

mean velocity head is needed; and to obtain a correct mean velocity head it is necessary to average the square roots of all the velocity head readings taken, throughout the cross-sectional area of the pipe, and then to square the average.

There is at present no royal road to obtaining accurate velocity measurements by means of the pitot tube. Investigators, to obtain accurate results, must have recourse to the painstaking methods adopted by Rowse. We are told that, for a 12-inch pipe, results within 2 per cent of correct may be obtained by using 0.8 of the velocity head in feet of gas at the center of the pipe. Lacking similar factors for pipes of other sizes, velocities must be calculated from readings taken at numerous points in the cross-sectional area of the pipe.

In recapitulation, it may be observed that:

I—As a result of the work of Rowse, engineers may now select a type of pitot tube which may be used, under certain conditions, with confidence.

II—Further investigation needed, to render the pitot tube more generally available as a means of measuring gas velocities, includes:

1—A means of determining accurately the velocity of gases in pipes whose length is less than 20 times the diameter.

2—The establishment of definite relations between the velocity head at the center of a pipe, and the mean velocity head, for pipes of various sizes and shapes.

NOTE—I am indebted to the author of the original paper which constitutes the basis for this one—Mr. W. C. Rowse—for his courtesy in reading this manuscript, and for valuable suggestions offered by him and adopted herein.

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### THE NON-UNIFORMITY OF DRYING OVEN TEMPERATURES

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While testing the accuracy of the heat control of a new electric drying oven, it was observed that there

In the above tests only those thermometers were used which had been standardized by the Bureau of Standards. With ovens having glass doors the thermometers were placed on the shelves and the temperatures read by making the observations through the glass in the door without opening the oven. With the other ovens the following scheme was adopted: Six 50 cc. Erlenmeyer flasks were filled with clean, dry sand, stoppered, and through the stoppers the thermometers were inserted so that the bulbs were held in the middle of the flasks. These flasks with their thermometers were then placed in the various positions in the ovens and after having remained there long enough to come to equilibrium they were removed and the thermometers read as quickly as possible. While this method is not absolutely accurate, it is sufficiently so to indicate whether or not there is any great variation in temperature.

After testing these various drying ovens the writer's attention was called to an article to R. G. Grimwood<sup>1</sup> on the "Analysis of Crude Glycerine by The International Standard Methods, 1911." In this article the author mentions difficulty when using a drying oven which complies with the International Standard Methods specifications and which shows a maximum variation of 16° C. on one shelf and between the two shelves a maximum variation of 45° C. He then describes a special electric drying oven which has proved satisfactory for drying glycerin. This oven showed a maximum variation of 2.2° C. from 160° C., the temperature desired. The results shown by Mr. Grimwood are very much better than the writer was able to obtain with any oven not surrounded by boiling water and steam.

The results in the above table show that elaborately designed and expensive ovens are no more reliable than the most simple and inexpensive ones. Of the ovens tested, only those surrounded by boiling water and steam are capable of maintaining even approximately uniform temperatures.

I wish to thank Dr. J. A. LeClerc for his interest

No.	Kind of oven	Reading of thermometer inserted through top of oven °C	Maximum range of temperature on		Maximum variation on both shelves °C	Approximate dimensions inside in.
			top shelf °C	lower shelf °C		
1	Electrically heated and controlled.....	107	99-114	90-108	24	12 × 12 × 14
2	Electrically heated and controlled.....	105	89-100	88-103	15	12 × 13 × 18
3	Electrically heated and controlled.....	103	94-104	89-102	15	9 × 9 × 15
4	Gas heated porcelain lined.....	90	88- 92	92-102	14	11 × 12 × 16
5	Gas heated air jacketed.....	100	94- 96	105-118	24	8 × 10 × 11
6	Gas heated constant level water and steam jacketed.....	98	96- 99	95- 98	4	13 × 15 × 15
7	Steam jacketed.....	100	101-101	101-102	2	15 × 8 in. diam.
8	Gas heated constant level water and steam jacketed vacuum oven..	100	100-100	100-100	0	15 × 8 in. diam.

was a wide range of temperature in different parts of the oven, not only between different shelves but also between different positions on the same shelf. Ordinarily the temperature recorded on the thermometer inserted through the top of an oven is taken as the temperature at which the drying is made, but it was seen that such could not be done with this particular oven. Following this observation a number of different types of drying ovens were tested as to their uniformity of temperatures throughout the drying chambers. The variations in temperature are shown in the accompanying table.

and suggestions in connection with the testing of these various ovens and the writing of this report.

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### A MANOSTAT FOR USE IN GAS ANALYSIS

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In the combustion of gases confined over mercury in a combustion pipette, more or less difficulty is always experienced by the operator in avoiding a difference of pressure due to the difference of level between that

<sup>1</sup> J. Soc. Chem. Ind., 32, 22.