

STUDYING THE EFFECT OF VARIOUS GASES ON THE OUTPUT CHARACTERISTICS OF THERMOCOUPLE PRESSURE TRANSDUCERS

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The main cause of the limited use of commercial thermocouple transducers for pressure measurements in modern technological processes using various gases in a moderate vacuum is the calibration of commercial transducers against dry air. Therefore, increasingly close attention is being paid to the problem of expanding the possibilities of using thermocouple transducers for accurately measuring the pressure of various gases, in particular, aggressive gases, in a pressure range of 5 to 1×10^{-3} mmHg. In this study, the possibility of using thermocouple pressure transducers with a conversion range of 20 to 5×10^{-5} mmHg and a conversion error of 10–15% for measuring the pressure of various gases has been explored; the output characteristics of the film transducer model taking into account the design features of the transducer have been calculated; and experimental studies of the output characteristics of thermocouple gas pressure transducers have been conducted. The calibration characteristics of the thermocouple transducer for air, nitrogen, carbon dioxide, and argon have been determined. Analysis of the experimental data suggests that the dependence of the effect of various gases on the calibration characteristics is more complex than the dependence that could be assumed according to the calculated data. Thus, the relative behavior of the curves in a pressure range of 1×10^{-4} to 10 mmHg does not remain constant and significantly depends on pressure. The discrepancy between the calculated and experimental data can apparently be attributed to the following factors: (i) idealization of the calculation model, (ii) insufficient reliability of reference data that characterize the studied gases, and (iii) design and technological imperfection of real pressure transducers. The calibration characteristics of thermocouple transducers depend on the type of gas; to date, correlation coefficients based on constants that determine gases (molecular mass, thermal conductivity, heat capacity), which could be introduced, even for a known composition of the gaseous medium, to take into account the effect of the gaseous medium composition on the pressure measurement accuracy have not been revealed. However, experimental studies have shown a real possibility of using thermocouple (and in a broader sense) thermal converters to measure the pressure of various gases in a wide pressure range with a low error, subject to mandatory precalibration of the transducers for each of the gases or their mixture. In addition, a constant pattern of the dependence of the calibration characteristic of the thermocouple transducer for different gases is observed over the entire pressure range of 5 to 5×10^{-3} mmHg. Owing to this feature, a thermocouple transducer can be calibrated for different gases at one pressure point using a strain transducer, the readings of which do not depend on the type of gas; subsequently, certain coefficients can be used for any transducers of this type in a pressure range of 5 to 5×10^{-3} mmHg.

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