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DARS 2229

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Alcoholic beverages — Methods of sampling and test

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Foreword

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This African Standard was prepared by ARSO/TC 18, *Alcoholic and non-alcoholic beverages*.

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Introduction

The production and consumption of alcoholic beverages has increased significantly in the continent. Therefore, there is a need to protect the consumers and control the quality of alcoholic beverages produced in the African continent through the application of acceptable sampling and testing procedures for the evaluation of the various inherent characteristics.

This standard is intended for the introduction of uniform methods of sampling and tests for alcoholic beverages.

Alcoholic beverages — Methods of sampling and test

1 Scope

This Working draft prescribes methods of sampling and tests for alcoholic beverages.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ARS 53, *General principles of food hygiene — Code of practice*

ARS 56, *Pre-packaged Foods — Labelling*

ARS 2223, *Distilled water — Specification*

OIML R22, *International alcoholometric tables*

3 Terms and definitions

For the purpose of this standard, the following terms and definitions apply.

3.1
observed specific gravity
specific gravity obtained by the pyknometer method at sample temperature, t °C with respect to that of water at 20 °C ± 0.05 °C

3.2
single bulk method
when a measured volume, say 100 mL, of a spiritous preparation is diluted and distilled to collect the same volume of distillate, that is 100 mL

3.3
double bulk method
when a measured volume, say 50 mL, of a spiritous preparation is diluted and distilled to collect distillate twice the original volume of sample, that is 100 mL

3.4
treble bulk method
when a measured volume, say 25 mL, of a spiritous preparation is diluted and distilled to collect thrice the volume of sample, that is 75 mL

3.5
quadruple bulk method
when a measured volume, say 25 mL, of a spiritous preparation is diluted and distilled to collect four times the volume of sample, that is 100 mL

3.6
lot
quantity of packed alcohol of the same type from the same batch of manufacture at one time

3.7
specific gravity
ratio of the mass of a given volume of the sample at the specified temperature to the mass of an equal volume of distilled water at the same temperature

4 Sampling requirements

4.1 General precautions in sampling

In drawing, preparing, storing and handling samples, the following precautions and directions shall be observed as far as possible:

a) samples shall be taken in a protected place not exposed to damp air, dust or soot;

b) the sampling instruments shall be clean and dry;

c) to draw representative sample, the contents of each container selected for sampling shall be mixed as thoroughly as possible by suitable means;

d) precautions shall be taken to protect the samples, the material being sampled, the sampling instrument and the container for samples from extraneous contamination;

e) samples shall be placed in suitable containers that are clean and dry. Appropriate sampling cans and tubes in terms of size and volume shall be used where required;

f) the sample containers shall be of such size that sufficient head space to allow for expansion of the liquid is left after pouring in the samples;

g) each sample container shall be sealed airtight with a suitable stopper after filling;

h) each sample thus sealed shall be marked with full details of sampling, including the date of sampling, and other details necessary for traceability. and

i) samples shall be stored in cool, dark and dry place.

4.2 Scale of sampling

4.2.1 Samples shall be randomly selected from each lot separately and tested for ascertaining their conformity to the requirements of relevant specifications.

4.2.2 The number of individual packages to be selected from a lot shall as far as practicable be as given in Table 1.

Table 1 — Scale of sampling

Number of packages in the lot	Number of packages to be selected
up to 1 200	9
1 201 to 3 600	12
3 601 to 10 800	15
10 801 and above	21

4.2.3 The individual packages from the lot shall be chosen at random. As a first step, 2 % of the cases or cartons shall be chosen at random. All the cases thus selected shall be opened and the individual packages examined visually for conditions of packing, the external appearance and the fill.

The lot shall be considered satisfactory if the individual packages in cases or cartons opened are found conforming to the requirements of the characteristics. In case any defectives are found, 5 % of the cases shall be opened and individual packages examined for similar characteristics.

From each of the cases or cartons opened, an approximately equal number of individual packages shall be picked up from its different parts of layers so as to obtain the required number of bottles in the sample (see Table 1).

4.2.4 The sample of individual packages selected as in 4.2.3 shall be divided at random into three equal sets and labelled with all the particulars of sampling. One of these sets of samples of individual packages shall be for the regulator, another for the vendor/manufacturer and the third for the reference.

4.3 Criteria for sample testing

4.3.1 Tests for ethyl alcohol content shall be made on the individual sample packages. Organoleptic tests shall be based on the product standard.

4.3.2 Tests for other requirements of the relevant specifications shall be made on the composite sample prepared by thorough mixing of equal quantities from individual sample packages.

4.4 Criteria for conformity

4.4.1 For those characteristics where a composite sample has been tested from a lot in accordance with 4.3.2, only one test result shall be available, and the result shall satisfy the requirements of the specifications.

4.4.2 When three or more sample of individual packages have been analyzed individually from a lot for any particular characteristic, the following procedure shall be followed for judging the conformity to the requirements of that characteristic:

4.4.2.1 For the different test results obtained by analyzing different individual samples, the average *(* $\overline{X}$ *)* and the range *(R)* shall be calculated as follows:

$$\text{Average}\ \left(\overline{X}\right) = \frac{\text{The sum of the test results}}{\text{Number of test results}}$$

Range (R) = The difference between the maximum and the minimum values of the test results.

4.4.2.2 If the specification limit for the characteristic is given as a minimum, then the value of the expression *(* $\overline{X}$ - 0.6*R)* shall be calculated from the relevant test results. If the value so obtained is greater than or equal to the minimum limit, the lot shall be declared as conforming to the requirement of that characteristic.

4.4.2.3 If the specification limit for the characteristic is given as a maximum, then the value of expression ($\overline{X}$ + 0.6R) shall be calculated from the relevant test results. If the value so obtained is less than or equal to the maximum limit, the lot shall be declared as conforming to the requirement of that characteristic.

4.4.2.4 If the characteristic has two-sided specification limits, then the value of the expression ($\overline{X}$ – 0.6R) and ($\overline{X}$ + 0.6R) shall be calculated from the relevant test results. If the values so obtained lie between the two specification limits, that lot shall be declared as conforming to the requirements of that characteristic.

5 Quality of reagents

Unless otherwise specified, analytical grade reagents and distilled water complying with ARSO XXX shall be used in all tests.

NOTE Pure chemicals, should mean chemicals that do not contain impurities which affect the results of analysis (chemicals of analytical grade).

6 Determination of ethyl alcohol

6.1 General

Ethanol content of a liquor preparation may be quantitatively determined by specific gravity determination. However, prior to this determination ethanol contained in the liquor shall be obtained practically free from all other dissolved and undissolved substances except water. Simple direct distillation suffices where the admixed or dissolved ingredients are not volatile with steam. When volatile substances are present, it is necessary either to render them incapable of distillation or to remove them. All liquor preparations containing volatile acids or ammonia (or amines) are neutralized by an alkali or acid (sodium hydroxide or sulphuric acid).

Free iodine, if present, may first be converted into sodium iodide by treatment with sodium thiosulfate. Volatile oils, solvents etc. are removed by adopting the single, double, treble or quadruple bulk method. Through use of any of these methods a definite volume of the distillate is collected and its specific gravity determined by pyknometer method. Through suitable use of appropriate Tables I or Table II, in Annex A, ethanol content of liquor preparation is determined

NOTE On account of high vapour pressure of ethyl alcohol and its affinity for water, distillation of a concentrated liquor preparation into its own volume of water (single bulk method) to obtain an accurate determination of the amount of alcohol present is practically impossible with the apparatus and method commonly used. Consequently double, treble and quadruple bulks are generally used. As regards the extent of dilution, it has been found that alcohol in 25 mL of concentrated liqour preparation when diluted with water even to the extent of 500 ml and the solution saturated with salt may be entirely removed in the first 100 mL of the distillate. In the case of very low concentration liquor (under 20 % alcohol) the single bulk method is normally employed.

The ethanol content may also be determined using analytical techniques typically employed like Alcolyzers, Densitometers, Gas Chromatography equipped with a flame ionization detector (GC-FID).

6.2 Apparatus and equipment

6.2.1 Distillation assembly, the apparatus may be assembled as shown in Figure 1. The distillate end of the condenser is attached to a 50-ml pipette suitably shortened at the upper end and attached to the condenser nozzle by means of rubber tubing. The lower part of this pipette is suitably curved so as to reach the bottom of the receiver where it is slipped into the minimum quantity of distilled water.

6.2.2 Receiver, 200-ml capacity round-bottomed flask

6.2.3 Pyknometer, as shown in Figure 2, 25- 50 ml capacity

6.2.4 Thermometer, with the range of 0 °C to 50 °C shall be used

6.3 Reagents

6.3.1 Sodium chloride, analytical grade

6.3.2 Petroleum ether, 60/80

6.4. Pyknometer method I

6.4.1 Apparatus

6.4.1.1 Distillation assembly, the delivery end of the condenser is attached to a glass tube with a bulb by means of a ground glass joint. The lower part of this tube should reach the bottom of the receiver and dip into the minimum quantity of distilled water.

6.4.1.2 Pyknometer, 25 to 50-ml capacity

6.4.1.3 Thermometer, 0 °C to 50 °C

6.4.1.4 Measuring flask, 200-ml capacity

6.4.2 Procedure

Take 200 mL of sample in a 500-ml distillation flask containing about 25 mL of distilled water and a few pieces of pumice stone. Complete the distillation in about 35 min and collect the distillate in a 200-ml measuring flask till the volume in the flask nears the mark. Allow the distillate to come to room temperature. Make up the volume to 200 mL with distilled water and mix thoroughly.

