

International Standard



5281

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

ANSI Internat Doc Sect

Aromatic hydrocarbons — Benzene, xylene and toluene — Determination of density at 20 °C

Hydrocarbures aromatiques — Benzène, xylène et toluène — Détermination de la masse volumique à 20 °C

First edition — 1980-02-15

FEB 22 1980

UDC 661.715.4/.7 : 531.756.3/.4

Ref. No. ISO 5281-1980 (E)

Descriptors : aromatic hydrocarbons, benzene, xylenes, toluene, density measurement, density (mass/volume), analysis methods, pycnometric analysis, areometric analysis

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 5281 was developed by Technical Committee ISO/TC 78, *Aromatic hydrocarbons*, and was circulated to the member bodies in October 1977.

It has been approved by the member bodies of the following countries :

Australia	Germany, F.R.	Portugal
Austria	Hungary	Romania
Brazil	India	South Africa, Rep. of
Bulgaria	Korea, Rep. of	Turkey
Chile	Mexico	United Kingdom
Czechoslovakia	Netherlands	USSR
Egypt. Arab Rep. of	Philippines	Yugoslavia
France	Poland	

No member body expressed disapproval of the document.

Aromatic hydrocarbons — Benzene, xylene and toluene — Determination of density at 20 °C

WARNING — Aromatic hydrocarbons are generally toxic by inhalation, ingestion or skin absorption. Volatile aromatic hydrocarbons are also highly flammable.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies pycnometer and hydrometer methods for the determination of the density at 20 °C of benzene, xylene and toluene.

2 REFERENCES

ISO 387, *Hydrometers — Principles of construction and adjustment*.

ISO 649, *Laboratory glassware — Density hydrometers for general purposes*.¹⁾

ISO 1995, *Aromatic hydrocarbons — Sampling*.²⁾

ISO 3507, *Pycnometers*.

3 DEFINITION

For the purpose of this International Standard, the following definition applies :

density : The ratio of mass to volume at a given temperature called the reference temperature.

For the purposes of standard tests, density is expressed in grams per millilitre. For all products the reference temperature is 20 °C.

This definition is concerned with mass, not with weight, in air, but the conversion tables given in the pycnometer method make allowance for the weighing in air. The scales of density hydrometers complying with ISO 649 are graduated in terms of mass per unit volume.

4 PRINCIPLES

4.1 Pycnometer method

Weighing of a pycnometer empty, then filled with water and, finally, filled with the aromatic hydrocarbon under test, at known temperatures. Calculation of the density from the values obtained, applying certain corrections given in tables.

4.2 Hydrometer method

Immersion of a hydrometer in the aromatic hydrocarbon under test, and recording of the hydrometer scale reading and the temperature. Calculation of the density from the values obtained, after applying a correction, obtained from the calibration certificate.

5 SAMPLING

Take a representative sample of not less than 1 000 ml from the bulk of the material.

Recommended methods of sampling are given in ISO 1995.

6 PYCNOMETER METHOD

6.1 Apparatus

6.1.1 Pycnometer, Lipkin, of borosilicate glass, 10 ml capacity, complying with the requirements of ISO 3507, type 1.

6.1.2 Water bath, glass-sided, of depth greater than 300 mm, thermostatically controlled to within 0,1 °C at any convenient temperature between 10 and 30 °C.

6.1.3 Thermometers, complying with the requirements given in the annex.

6.2 Procedure

6.2.1 Cleaning

Before calibrating the pycnometer (6.1.1), or when any liquid fails to drain cleanly from the walls or capillary of the pycnometer, clean it as follows.

Fill the pycnometer with chromic acid solution, or alternatively with a suitable distilled detergent. Allow to stand overnight empty and rinse well with distilled water followed by anhydrous acetone. Dry the pycnometer by passing a slow stream of dry filtered air through it. Between determinations, rinse the pycnometer with toluene followed by anhydrous acetone and dry it as before.

