructed nomogram for the complete calculation.

THE B.T.P.S.-VOLUME CORRECTION FACTORS

Applying the gas laws, Comroe's factors were obtained from the equation:

$$\begin{aligned} \text{Correction factor} &= \left(\frac{273+37}{273+T} \right) \times \left(\frac{760-P}{760-47.1} \right) \\ &= 0.435 \left(\frac{760-P}{273+T} \right) \end{aligned}$$

where T°C. is the laboratory temperature, and P mm. Hg is the partial pressure of water vapour at T°C.

The Table shows the B.T.P.S.-volume correction factors from 15 to 40°C., the 20–37°C. range having been derived from Comroe *et al.* (1962).

TABLE

Temperature (°C.)	Partial Pressure of Water Vapour (mm. Hg)	B.T.P.S.-volume Correction Factor
15	12.8	1.128
16	13.6	1.123
17	14.5	1.118
18	15.5	1.113
19	16.5	1.108
20	17.5	1.102
21	18.7	1.096
22	19.8	1.091
23	21.1	1.085
24	22.4	1.080
25	23.8	1.075
26	25.2	1.069
27	26.7	1.063
28	28.3	1.057
29	30.0	1.051
30	31.8	1.045
31	33.7	1.039
32	35.7	1.032
33	37.7	1.026
34	39.9	1.020
35	42.2	1.014
36	44.6	1.007
37	47.1	1.000
38	49.7	0.994
39	52.4	0.987
40	55.3	0.980

Modified from Comroe *et al.* (1962)

THE B.T.P.S.-VOLUME CORRECTION NOMOGRAM

Using the full range of factors, a nomogram has been constructed which enables B.T.P.S.-volumes to be obtained with a precision of 10 ml. in the range 0–8,000 ml. (Figure).

In this Unit an enlarged version of the nomogram has been firmly pasted on to plyboard and lacquered. Readings are taken by means of a Perspex strip, $\frac{1}{8}$ in. thick, with a single midline ruling.

Since laboratory temperature usually remains constant for a particular test session, it is convenient to fix the ruling at this reading. This is simply done by drilling fine holes through the degree points on the temperature scale, and fixing a suitable pin through the hair-line at one end of