Find out the specific gravity of the distillate at the required temperature with the help of a pyknometer. Obtain corresponding alcohol, percent by volume, from the table given in Annex A.

6.5 Distillation method

6.5.1 Apparatus

6.5.1.1 Distillation assembly

6.5.1.2 Measuring flask, 200- ml capacity

6.5.1.3 Separating funnels, 500-ml capacity

6.5.2 Reagents

6.5.2.1 Sodium chloride powder

6.5.2.2 Petroleum ether, 40 °C to 60 °C.

6.5.2.3 Sodium hydroxide, 0.1 N.

6.5.2.4 Phenolphthalein powder

6.6 Procedure

Measure 200 mL of the liquor sample in a measuring flask. Transfer to a separating funnel, wash, the measuring flask with about 100 mL of water, add the washings to the content of the separation funnel and add sufficient powdered sodium chloride to saturate the liquid. Add about 100 mL of petroleum ether and shake vigorously for 2 min to 3 min. Allow the mixture to stand for 15 min to 30 min and run the lower layer into a distillation flask. Wash the petroleum layer twice with about 20 mL of the saturated solution of sodium chloride.

Add these washings to the distillation flask. Make the mixed solutions just alkaline with sodium hydroxide solution using phenolphthalein powder as indicator, add a little pumice powder and distil. Collect the distillate in the measuring flask till it nears the mark. Bring the distillate to room temperature, make up the volume to with distilled water and mix thoroughly.

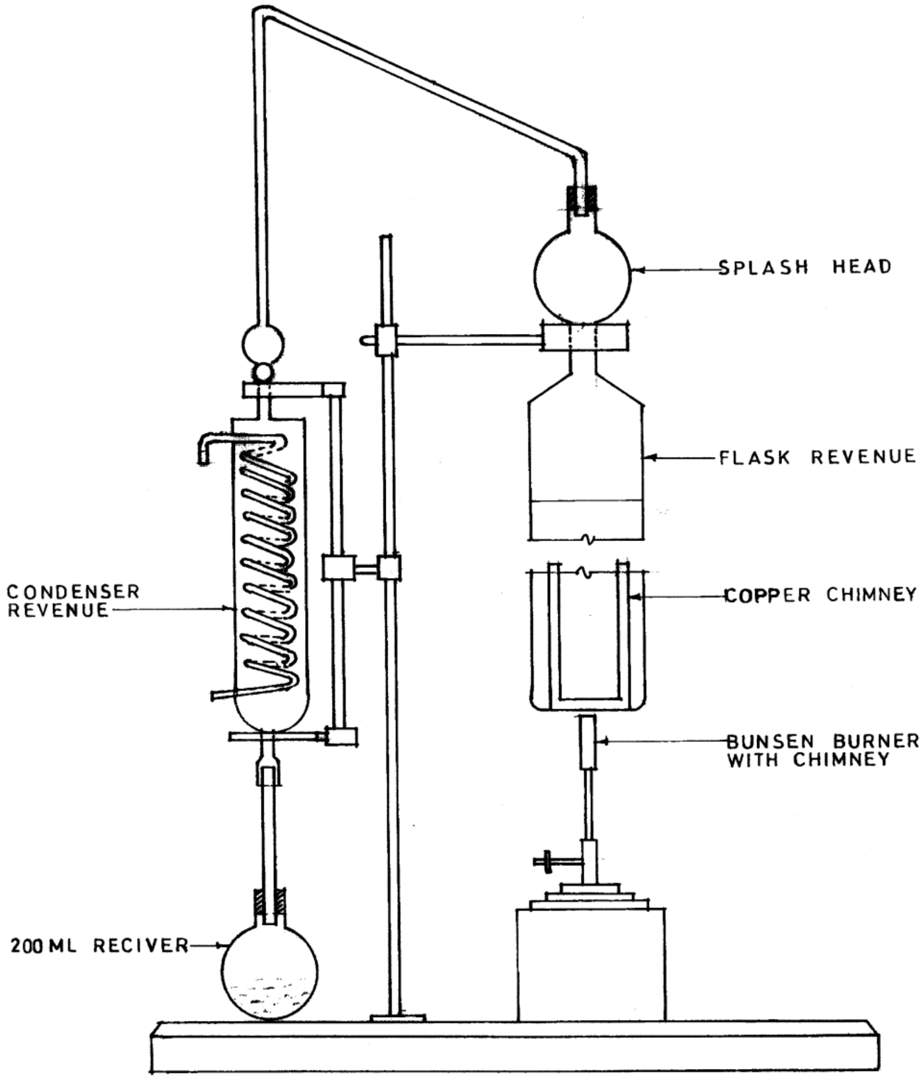


Figure 1 — Distillation assembly

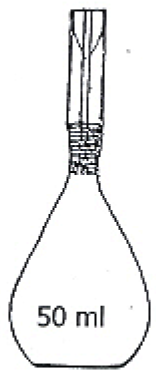


Figure 2 — Pyknometer capillary stoppered

7 Determination of specific gravity

7.1 Method

The specific gravity may be determined by means of a pyknometer (specific gravity bottle) or a special hydrometer for example the International Organization of Legal Metrology (OIML) hydrometer or densitometer. For accurate work the method using the specific gravity bottle shall be adopted in conjunction with the OIML R22.

7.2 Apparatus

For determination of specific gravity, two alternate specific gravity bottles showing Figure 3A and 3B are prescribed. In case of dispute the vacuum jacketed specific gravity bottle shown as Figure 3A shall be used.

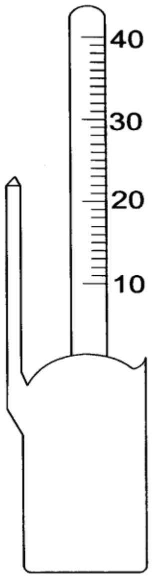


Figure 3A — Vacuum jacketed specific gravity bottle

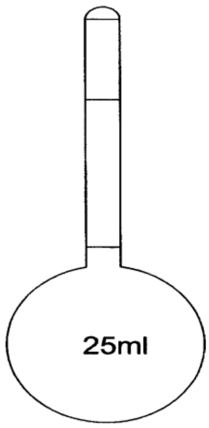


Figure 3 B — Renault's specific gravity bottle

7.3 Procedure

Weigh empty and dry pyknometer and record its weight. Cool the test sample of the material to 20 °C and fill into the pyknometer cooled to 20 °C. Fill the pyknometer to overflowing, taking care to avoid any head space and close with stopper. Clean and thoroughly dry the pyknometer before recording the sample temperature. Weigh immediately.

7.4 Calculation

Specific gravity at 20 °C

$$= \frac{A - B}{C - B}$$

where

A is the mass in grams of the specific gravity bottle with the sample at 20 °C;

B is the mass, in grams of the specific gravity bottle;

C is the mass, in grams, of the specific gravity bottle with water at 20 °C.

8 Determination of volatile acidity

8.1 Reagents

8.1.1 Standard sodium hydroxide, 0.05 M

8.1.2 Phenolphthalein indicator, 10g/L, prepare 1 % of phenolphthalein by dissolving 1 g of phenolphthalein in 100 mL of ethanol

8.2 Procedure

Take 50 mL of the distillate obtained from the determination of ethyl alcohol (see Clause 6) and titrate against standard alkali using phenolphthalein as indicator.

NOTE 1 ml of standard sodium hydroxide is equivalent to 0.003 g of acetic acid.

8.3 Calculation

Volatile acids expressed as acetic acid, grams per litre of absolute alcohol.

$$= \frac{V \times 0.003 \times 2}{V_1}(1000)$$

where

V is the volume in ml of alkali used for titration;

V_1 is the alcohol, % by volume.

9 Determination of fixed acidity

9.1 Reagents

9.1.1 Standard sodium hydroxide, 0.05 M

9.1.2 Phenolphthalein indicator, 10 g/L, prepare 1 % of phenolphthalein by dissolving 1 g of phenolphthalein in 100 mL of ethanol

9.1.3 Distilled water, distilled and boiled to remove carbon dioxide and neutralized

9.2 Procedure

Take 50 mL of the sample and evaporate to near dryness. Dilute with neutralized distilled water to 100 mL and again evaporate to dryness.

Dilute and titrate against standard sodium hydroxide solution using phenolphthalein as indicator. (1 mL of the standard sodium hydroxide is equivalent to 0.003 75 g of tartaric acid).

9.3 Calculation

Fixed acidity expressed as tartaric acid, grams per litre of absolute alcohol.

$$= \frac{V \times 0.003\,75 \times 1000 \times 2}{V_1}$$

where

V is the volume in mL of the standard sodium hydroxide used in the titration;

V_1 is the alcohol, % by volume.

10 Determination of total acidity

10.1 Method 1

10.1.1 Reagents

10.1.1.1 Standard sodium hydroxide, 0.05 M

10.1.1.2 Phenolphthalein indicator, 10 g/L, prepare 1 % of phenolphthalein by dissolving 1 g of phenolphthalein in 100 mL of ethanol.

10.1.2 Procedure

Take 50 mL of the sample and add about 200 mL of neutralized, distilled water. Titrate against sodium hydroxide solution using phenolphthalein as indicator.

NOTE 1 mL of standard sodium hydroxide is equivalent to 0.003 g of acetic acid.

10.1.3 Calculation

Total acidity, expressed as tartaric acid, grams per litre of absolute alcohol.

$$= \frac{0.00375 \times V \times 1000 \times 2}{V_1}$$

where

V is the volume, in mL of 0.1 N sodium hydroxide solution used for titrations;

V_1 is the absolute alcohol, per cent by volume.

