

U. S. Department of Commerce
Frederick B. Dent
Secretary

National Bureau of Standards
Richard W. Roberts, Director

National Bureau of Standards
Certificate of Calibration
Standard Reference Material 1629
Nitrogen Dioxide Permeation Device

This Standard Reference Material consists of a nitrogen dioxide permeation device, individually calibrated, for use in the preparation of gases of known nitrogen dioxide content. It is intended for the standardization of apparatus and procedures used in air pollution and related chemical analyses.

The certified permeation rate in micrograms of nitrogen dioxide per minute at 25 °C is given in a table accompanying each device. The uncertainty given for this value is the 95 percent confidence limit of the mean based on ten measurements of the rate. This certified value is considered valid within the limits shown for a period of six months from the date of shipment from the National Bureau of Standards.

The nitrogen dioxide permeation device was fabricated by W. D. Dorko and E. R. Deardorff of the Analytical Chemistry Division. Measurements of permeation rates were performed by D. Friend.

The overall direction and coordination of the technical effort leading to certification were performed under the chairmanship of E. E. Hughes and J. K. Taylor.

The technical and support aspects involved in the fabrication, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by T. W. Mears.

Washington, D. C. 20234
March 11, 1975

J. Paul Cali, Chief
Office of Standard Reference Materials

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Use

This device can be used to produce mixtures of nitrogen dioxide in air or other gas by placing the device in a stream of the dry gas flowing at a known rate and at a known constant temperature. The accuracy of the concentration produced is dependent not only on the accuracy with which the device is calibrated but, as importantly, on the accuracy with which the rate of flow and the temperature are known. Systems for generating known concentrations of nitrogen dioxide with the device are described elsewhere (1) (2).

When the device is first placed in service a period of at least 24 hours should be allowed for equilibration at the temperature at which it is to be used.

It is recommended that the device be used at the calibration temperature of 25.0 °C, but if the temperature does not vary more than 5 °C from 25 °C an adjustment to the rate may be made according to the equation:

$$\log R_t = \log R_{25\text{ }^\circ\text{C}} + 0.035104 (t - 25.0)$$

where R_t is the permeation rate of the device at the temperature of use, t , and R_{25} is the certified rate of the device at 25.0 °C. The constant, 0.035104, is empirically determined using observations of the temperature-rate relationships for identical devices at temperatures between 20 °C and 30 °C. The additional uncertainty in the calculated value for the rate at temperatures of 1 °C above or below 25.0 °C is approximately ± 0.4 percent; and 5 °C above or below 25.0 °C, the added uncertainty is ± 2 percent of the certified rate.

Precautions and Storage

The rate of permeation of nitrogen dioxide from this device may be adversely affected by exposure to temperatures greater than 35 °C and by exposure to moist air. It is recommended that the device be stored between periods of use in a container maintained at about 25 °C and through which a slow flow of dry air (<5 percent relative humidity) is passed. Upon receipt of the device it should be removed from the protective plastic sleeve and placed in the above described storage container. At no time should the device be exposed to moist air other than for the brief period necessary for transfer from one container to another. Low temperature storage of the device is not recommended.

The device consists essentially of a glass reservoir and a short Teflon permeation tube. The device contains less than a gram of liquid nitrogen dioxide at a pressure of one atmosphere (100 kPa). The device is fragile and care should be exercised in handling. In the event of breakage care should be taken that no person is exposed to the fumes.

Calibration

This device was individually calibrated by gravimetric determination of the weight loss at 25 °C. The device was held at this temperature for a period of not less than two months during which time, periodic measurements of weight were made.

The accuracy of calibration was estimated from measurements of approximately 50 devices in this lot. The uncertainties are the approximate half-width of the 95 - percent confidence interval. It is believed that the systematic error concerned with these calibrations is negligible.

References

- (1) Health Laboratory Science, No. 1, 4 (1970)
- (2) F. P. Scarringelli, A. E. O'Keefe, E. Rosenhart and J. P. Bell, Anal. Chem. 42, 871 (1970)