1) At present at the stage of draft. (Revision of ISO/R 649.)

2) At present at the stage of draft.

6.2.2 General procedure

Remove any static charge from the dry, clean pyknometer, which may conveniently be done by breathing on it, or alternatively by wiping it with a clean, lint-free cloth slightly dampened with water.

Suspend the pyknometer in the balance case for 15 min, then weigh it to the nearest 0,1 mg.

Fill the pyknometer by holding it in an upright position and placing the hooked tip in the liquid; the liquid will be drawn over the bend in the capillary tube by surface tension and the pyknometer will then fill by syphoning. Break the syphon when the liquid level in the bulb arm of the pyknometer reaches the graduated capillary tube. Clean the hooked tip, remove any static charge and weigh as described above. Calculate the mass of liquid in the pyknometer. Place the filled pyknometer in the holder and place the assembly in the water bath (6.1.2) so that the pyknometer is vertical and the liquid levels in the capillary arms are just below the surface of the water. When the liquid has reached the water bath temperature as indicated by a static liquid level (usually in about 10 min) and while the instrument is still in the water bath, read the liquid levels in the capillary arms to the nearest 0,2 of a small division.

Record the sum of the two readings to give the scale volume and also record the temperature of the water bath to the nearest 0,1 °C.

6.2.3 Calibration

Using freshly boiled and cooled distilled water, and following the procedure described above, record the mass of water, the scale volume and the temperature reading for a filling that gives a water level in the pyknometer that is near the top of each scale. Repeat this operation three times, removing a little water each time, so that the series of scale volumes obtained is spaced at approximately equal distances over the whole length of the pyknometer scale.

For each series of recordings calculate the volume, V_{20} , in millilitres, of the pyknometer at 20 °C as follows :

$$V_{20} = m_t \times M_1$$

where

m_t is the difference, in grams, between the results of weighing the pyknometer full and weighing it empty at t °C;

M_1 is the multiplication factor, in millilitres per gram, obtained from table 1 as a function of t ;

t is the water bath temperature, in degrees Celsius.

Plot the corresponding scale volumes and the volumes at 20 °C and construct a mean straight line through the four points, none of which should be more than half a pykno-

meter scale division from this line. If this limitation is not satisfied and, after making further checks, it is found that an acceptable straight line cannot be constructed through the points, a non-uniform bore of the capillary tubes is indicated and the pyknometer shall be rejected.

The line so obtained is the calibration graph of the pyknometer relating the scale volume to the volume of the pyknometer at 20 °C.

6.3 Determination of density of aromatic hydrocarbons

Determine the density of the sample (see clause 5) using the procedure specified in 6.2.2.

6.4 Calculation of density

Calculate the density, ρ_{20} , in grams per millilitre, of the sample at 20 °C as follows :

$$\rho_{20} = \frac{m}{V_{20}} \times M_2 + 0,0012$$

where

m is the corrected mass, in grams, of the test portion at t °C, obtained from the mass, the scale volume and the calibration graph;

M_2 is the multiplication factor, obtained from table 2 as a function of t ;

t is the water bath temperature, in degrees Celsius;

V_{20} is the pyknometer volume at 20 °C, in millilitres, calculated in accordance with 6.2.3.

6.5 Precision

The precision of the test method, as obtained by statistical examination of interlaboratory results obtained for benzene, toluene and xylene, is as follows :

6.5.1 Repeatability (r)

The value below which the absolute difference between two single test results, on identical test material, obtained by one operator in one laboratory using the same equipment within a short interval of time, applying the standardized test method, may be expected to lie with a 95 % probability, is 0,000 2 g/ml.

6.5.2 Reproducibility (R)

The value below which the absolute difference between two single test results, on identical test material, obtained by operators in different laboratories, applying the standardized test method, may be expected to lie with a 95 % probability, is 0,000 3 g/ml.