10.2 Method 2

10.2.1 Apparatus

10.2.1.1 pH meter

10.2.1.2 Magnetic stirrer

10.2.2 Reagents

10.2.2.1 Standard sodium hydroxide, 0.05 M

10.2.2.2 Buffer solutions, of pH = 4.0, 7.0 and 10.0

10.2.3 Procedure

Calibrate and standardize the pH meter using the buffer solutions of pH = 4.0, 7.0 and 10.0. Add approximately 100 mL of distilled water to 250-ml beaker. Place one stirrer in the beaker and place it on the magnetic stirrer. Carefully immerse the electrode into the beaker. Add approximately 50 mL of sample and rapidly titrate with standard sodium hydroxide solution to pH 8.2. Add 50 mL of sample into the resulting solution and titrate to pH 8.2. Record the volume of standard sodium hydroxide solution consumed for the second titration.

10.2.4 Calculation

Calculate the total acidity as follows:

Total acidity expressed as tartaric acid, grams per litre of absolute alcohol:

$$= \frac{V \times 0.00375 \times 1000 \times 2}{V_1}$$

where

V is the volume of standard sodium hydroxide used for titration, in ml;

V_1 is the alcohol, percent by volume.

NOTE 1 mL of standard sodium hydroxide is equivalent to 0.00375 g of tartaric acid.11 Determination of esters as ethyl acetate.

11 Determination of esters

11.1 General

The esters as ethyl acetate may also be determined using Gas Chromatography equipped with a flame ionization detector (GC-FID).

11.2 Reagents

11.2.1 Standard sodium hydroxide, 0.1 M

11.2.2 Standard sulphuric acid, 0.05 M

11.3 Procedure

11.3.1 To the neutralized distillate from the volatile acidity determination (8.2) add 10 mL of the standard alkali and reflux it on a steam bath for an hour. Cool and back titrate the excess alkali with standard sulphuric acid.

NOTE 1 mL of standard alkali is equivalent to 0.0088 g of ethyl acetate.

11.3.2 Simultaneously run a blank taking 50 mL of distilled water in place of the distillate of the sample in the same way. The difference in titration value in millilitres of the standard acid solution gives the equivalent ester.

11.4 Calculation

Esters expressed as ethyl acetate, grams per litre of absolute alcohol:

$$= \frac{V \times 0.0088 \times 2}{V_1}(1000)$$

where

V is the difference in ml of standard acid used for blank and experiment;

V_1 is the alcohol, % by volume.

12 Determination of aldehydes as acetaldehydes

12.1 General

The aldehyde as acetaldehydes content may also be determined using Gas Chromatography equipped with a flame ionization detector (GC-FID), HPLC-UV, may also be used'

12.2 Apparatus

12.2.1 Iodine flask, of 250-mL capacity

12.2.2 Burette, of 25/50-mL capacity

12.3 Reagents

12.3.1 Sodium bisulphite solution, approximately 0.0025 M (0.05 N).

12.3.2 Standard iodine solution, 0.0025 M (0.05 N)

12.3.3 Standard sodium thiosulphate solution, 0.0025 M (0.05 N)

12.3.4 Starch, 1 %, as indicator

12.4 Procedure

Take 50 mL of the distillate obtained during ethanol determination, in 250-ml iodine flask and add 10 mL of bisulphite solution. Keep the flask in a dark place for 30 min with occasional shaking. Add 25 mL of the standard iodine solution and back titrate excess iodine against standard sodium thiosulphate solution using starch as indicator. Run a blank taking 50 mL of distilled water in place of the distillate of the liquor in the same way. The difference in titration value in millilitres sodium thiosulphate solution gives the equivalent aldehydes.

NOTE 1 mL of the standard sodium *thiosulphate* solution is equal to 0.0011 g of the acetaldehydes).

12.5 Calculation

Aldehydes expressed as acetaldehydes, grams per litre of absolute alcohol:

$$= \frac{0.0011 \times 2 \times V \times 1000}{V_1}$$

where,

V is the difference in ml of standard sodium thiosulphate solution used for blank and experiment;

V_1 is the alcohol, % by volume.

13 Determination of furfural

13.1 Apparatus

13.1.1 Nessler tubes, with flat bottom tubes of thin colourless glass of 25 mm in diameter, about 150 mm in length and graduated at 50 mL. The depth measured internally from the graduation mark to the bottom shall not vary by more than 2 mm.

13.1.2 Nessler comparator

13.2 Reagents

13.2.1 Aniline, distilled and colourless

13.2.2 Hydrochloric acid, specific gravity 1.125

13.2.3 Furfural free alcohol: Let alcohol containing 5 g of m-phenylenediamine hydrochloride stand at least for 24 h with frequent shaking (previous treatment with potassium hydroxide is not necessary).

Reflux for at least 8 hours, longer if necessary. Let stand overnight and distil, rejecting the first 100 mL and the last 200 mL of the distillate. If this gives a coloration with aniline hydrochloride, repeat the treatment.

13.2.4 Standard furfural solution: Dissolve 1 g of redistilled, colourless furfural in 100 mL of the furfural free alcohol. Prepare standard furfural solution by diluting 1 mL of this solution to 100 mL with 50 % furfural free alcohol. 1 mL of this diluted solution contains 0.1 mg of furfural (strong furfural solution shall retain its strength but the diluted standard solution should be prepared afresh every time).

13.3 Procedure

Take 5 mL of the distillate obtained for ethanol determination, add 1 mL of the colourless aniline and 0.5 mL of the hydrochloric acid, and keep for 15 min.

13.4 Expression of results

If red colour appears, this indicates the presence of furfural, and the sample fails the test.

14 Determination of methyl alcohol

Two methods, namely, spectrophotometric method and gas chromatography method are employed. The spectrophotometric method is sufficiently sensitive for routine type of analysis. The gas chromatography method is more sensitive and shall serve as an alternative method.

14.1 Spectrophotometric method

14.1.1 Apparatus

14.1.1.1 Spectrophotometer, of any make with wavelength range from 350 nm to 700 nm and a maximum band width of 5 mm

14.1.2 Reagents

14.1.2.1 Sodium bisulphate, AR grade

14.1.2.2 Potassium permanganate solution: Dissolve 3.0 g of potassium permanganate and 15.0 mL of phosphoric acid in 100 mL distilled water. The solution shall be prepared monthly.

14.1.2.3 Sodium salt of chromotropic acid solution (sodium 1,8-dihydroxynaphthalene-3,6-disulphonate), 5 % aqueous solution (m/v).

a) Prepare fresh solution every week of either acid or salt and filter, if not clear.

b) If necessary, prepare purified chromotropic acid ot its sodium salt in 25 mL water (add 2 ml sulphuric acid to aqueous solution of salt to convert it to free acid). Add 50 mL of methyl alcohol heat just to boiling and filter. Add 100 mL isopropyl alcohol to precipitate free acid chromotropic acid. Add more isopropyl alcohol to increase yield of purified acid.

14.1.2.4 Methanol stock solution: Dilute 1.0 g of methanol (99.9 %, v/v) to 100 mL with 40 % (v/v) ethanol (methanol free). Dilute 10 mL of this solution to 100 mL with 40 % ethanol (methanol free).

14.1.2.5 Methanol standard solutions: Dilute appropriate volume of methanol stock solution (see 14.1.2.4) to 100-mL volumetric flasks with 40 % (v/v) ethanol (methanol free) to get final concentration 20, 40, 60, 80 and 100 ppm of methanol.

14.1.3 Procedure

Take 50 mL of sample in a simple still and distil, collecting about 40 mL of distillate. Dilute 1 mL of distillate to 5 mL with distilled water and shake well. Take 1 ml of this solution, 1 mL of distilled water (for blank) and 1 mL of each of methanol standard solutions into 50-ml stoppered test tubes and keep them in an ice-cold water-bath.

Add to each test tube 2 ml of potassium permanganate reagent and keep aside for 30 min. Decolorize the solution by adding a little sodium bisulphate and add 1 ml of chromotropic acid solution. Mix well and add 15 ml of sulphuric acid slowly with swirling and place in hot water bath maintaining at 80 °C for 20 min. Observe the colour development from violet to red. Cool the reaction mixture and measure the absorbance at 575 nm using 1 cm path length cell.

14.1.4 Calculation

Calculate methanol content in grams per litre of absolute ethanol as follows:

$$\frac{A_2 \times C \times D \times 1000}{A_1 \times S}$$

where

A_2 is the absorbance for sample standard solution;

C is the concentration of methanol standard solution, g/ml;

D is the dilution factor for sample solution;

A_1 is the absorbance for methanol standard solution;

S is the ethanol content of liquor sample in % (v/v)

14.2 Gas chromatographic method

14.2.1 Apparatus

14.2.1.1 Gas chromatograph and operating parameters: Gas chromatograph equipped with flame ionization detector and split injection port and fixed with a capillary column of HP Carbowax 20M or equivalent having the dimensions of 25 m length, 0.32 mm ID and 0.30 µ film thickness. The split ratio will be approximately 1: 40 with nitrogen or helium as a carrier gas at the flow rate of about 1.7 ml/min. The detector and injector port temperatures may be maintained at about 250 °C. Keep the oven temperature at 45 °C for 4 min, raise to 100 °C/min at the rate of 10°C/min and finally to 200 °C for 10 min at the rate of 15 °C.

NOTE Optimum operating conditions may vary with column and instrument used and must be determined by using standard solutions. Adjust the parameters for maximum peak sharpness and optimum separation. With high level standard n-propanol may be used for optimization of the equipment..