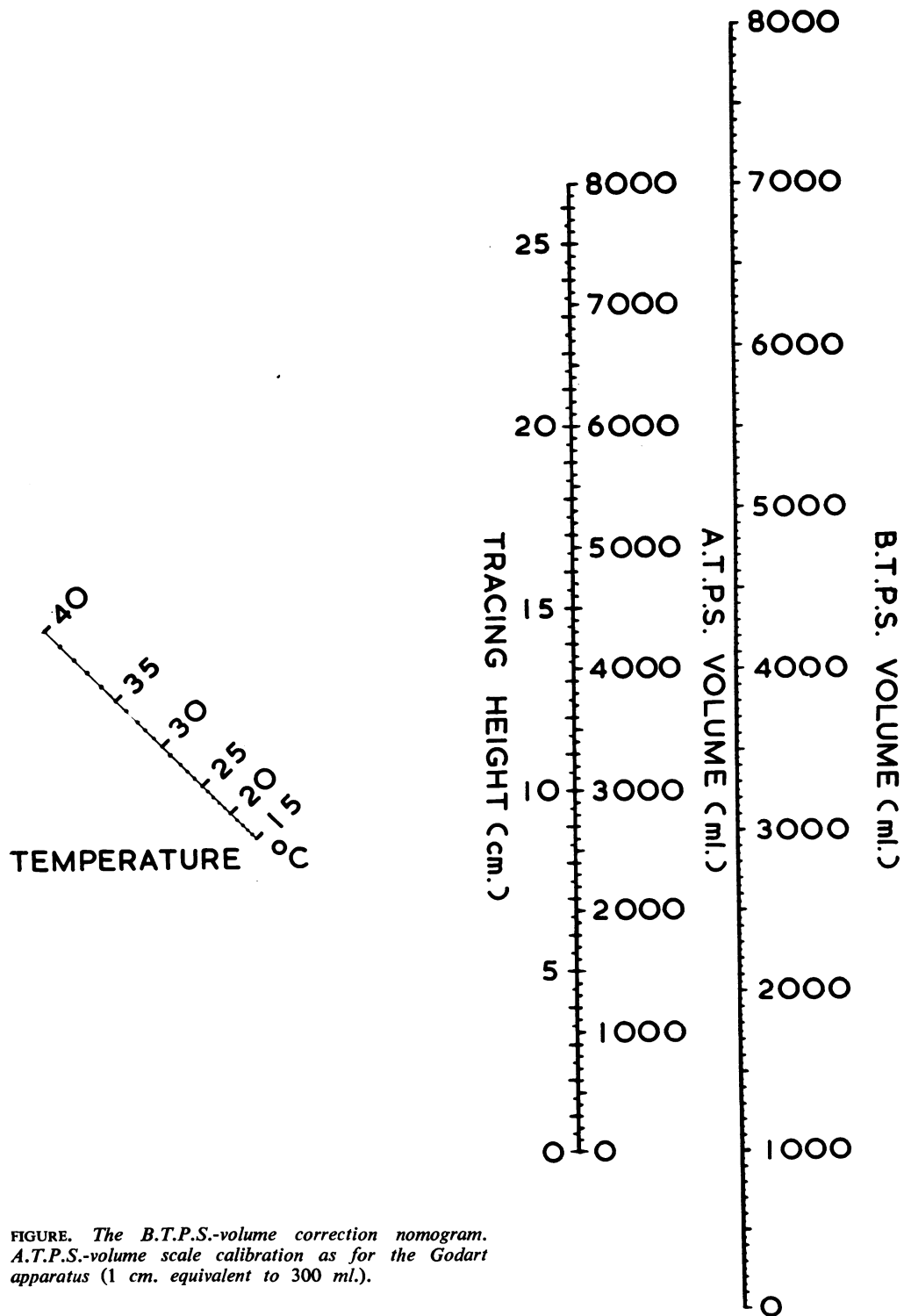


FIGURE. The B.T.P.S.-volume correction nomogram. A.T.P.S.-volume scale calibration as for the Godart apparatus (1 cm. equivalent to 300 ml.).

the Perspex strip. Speed and ease of operation of the nomogram are then greatly improved.

With the temperature point fixed, the ruler is rotated to the value of the tracing height measurement (centre scale) and the corresponding B.T.P.S.-volume read off the right-hand scale. A.T.P.S.-volumes are scaled alongside tracing height, should these be required. For apparatus where the relation of 1 cm. tracing height: 300 ml. A.T.P.S.-volume does not apply, only the tracing height scale need be changed, since the inter-relations of temperature, A.T.P.S.-volume, and B.T.P.S.-volume remain the same.

A convenient size for a working nomogram has been found to be that with a B.T.P.S.-volume scale 16 in. in length, when 0.1 in. corresponds to 50 ml. Such a nomogram requires a 12-inch ruler.

SUMMARY

In pulmonary function tests repetitive calculations are required to convert the height of the spirometer tracing in centimetres into gas volume, and then

to apply temperature and pressure corrections. For some time, a range of factors (Comroe) has been available to assist in the second of these calculations.

This paper presents an easily constructed nomogram which performs the complete conversion of centimetres of spirometer tracing height to millilitres of gas volume, corrected to body temperature and pressure saturated with water vapour, with a precision of 10 ml. over the range 0–8,000 ml., for temperatures between 15 and 40°C.

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REFERENCE

- Comroe, J. H., Forster, R. E., Dubois, A. B., Briscoe, W. A., and Carlsen, E. (1962). *The Lung: Clinical Physiology and Pulmonary Function Tests* 2nd ed., p. 334. Year Book Publ., Chicago.