14.2.1.2 Syringe, 10 µl, Hamilton Co. No. 701, or equivalent

14.2.2 Reagents

14.2.2.1 Ethanol (methanol–free)

14.2.2.2 n-Pentanol internal standard, 0.05 % v/v n-pentanol in 40 % v/v ethanol (methanol-free)

14.2.2.3 Methanol stock solution, Dilute 1.0 g of methanol (99.9 %, v/v) to 100 mL with 40 % (v/v) ethanol (methanol-free)

14.2.2.4 Methanol standard solution: Dilute 10 mL of methanol stock solution [see 14.2.2(c)] to 100 mL with 40 % (v/v) ethanol (methanol-free). Dilute 10 mL of this solution to 100 mL with 40 % (v/v) ethanol (methanol-free). Transfer 5 mL of the resulting solution into a 10-ml stoppered test tune, add 1 mL of n-pentanol internal standard solution and mix well.

14.2.3 Procedure

Transfer 5 mL of sample into a 10-ml stoppered test tube, add 1 mL of n-pentanol internal standard solution and mix well. Inject 2 µl of methanol standard solution into chromatograph and record the chromatogram. Adjust the operating parameters and attenuation to obtain measurable peaks (at least 25 % of full-scale deflection). Determine the retention time of methanol and n-pentanol. Inject 2 µl sample solution into chromatograph and record the chromatogram (adjust attenuation, if necessary).

14.2.4 Calculation

Calculate methanol content in grams per litre of absolute alcohol as follows:

$$= \frac{R_2 \times C \times D \times 1000}{R_1 \times S}$$

where

R_2 is the peak ratio of methanol to n-pentanol for sample solution;

C is the concentration methanol in standard solution, in g/ml;

D is the dilution factor for sample solution;

R_1 is the peak ratio of methanol to n-pentanol for standard solution;

S is the ethanol content of liquor sample, in % (v/v).

15 Determination of ash

15.1 Apparatus

15.1.1 Muffle furnace

15.1.2 Desiccator

15.1.3 Water bath

15.1.4 Dish, 50-ml capacity, silica or platinum

15.2 Procedure

Shake the contents of the container. Evaporate 100 mL of the sample in a dried, tared dish on a water bath. Place the dish with the residue in the muffle furnace maintained at 450 °C to 500 °C for about an hour. Cool the dish in a desiccator and weigh.

15.3 Calculation

$$\text{Ash, \% mass by volume} = \frac{100(W_2 - W_1)}{\text{V}}$$

where

W_1 is the weight of the empty dish;

W_2 is the weight of the dish with ash;

V is the volume in ml of liquor taken for ash determination.

16 Determination of suspended solids

16.1 Apparatus

16.1.1 Hot air-oven

16.1.2 Filter paper, Whatman no 42 or equivalent of about 9 cm diameter.

16.1.3 Desiccator

16.2 Procedure

16.2.1 Dry a filter paper at 105 °C for 3 hours in an oven. Cool in the desiccator and weigh immediately. Mix the contents of the container thoroughly by shaking. Take 250 mL and filter through the filter paper. Dry the filter paper in air-oven at 105 °C for 3 hours. Cool in desiccator and weigh. Express the results to four decimal places.

16.3 Calculation

Suspended solids, per cent (mass/volume):

$$= \frac{100(M_2 - M_1)}{V}$$

where

M_2 is the mass of the filter paper with dry material;

M_1 is the mass of the filter paper;

V is the volume, in mL, of sample taken.

17 Determination of dissolved solids

17.1 Apparatus

17.1.1 Hot air-oven

17.1.2 Water-bath

17.1.3 Volumetric flask, 200 mL capacity

17.1.4 Dish, 50 mL capacity, silica or platinum

17.1.5 Desiccator

17.2 Procedure

Evaporate 200 mL of filtrate (*see* 18.2) in a dried, tarred dish on a water-bath. Dry the dish in an air-oven at 105 °C for 3 hours, cool in a desiccator and then weigh the dish. Calculate the dissolved solids as per cent mass by volume. Express the result to four decimal places.

17.3 Calculation

Dissolved solids, percent mass / volume

$$= \frac{100\,(M_2 - M_1)}{V}$$

where

M_2 is the mass of the, dish with dry material;

M_1 is the mass of the dish;

V is the volume in ml of sample taken.

18 Determination of total solids

18.1 General

Determine the percentage of total solids by adding the suspended solids (16.3) and dissolved solids (17.3). The total solids may also be determined by the method given in 20.2.

18.2 Procedure

Place 200 mL of the sample in a dried, tared dish into an air-oven. Bring the temperature to 105 °C and hold for at least 3 hours or until the liquid is completely evaporated. Cool in a desiccator and reweigh the dish. Express the result to four decimal places.

18.3 Calculation

Total solids, percent (mass / volume)

$$= \frac{100\left(M_2 - M_1\right)}{V}$$

where

M_2 is the mass of the, dish with dry material;

M_1 is the mass of the dish;

V is the volume in mL of sample taken.

19 Determination of higher alcohol as amyl alcohol

19.1 General

Two methods have been prescribed. Method (I) may be used to determine approximately the quantity of higher alcohol in process control. Method (II) shall be used as a reference method.

The higher alcohol as amyl alcohol may also be determined using Gas Chromatography equipped with a flame ionization detector (GC-FID).

19.2 Method I — Komarowski method

19.2.1 Reagents

19.2.2.1 Salicycllic Aldehyde, dissolve 1 % salicylic aldehyde in 95 % alcohol, free of higher alcohol

19.2.2.2 Sulphuric acid

19.2.2 Procedure

19.2.2.1 Take a clean glass-stoppered bottle and wash it twice with the product to be tested. Similarly wash small graduated cylinder or a 100-mL pipette.

19.2.2.2 Take 10 mL of sample in the bottle and add 1 mL of 1 % salicylic aldehyde and 20 mL of concentrated sulphuric acid. Allow to stand at room temperature for over 12 hours.

Note the colour changes. For quick routine analysis, the colour change may be noted after a shorter interval.

19.2.3 Expression of results

19.2.3.1 The colours developed after the reaction indicate the amount of higher alcohol as follows:

Colour		Amount of higher alcohol
Light yellow	—	Only traces
Yellow to brownish	—	About 0.01 % (v/v)
Brown	—	0.02 to 0.03 % (v/v)
Red	—	0.05 to 0.1 % (v/v)
Dark red to black	—	Above 0.1 % (v/v)

19.3 Method II

19.3.1 Apparatus

Spectrophotometer

19.3.2 Reagents

19.3.2.1 P-Dimethylaminobenzaldehyde solution: In 100-ml volumetric flask, dissolve 1 g of P-dimethylaminobenzaldehyde in mixture of 5 mL sulphuric acid and 90 mL water and dilute to mark with water.

19.3.2.2 Isobutyl alcohol

19.3.2.3 Isoamyl alcohol

19.3.2.4 Ethyl alcohol,redistilled, middle 50 % fraction

19.3.2.5 Synthetic standard higher alcohol

Weigh 2 g isobutyl alcohol and 8 g isoamyl alcohol into 1-l volumetric flask and dilute to mark with water. Pipette two 10 mL portions into 100-ml volumetric flasks and dilute to mark, one with water and other with alcohol.

Prepare working standards for products in range 0 % to 85 % containing 1.0 g to 6.0 g synthetic higher alcohol per 100 L by diluting 1.0 mL to 6.0 mL aliquots of aqueous standard solution to 100 mL with alcoholic solution percentage of expected for dilute sample when pipetted analysis tube. Prepare similar working standard for products in range 85 % to 95 % by diluting 1.0 to 6.0 aliquots of standard solution of percentage of the sample or its dilution.

19.4 Procedure

19.4.1 Preparation of sample

Take 200 mL of sample liquor in 500-ml erlenmeyer flask, add about 35 mL water and a few pieces of anti-bumping granules. Distil slowly into 500-ml volumetric flask until distillate is nearly at mark. Dilute to mark and mix.

19.4.2 Pipette 2 mL aliquots of sample or dilute sample, 2 mL water (for reagent blank) and 2 mL aliquots of standards into 15 mm × 150 mm stoppered or covered test tubes stopper or cover tubes, and place in rack then in ice-bath. Pipette 1 mL P-dimethylaminobenzaldehyde solution into each tube. Shake tubes individually and replace in ice-bath for 3 min. Transfer rack of tubes from ice-bath to boiling water bath and boil for 20 min. Transfer tubes to ice-bath for 3 min to 5 min then to room temperature bath. Read percentage transmittance at 530 nm to 535 nm against reagent black or reference (Use same wavelength for both standards and unknown).

Plot a higher alcohol per 100 L on linear scale as abscissa against percentage T as ordinate on log scale of semi log paper. Convert percentage transmittance of samples to g higher alcohol per 100 L from standard curve. If dilution was used, multiply g higher alcohol to obtain g higher alcohol per 100 L (found by dilution factor to obtain g higher alcohol per 100 L) in original sample.

Analyse 2 levels of standard with each series of unknowns.

19.4.3 Precision expected

Whiskies and brandies ± 5 %; rum ± 8 %, in vodka spirits ± 0 per 100 L.

20 Test for miscibility with water

20.1 Mix 10 mL of the sample with 90 mL distilled water in a suitable glass vessel and allow to stand at room temperature for one hour. Compare the clarity of the mixture with that of an equal volume of water.

20.2 The material shall be taken to comply with the specified requirement if there is no noticeable difference in clarity between the mixture and water.

21 Test for alkalinity

21.1 Reagents

Phenolphthalein indicator, 1 %

21.2 Procedure

Place 100 mL of water and a few pieces of glass beads in 500 mL conical, flask. Boil gently for 5 min to eliminate carbon dioxide then cool slightly and add 100 mL of the sample. Boil gently for a further period of 5 min.

At the end of this period, close the neck of the flask with a stopper carrying a soda-lime guard tube, and allow to cool to room temperature. Remove the stopper, add 0.5 mL of phenolphthalein indicator and examine for alkalinity.

21.3 Expression of results

If pink colour is observed, the sample is alkaline.

22 Test for permanganate reaction time

22.1 Apparatus

Graduated measuring cylinder, stoppered, 100 mL capacity

22.2 Reagents

22.2.1 Standard potassium permanganate solution, 0.01 N

22.2.2 Hydrochloric acid, 37 %

22.3 Procedure

22.3.1 Clean thoroughly the graduated measuring cylinder first with concentrated hydrochloric acid, then with water and finally with the sample to be tested. Place 20 mL of the sample in the cylinder, bring the temperature to 20 ºC placing the cylinder in cold water, add 1.0 mL of standard permanganate solution by means of a 1-ml pipette noting the exact time as soon as addition is over. Mix the contents at once and keep the cylinder at 20 ºC and away from bright light.

22.3.2 The sample shall be taken to have satisfied the test if the pink colour does not disappear for 30 min.

23 Determination of carbon dioxide

23.1 Method I

23.1.1 Apparatus

23.1.1.1 Chittick gasometric carbon dioxide apparatus, as shown in Figure 4

23.1.1.2 Description of the apparatus

The apparatus consists of an evolution flask A made of pyrex glass and having 25 mL capacity acid burette *F* graduated at 5 mL intervals. A glass tube passed through one hole of the stopper of the evolution flask and is connected with the glass tube B which has a stop-cock C by a rubber tube. The gasometric tube D, with graduations having a volume of 100 mL, is connected to a levelling bulb E of 300 mL capacity.

23.1.2 Reagents

Displacement solution

To a solution of 100 g of sodium chloride or sodium sulphate in 350 mL of water, add about 1 g sodium carbonate and 2 mL methyl orange, then 1.5 sulphuric acid to a decidedly pink colour and stir until all Carbon dioxide is removed. The solution seldom needs replacing.

23.1.3 Procedure

Cool beer to 0 ºC and pour 50.0 mL of it into an evolution flask carefully so as to avoid splashing or loss of Carbon dioxide and connect with the double bored stopper. Open the stop- cock *C* and by means of the levelling bulb (containing the displacement solution) adjust the level of the liquid in the gasometer to 10 mL above zero. Allow 1 min to 2 min for equalizing the temperature and barometric pressure within, then close the stop-cock and lower the levelling bulb to reduce the internal pressure. Slowly run into the evolution flask from the burette F 5 mL of 1: 5 sulphuric acid, always keeping the levelling solution in the bulb below that in the gasometer. To secure complete evolution, first rotate and then vigorously agitate the evolution flask once in every minute until a constant gas volume is obtained (at least 10 min). After allowing standing for 5 min, adjust the liquid in the gasometer to be on a level with that in the bulb. Read the volume of gas on the gesometric tube at room temperature and pressure. Bring this volume to NTP.

23.1.4 Calculation

$$= \frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$$

where

P_1 is the barometric pressure at the time of reading the volume of carbon dioxide;

V_1 is the volume of carbon dioxide in the gasometric tube;

T_1 is the room temperature (T ºC + 273);

P_2 is the 760 mm Hg at NTP;

V_2 is the volume of carbon dioxide;

T_2 is the 273° absoute temperature scale;

22.4 L of Carbon dioxide at NTP shall weigh 44 g. Therefore, mass in grams of V_2 L of Carbon dioxide at NTP is given as:

$$= \frac{44 \times V_2}{22.4}$$

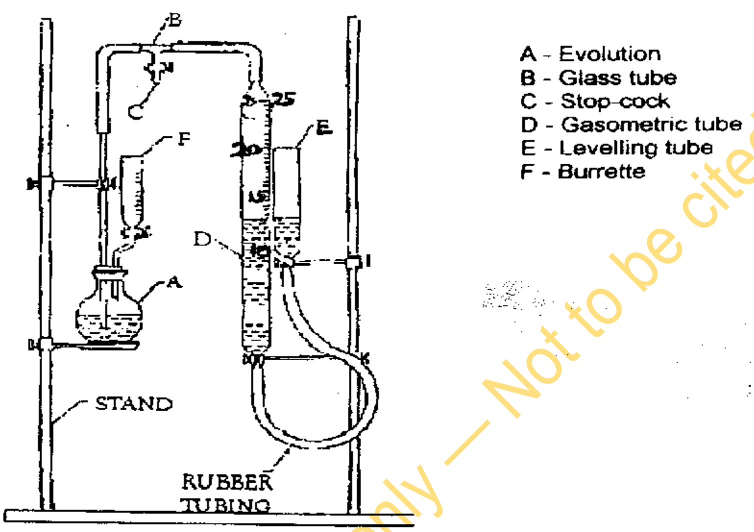


Figure 4 — Chittick gasometric carbon dioxide apparatus

23.2 Method II

Carbon dioxide is absorbed in sodium hydroxide solution, released with excess acid, and the volume determined monometrically. The result is expressed as grams of carbon dioxide per litre.

23.2.1 Apparatus

The apparatus for the determination is shown diagrammatically in figure 5. The reaction flask A is a conical flask of 100 mL capacity with a B19 neck, a central well (8 mm internal diameter, 25 mm deep) and the bottom thickened to withstand vacuum. The apparatus should preferably be in a room with temperature controlled to within ±2 ºC.

a) Vacuum pump

b) Safety pipettes, 0.5 mL and 5.0 mL.

c) Sample bottles, e.g. nominal bottles having a graduation mark at 300 mL.

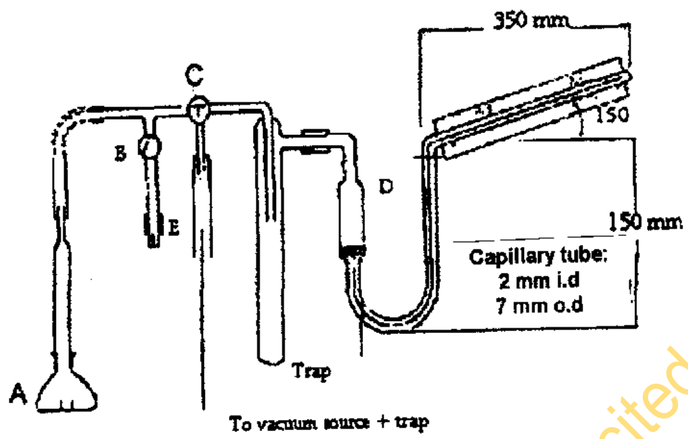
d) Sampling coil made from 3 mm ID stainless steel tubing consisting of 15 turns – 20 turns, 25 mm – 30 mm diameter and having a straight end long enough to reach to the bottom of the sample bottle selected.

23.2.2 Reagents

23.2.2.1 Sodium hydroxide solution, 40 %, w/v. Dissolve 400 g sodium hydroxide reagent grade in distilled water, cool and make up to 1 L with distilled water

23.2.2.2 Sulphuric acid, 50 %, v/v

23.2.2.3 Antifoam, hexanol



A – Reaction flask
B – Two –way vacuum tap
C – Three-way vacuum tap
D – Zero setting
E – Drawn – out capillary air bleed

Figure 5 — Diagram of apparatus for manometric estimation of carbon dioxide

23.2.2.4 Standard sodium carbonate solutions

Dissolve weights of reagent grade anhydrous sodium carbonate equivalent to known weights of carbon dioxide in freshly boiled distilled water, mix with a volume of 40 % sodium hydroxide solution equivalent to that used in the determination and dilute to a standard volume. Thus, for a nominal bottle containing 290 mL beer and treated with 10 mL of 40 % w/v sodium hydroxide solution use the following weights of sodium carbonate:

Carbon dioxide g/l	Anhydrous sodium carbonate g/300 mL
2.0	1.3968
3.0	2.0951
4.0	2.7935
5.0	3.4919
5.1	4.1903

23.2.3 Procedure

23.2.3.1 Standardization of apparatus

Pipette 5.0 mL of standard sodium carbonate solution into the outer compartment of flask A, add one drop of antifoam and pipette 0.5 mL 50 % sulphuric acid into the central well. Light by grease the ground glass joint of the flask and connect to the manometer. Close the two way tap B and position the tree way tap C so that the flask, manometer and vacuum source are interconnected. Bring the mercury in the manometer below the zero-setting point D and turn by C so that only flask is connected to the manometer. Bring the mercury in the manometer to the zero-point D by use of tap B. Mix the contents of the flask by tilting the flask and shaking vigorously, holding the flask lightly by the neck only, until the manometer reaches a constant level. Note the manometer reading and prepare a calibration graph from the value obtained from the standard solutions used.

23.2.3.2 Preparation of samples

Great care is needed to avoid escape of gas during sampling. Cool bottled or canned beer to 0 ºC for about 1 h. carefully remove the crown or pierce the can, add sodium hydroxide solution at a rate of 10 mL per 290-ml bottle and mix the bottle contents.

Beer in tanks or casks may be sampled by the attachment of the sampling coil to the sampling cork. Allow beer to flow through the coil until the stream shows no gas evolution, then slowly fill the sample vessel containing the requisite amount of sodium hydroxide solution (e.g. nominal 290-ml bottle containing 10 mL, 40 % w/v sodium hydroxide solution) and mix the contents.

23.2.3.3 Determination

Place 5.0 mL of the sodium hydroxide treated sample in the outer compartment of the flask *A* and follow the procedure as described under standardization of apparatus. Determine the carbon dioxide content of the beer by referring the manometer reading obtained to the calibration graph.

23.2.3.4 Precision

The precision of the method is approximately ± 0.2 g/l.

NOTE Great care must be exercised in the collection and disposal of samples. Containers used for the collection of samples from tanks must be coded to prevent their use for any other purpose – in particular containers which could be used for food and drink must be avoided. Samples of beers in final package must be transferred to other containers after the addition of sodium hydroxide and the bottle or can immediately washed out.

24 Determination of sorbic acid

24.1 Principle

24.1.1 This analysis involves steam distillation of the free sorbic acid oxidation to malonaldehlyde using dichromate and reaction with thiobarbituric acid to form a red complex. This determined spectrophotometrically at 532 nm.

24.2 Apparatus

24.2.1 Steam distillation apparatus

24.2.2 Volumetric flasks, 50 mL, 100 mL, 500 mL, 1 L

24.2.3 Boiling water bath

24.2.4 Spectrophotometer

24.3 Reagents

24.3.1 Magnesium Sulphate Heptahydrate

24.3.2 Sulphuric acid solution, 0.5 M and 0.005 M

24.3.3 Sodium hydroxide solution, 1 M

24.3.4 Dichromate solution, 1 M

Mix equal volumes of 0.15 M sulphuric acid and a solution of 0.5 g potassium dichromate ($K_2Cr_2O_7$) in 1 L of water, prepare fresh as needed.

24.3.5 Thiobarbituric acid (TBA) solution: Dissolve 0.5 g TBA in 25 mL water + 20 mL 0.5 M sodium hydroxide, add 11 mL 1 m hydrochloric acid and dilute, to 100 mL with water.

24.4 Procedure

Weigh 50 g sample to a litre steam distillation flask. Add 100 mg magnesium sulphate (Mg $SO_4.7H_2O$) and 100 mL 0.5 M sulphuric acid. Add 10 mL of 1M sodium hydroxide in the steam distillation apparatus receiver. Steam distils rapidly.

NOTE Do not heat the flask containing the sample during distillation, otherwise a coloured distillate may arise. Collect about 450 mL distillate in 30 min.

Cool and transfer the distillate to a 500-mL volumetric flask. Add 15 mL of 0.5 M sulphuric acid and make up to volume with water then mix.

Pipette 2 mL of distillate into a test tube and add 2 mL of freshly prepared dichromate solution. Heat in a boiling water bath (at 100 ºC) for 5 min. Cool and then add 2 mL thiobarbituric acid solution and heat in a boiling water bath for 10 min. Cool rapidly and transfer to a 50-ml volumetric flask with water. Make to volume with water. Measure the absorbance of the solution at 532 nm using a 1 cm cuvette, water as the reference. Prepare a standard curve as follows:

Dissolve 1.0 g of sorbic acid in a small volume of 1 M NaOH and dilute to 1 L with water. This is the stock solution (1mg/ml). Prepare a blank and four working standard solutions by first pipetting 25.0 mL of the stock solution to a 500-ml volumetric flask (50 µg/mL) and diluting to volume with water. Next, pipette 0.0, 10.0, 20.0, 50.0 and 80.0 of this solution into five 100-ml volumetric flasks and dilute to volume with water (range 0.5, 10, 25 and 40 µg/mL). Pipette 2 mL of each of the working standards and blank into five test tubes and continue as in the above procedure, starting at addition of dichromate solution. Plot absorbance versus µg Sorbic acid for a standard curve.

(µg Sorbic = 0, 10, 20, 50, 80 in the 2 mL aliquots).

24.5 Calculation

Sorbic acid (ppm) $= \frac{A}{S} \times \frac{500}{2}$

where

A is the µg sorbic acid corresponding to the sample absorbance, taken from the standard curve;

S is the sample weight in g.

25 Determination of acidity in wines

Methods for determination of total acidity and volatile acidity have been prescribed-respectively in 25.1 and 25.2. Any of these methods may be used depending on the requirements.

25.1 Total acidity

25.1.1 Apparatus

25.1.1.1 Burette, 25-ml or 50-ml, calibrated in 0.05 mL or 0.1 mL

25.1.1.2 Pipette,5-ml

25.1.1.3 Erlenmeyer flask, 500-ml

25.1.2 Reagents

25.1.2.1 Sodium hydroxide solution, 0.1 M, carbonate free

25.1.2.2 Phenolphthalein solution, 0.1 g in 100 mL of 60 % rectified spirit

25.1.3 Procedure

25.1.3.1 Removal of carbon dioxide

Remove carbon dioxide, if present, by following any of the two methods:

a) Place 25 mL sample of the material in a small Erlenmeyer flask and connect to water aspirator. Agitate for one minute under vacuum.

b) Place 25 mL sample of the material in a small Erlenmeyer flask, heat to incipient boiling for 30 s, swirl and cool.

25.1.3.2 Place 200 mL of boiling distilled water in a 500-ml wide-mouth Erlenmeyer flask. Add 1 mL of phenolphthalein indicator and titrate to a faint but distinct pink colour. Pipette 5 mL to 10 mL of degassed sample (25.1.3.1) into the flask and titrate to the same endpoint. In the case of dark and red wines some practice is needed to recognize the end-point detection since the colour change is not exactly the same as with the water. A better detection of the colour change may be obtained if a light source is placed under the flask.

25.1.3.3 Calculation

Total acidity as tartaric acid, gram per litre of absolute alcohol:

$$= \frac{V_1 \times M \times 0.075 \times 1000}{V_2}$$

where

V_1 is the volume in mL of sodium hydroxide solution used in titration;

M is the molarity of sodium hydroxide solution;

V_2 is the alcohol content the (wine) sample.

25.2 Volatile acidity

25.2.1 Apparatus: Sellier's apparatus as shown in Figure 6.

25.2.2 Reagents

25.2.2.1 Sodium hydroxide solution, 0.025 M to 0.05 M, standardized, carbonate free

25.2.2.2 Phenolphthalein solution, 0.1 g in 100 mL of 60 % rectified spirit

25.2.3 Procedure

Fit the Sellier tube into one hole of the rubber stopper into the other hole place an 'L' shaped glass tube. Attach a short section of rubber hose to the end of the glass tube. Fit the rubber stopper to the 500-ml Erlenmeyer flask. Attach the flask to the ring stand and connect the Sellier tube to the distillation trap and the trap to the condenser. Start cold water running in the condenser. Place about 250 mL of distilled water in the 500-ml Erlenmeyer flask.

Pipette 10 mL of decarbonated wine into the Sellier tube and slightly connect the trap and condenser. Place the 250-ml flask (marked with a wax pencil at 100 mL) under the condenser outlet. Light the burner under the 500-ml Erlenmeyer flask and heat until steam. issues from the outlet. Now use the pinchcock to close the outlet from the 500-ml flask thus forcing steam into the Sellier tube. The distillation should be conducted rapidly until 100 mL have been collected. Before removing the flame, open the pinchcock. Place the flask containing the distillate on the hot plate (operating on medium heat) and bring the contents to a boil. Do not allow to boil vigorously, nor continue the boiling more than 30

s. Add 3 drops of the phenolphthalein solution and titrate while still hot to a faint pink endpoint using sodium hydroxide solution. Record the amount of sodium hydroxide used and its molarity.

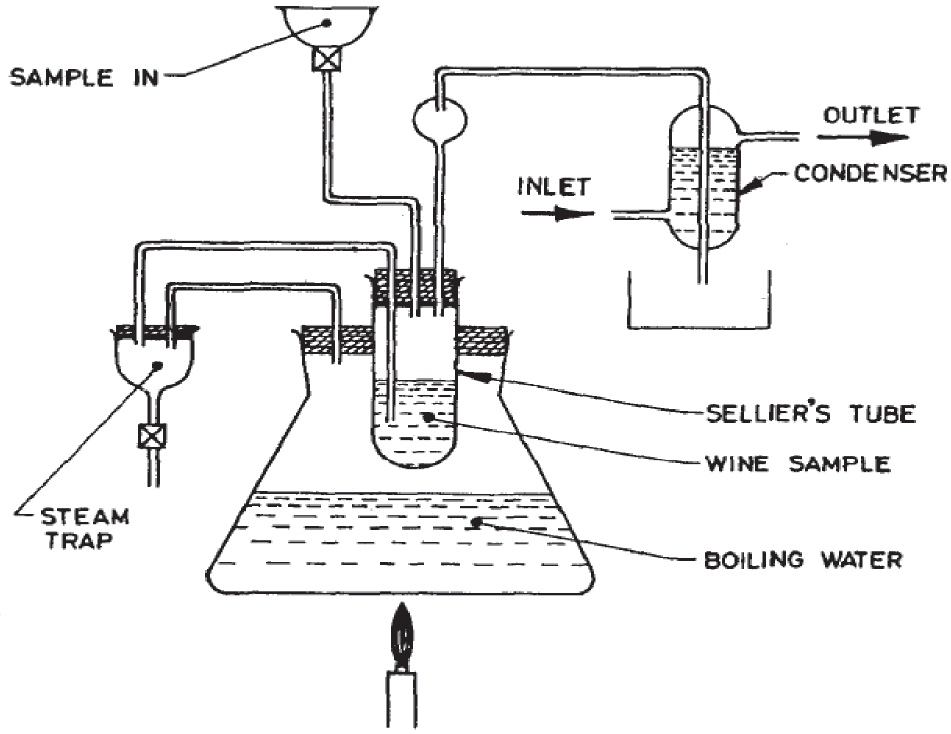


Figure 6 — Sellier's apparatus

25.2.4 Calculation

Volatile acidity (expressed as acetic acid), grams per litre absolute alcohol:

$$= \frac{M_1 \times N \times 1000 \times 0.060}{M_2}$$

where

V_1 is the volume in ml of sodium hydroxide solution;

M is the molarity of sodium hydroxide solution;

V_2 is the alcohol content of wine sample.

26 Determination of overpressure in sparkling wines

26.1 Principle

After thermal stabilisation and agitation of the bottle, the overpressure is measured using an aphrometer (pressure gauge). It is expressed in Pascals (Pa).

26.2 Apparatus

The apparatus, which measures the overpressure in bottles of sparkling and semi-sparkling wines, is called an aphrometer. It can be in different forms depending on the stopper of the bottle (metal capsule, crown, plastic or cork stopper).

26.2.1 Bottles with capsules

It is made up of three parts (see figure 7):

a) The top part (a screw needle holder) is made up of a manometer, a manual tightening ring, an endless screw, which slips into the middle part, and a needle, which goes through the capsule. The needle has a lateral hole that transmits pressure to the manometer. A joint ensures the tightness of the whole thing on the capsule of the bottle.

b) The middle part (or the nut) enables the centring of the top part. It is screwed into the lower part, which strongly holds onto the bottle.

c) The lower part (clamp) is equipped with a spur, that slips under the ring of the bottle in order to hold the whole thing together. There are rings adaptable to every kind of bottle.

26.2.2 Bottles with corks

It is made up of two parts (see figure 8):

a) The top part is identical to the previous apparatus, but the needle is longer. It is made up of a long empty tube with a pointer on one end to aid in going through the cork. This pointer can be moved and it falls in the wine once the cork has been pierced.

b) The lower part is made up of a nut and a base sitting on the stopper. This is equipped with four tightening screws used to maintain everything on the stopper.

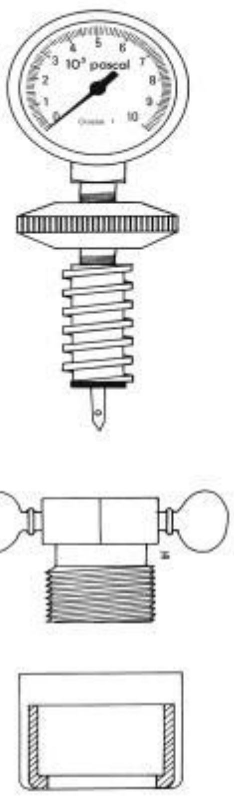


Figure 7 — Aphrometer for capsules

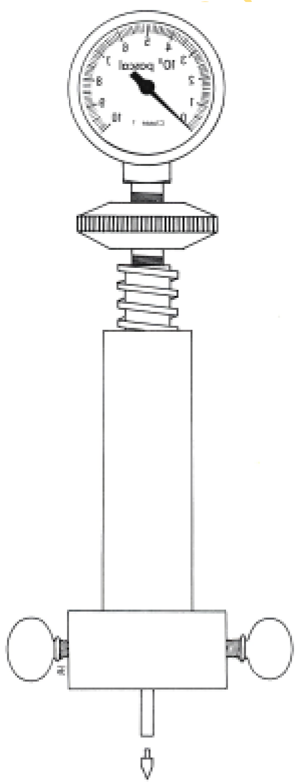


Figure 8 — Aphrometer for stoppers

NOTE Remarks concerning the manometers that equip these two types of apparatus:

a) The apparatus can be either a mechanical Bourdon tube or digital piezoelectrical captors. In the first case, the Bourdon tube must be made of stainless steel.

b) They are graduated in Pascals (Pa). For sparkling wine, it is more practical to use 10^5 Pascals (10^5 Pa) or kilopascal (kPa) as the unit of measurement.

c) Aphrometers can be from different classes. The class of a manometer is the reading precision compared to the full scale expressed in percentages (e.g. manometer 1000 kPa class 1, signifies the maximum usable pressure 1000 kPa, reading at ± 10 kPa). Class 1 is recommended for precise measurements.

26.3 Procedure

Measurements can be carried out on bottles if the temperature has stabilised for at least 24 hours. After piercing the crown, the cork or plastic stopper, the bottle must be vigorously shaken to reach a constant pressure in order to make a reading.

26.3.1 Capsuled bottles

Slip the clamp's spur binders under the ring of the bottle. Tighten the nut until the whole thing is tight on the bottle.

The top part is screwed on the nut. To avoid losing gas, piercing the capsule should be done as quickly as possible in order to bring the joint in contact with the capsule. The bottle must be shaken vigorously to reach a constant pressure in order to make a reading.

26.3.2 Bottles with stopper

Place a pointer at the end of the needle. Position this fixture on the cork. Tighten the four screws on the stopper.

Tighten the top part (the needle goes through the cork). The pointer should fall in the bottle so that the pressure can be transmitted to the manometer. Make a reading after shaking the bottle until reaching constant pressure. Recuperate the pointer after the reading.

26.4 Expression of results

The overpressure at 20°C ($Paph_{20}$) is expressed in Pascals (Pa) or in kilopascals (kPa).

This must be in accordance with the precision of the manometer (for example: 6.3 10^5 Pa or 630 kPa and not 6.33 10^5 Pa or 633 kPa for the manometer 1000 kPa full scale, of class 1).

When the temperature measurement is other than 20 °C, it is necessary to correct this by multiplying the pressure measured by an appropriate coefficient as specified in Table 2).

Table 2 — Relationship of $Paph_{20}$ excess pressure of semi-sparkling and sparkling wine at 20 °C with the $Paph_t$ excess pressure at temperature *t*

0	1.85	13	1.24
1	1.80	14	1.20
2	1.74	15	1.16
3	1.68	16	1.13
4	1.64	17	1.09
5	1.59	18	1.06
6	1.54	19	1.03
7	1.5	20	1.00
8	1.45	21	0.97
9	1.40	22	0.95
10	1.36	23	0.93
11	1.32	24	0.91
12	1.28	25	0.88

27 Determination of haze in beer

27.1 Introduction

Formazin, the condensation product of hydrazine and hexanethylene-tetramine has been adopted by the American Society of Brewing Chemists and the Institute of Brewing and Distilling as a convenient standard for comparison of haze readings obtained by visual or instrumental procedures. The preparation described is the basis of definition of EBC Formazin Haze Units.

27.1.1 Apparatus

27.1.1.1 Radiometer, Haze meter and Glass cuvette

27.1.1.2 Volumetric flasks and pipettes

27.1.1.3 Analytical balance

27.1.2 Reagents

27.1.2.1 Hexamethylene-tetramine, 'Puriss' grade

27.1.2.2 Hydrazinesulphate, analytical reagent grade

27.1.2.3 Distilled water

27.1.3 Preparation of standards

27.1.3.1 Prepare a 10 % solution of hexamethylene-tetramine in distilled water in a volumetric flask.

27.1.3.2 Prepare a 1 % solution of hydrazine sulphate in distilled water. Allow at least 4 h to elapse for complete dissolution.

27.1.3.3 Mix equal volumes, measure by pipette, of the two solutions and allow to stand for at least 24 hours to complete the precipitation of formazin. The preparation is referred to as formazin haze concentrate. This concentrate is stable for 2 to 3 months.

27.1.3.4 Dilute one volume of concentrate to ten volumes with distilled water in a volumetric flask. This standard suspension is equal to 100 EBC. This solution is stable for 4 to 5 days.

27.1.3.5 Prepare working standards (0.5 to 5 units) by further dilution of the '100 units' suspension with distilled water. These standards have to be prepared daily.

27.1.4 Calibration of radiometer haze meter

27.1.4.1 Check that the centreing device, measuring chamber and all windows are clean.

271.4.2 Fill the measuring chamber with clean water to just below the cover of the centreing device.

27.1.4.3 Check that the galvanometer needle reads zero at its position of rest. If not, this can be adjusted by means of the screw situated just above the pivot of the needle.

27.1.4.4 Check zero by turning scale to zero covering the window in the rear of the measuring chamber (a can end is particularly suitable for this) and depressing the lamp switch. No deflection of the needle shall be detected.

27.1.4.5 Fill the cuvette with a formazin standard of 1.0 EBC. Place in the centreing device. Lower the lid and depress the key to switch on the lamp. Set the scale to 1.0 EBC. The needle shall be at the zero mark. If the needle is not at zero, adjust it (if possible) by adjusting the screw located behind a small detachable cap on the front of the instrument.

27.1.4.6 Check the remainder of the scale between 0 and 5.0 EBC with the other standard solutions.

27.1.4.7 If necessary prepare a calibration graph relating scale to actual standard values.

27.1.4.8 This calibration shall be carried out at least once per month.

27.2 Introduction

All haze measurements shall be made in 'screw top' or 'crown finish' half pint clear glass bottles having an internal diameter as near to 5.5 cm as possible. Owing to large colour variations in amber bottles, it is not possible to apply an average correction factor. The radiometer haze meter becomes less sensitive to haze measurements for dark beers due to light absorption by the dark colour.

27.2.1 Apparatus

27.2.1.1 Radiometer haze meter

27.2.1.2 Refrigerator

27.2.1.3 Water bath

27.2.1.4 Clear flint half pint bottles i.e. 10 fl.oz. Winchester with screw stopper of half pint clear beer bottle without surface markings on body sides.

27.2.2.2 Procedure

27.2.2.2.1 Permanent haze

27.2.2.1.1 Fill the bottle with a sample of beer and cap.

27.2.2.1.2 Warm or cool the beer to room temperature (approximately 18 ºC to 20 ºC).

27.2.2.1.3 Fill the measuring chamber of the haze meter with clean water and check that the meter gives a low reading (0.1 EBC should be obtained with distilled water).

27.2.2.1.4 Rinse the outside of the sample bottle containing the beer to be measured in the chamber. Ensure that the side seam (mould line) on the bottle is positioned at a centreing blade i.e. does not lie in the path of the light beam.

27.2.2.1.5 Close the lid, switch on the light and centre the galvanometer needle by turning the scale knob.

Approach the zero mark from both above and below and note the reading for each.

27.2.2.1.6 Make the determinations of haze by turning the bottle through 90º angles. The average of the four readings is the value to be recorded. This is the permanent haze value of the beer.

27.2.2.2 Chill haze

27.2.2.2.1 Place the sample in the refrigerator for 48 hours at 0 ºC.

27.2.2.2.2 Take the sample from the refrigerator. Mix contents by inversion of the bottle.

27.2.2.2.3 Allow the gas bubbles in the beer to clear by allowing the bottle to stand for 1 min to 2 min then read the haze. The reading at 0 ºC shall be taken before any rise in temperature occurs, therefore all precautions shall be taken to ensure that the bottle is kept cold during this time.

27.2.2.2.4 This reading gives the total haze of the beer.

The chill haze is obtained by subtracting the permanent haze from the total haze.

$$\text{Chill haze} = \text{Total haze} - \text{Permanent haze}$$

NOTE 1 The centreing device shall be removed and cleaned daily. All the windows and filters are wiped clean with a soft cloth.

NOTE 2 Slight contamination of the water in the measuring chamber does not affect the results appreciably, but where large numbers of hazes are being determined and the water becomes 'dirty' relatively quickly, it is recommended that when the empty meter reading reaches 0.5 EBC the chamber shall be revised and refilled with clean water.

NOTE 3 All bottles shall be checked to ensure that they are not excessively scratched or malformed.

NOTE 4 Transfer of a carbonated beer to a cuvette can introduce appreciable errors due to large numbers of gas bubbles scattering the light to give false haze values.

27.3 Introduction

a) This method estimates how long it takes packaged lager to go hazy when stored at 20 ºC;

b) The length of time, measured in weeks, that the beer will last without its total haze exceeding 2.5 ºEBC, is taken as the actual shelf-life.

27.3.1 Apparatus

27.3.1.1 Radiometer haze meter

27.3.1.2 Flint-glass half pint commercial bottles

27.3.1.3 Refrigerator

27.3.2 Method

27.3.2.1 Bottled beer excluding beer in 330-ml bottles.

27.3.2.1.1 Four clear glass bottles are fed into the filler and are filled, crowned and pasteurized in exactly the same way as the bottles going out to trade so that their top-space-air contents will be similar.

27.3.2.1.2 The bottles are then chilled and held at 0 ºC for 48 h.

27.3.2.1.3 The bottles are removed from the refrigerator and are gently inverted. They are then allowed to stand for a minute or so to allow the gas bubbles to disperse, before determining the haze value. Four readings shall be taken on each bottle, at roughly 900 to each other, and the average reading computed. It is important to avoid taking readings through the bottle mould joints.

27.3.2.1.4 After storage in dim light for 26 days at room temperature (20 ºC), the bottles are chilled to 0 ºC for48 h and the total haze determined as in 27.3.2.1.3.

27.3.2.1.5 The procedure described in 27.3.2.1.3 is repeated until the total haze is equal to or exceeds 2.5º EBC. The time, in weeks, for the haze to reach 2.5^0 EBC is then calculated.

27.3.2.2 Canned beer

27.3.2.2.1 The shelf-life test on canned beer is a more destructive one than that for bottled beer and more samples are necessary. The following equation can be used to calculate the number of samples required from each packaging.

$$\frac{4 + \textit{specified shelf life}}{4}$$

27.3.2.2.2 All the sample cans are chilled and held in a refrigerator at 0 ºC for 48 h.

27.3.2.2.3 The cans are removed from the refrigerator and all but one are placed in a store at room temperature (i.e. roughly 20 ºC) for 28 days.

27.3.2.2.4 The one can set aside is gently inverted to re suspend any sediment and is then opened. Its contents are carefully transferred to a flint-glass bottle which is crowned to stand undisturbed until the gas bubbles have cleared. The bottle is placed in the haze meter and the total haze determined as described in 27.3.2.1.3.

27.3.2.2.5 The procedure described in 27.3.2.1.3 and 27.3.2.1.5 is repeated until the total haze is equal to or exceeds 2.5 ºEBC. When this occurs a further 3 cans are tested and the average haze value calculated. The time, in weeks, to reach a total haze of 2.5º EBC is then computed.

27.3.2.3 Beer in 330-ml bottles

27.3.2.3.1 The method described in 27.3.2.1 is used, and the samples are decanted into half pint flint-glass bottles before determining the haze.

28 Reporting

In reporting the result of a test or analysis made in accordance with this standard, if the final value observed or calculated is to be rounded off, it shall be done in accordance with EAS 124.

Annex A
(normative)

Alcohometric tables

TABLE I $\varrho = \varrho\,(p, t)$

p \ t	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	
0												0
1												1
2												2
3												3
4												4
5												5
6												6
7												7
8												8
9												9
10												10
11												11
12												12
13												13
14												14
15												15
16												16
17												17
18												18
19											978,14	19
20											977,64	20
21										977,30	977,12	21
22									977,00	976,79	976,57	22
23								976,74	976,50	976,25	975,99	23
24							976,50	976,23	975,95	975,66	975,37	24
25						976,26	975,97	975,66	975,35	975,02	974,69	25
26					976,03	975,71	975,37	975,03	974,68	974,32	973,96	26
27				975,79	975,44	975,07	974,71	974,33	973,94	973,55	973,16	27
28			975,53	975,15	974,76	974,36	973,96	973,55	973,14	972,71	972,29	28
29		975,24	974,83	974,42	974,00	973,57	973,14	972,70	972,25	971,80	971,34	29
30	974,91	974,48	974,04	973,60	973,15	972,69	972,23	971,76	971,29	970,81	970,32	30
31	974,09	973,63	973,16	972,69	972,21	971,73	971,24	970,74	970,24	969,74	969,23	31
32	973,16	972,68	972,19	971,69	971,18	970,67	970,16	969,64	969,12	968,59	968,05	32
33	972,14	971,63	971,12	970,59	970,07	969,53	969,00	968,45	967,91	967,36	966,80	33
34	971,03	970,49	969,96	969,41	968,86	968,31	967,75	967,19	966,62	966,05	965,48	34
35	969,82	969,26	968,71	968,14	967,57	967,00	966,42	965,84	965,26	964,67	964,08	35
36	968,52	967,95	967,37	966,79	966,20	965,61	965,02	964,42	963,82	963,21	962,60	36
37	967,13	966,55	965,95	965,35	964,75	964,14	963,53	962,92	962,30	961,68	961,06	37
38	965,67	965,07	964,46	963,84	963,23	962,61	961,98	961,36	960,73	960,09	959,46	38
39	964,13	963,51	962,89	962,27	961,64	961,00	960,37	959,73	959,08	958,44	957,79	39
40	962,52	961,89	961,26	960,62	959,98	959,33	958,69	958,03	957,38	956,72	956,06	40
41	960,85	960,21	959,56	958,91	958,26	957,61	956,95	956,29	955,62	954,96	954,29	41
42	959,12	958,47	957,81	957,15	956,49	955,83	955,16	954,49	953,82	953,14	952,46	42
43	957,33	956,67	956,01	955,34	954,67	954,00	953,32	952,64	951,96	951,28	950,59	43
44	955,50	954,83	954,16	953,49	952,81	952,13	951,44	950,75	950,07	949,37	948,68	44
45	953,63	952,95	952,27	951,59	950,90	950,21	949,52	948,83	948,13	947,43	946,73	45
46	951,71	951,03	950,34	949,65	948,96	948,27	947,57	946,87	946,16	945,46	944,75	46
47	949,77	949,08	948,38	947,69	946,99	946,29	945,58	944,87	944,16	943,45	942,74	47
48	947,79	947,09	946,39	945,69	944,99	944,28	943,57	942,85	942,14	941,42	940,70	48
49	945,79	945,09	944,38	943,67	942,96	942,24	941,53	940,81	940,09	939,37	938,64	49
50	943,76	943,05	942,34	941,63	940,91	940,19	939,47	938,74	938,02	937,29	936,56	50

TABLE I $\varrho = \varrho\,(p, t)$

p \ t	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	
50	943,76	943,05	942,34	941,63	940,91	940,19	939,47	938,74	938,02	937,29	936,56	50
51	941,71	941,00	940,28	939,56	938,84	938,11	937,39	936,66	935,93	935,19	934,46	51
52	939,65	938,93	938,20	937,48	936,75	936,02	935,29	934,55	933,82	933,08	932,34	52
53	937,56	936,84	936,11	935,38	934,64	933,91	933,17	932,43	931,69	930,95	930,21	53
54	935,46	934,73	934,00	933,26	932,52	931,78	931,04	930,30	929,55	928,81	928,06	54
55	933,34	932,61	931,87	931,13	930,39	929,64	928,90	928,15	927,40	926,65	925,90	55
56	931,21	930,47	929,73	928,98	928,24	927,49	926,74	925,99	925,23	924,48	923,72	56
57	929,07	928,32	927,58	926,83	926,08	925,32	924,57	923,81	923,06	922,30	921,54	57
58	926,91	926,16	925,41	924,66	923,90	923,14	922,39	921,63	920,87	920,11	919,34	58
59	924,74	923,99	923,23	922,47	921,71	920,95	920,19	919,43	918,67	917,90	917,13	59
60	922,56	921,80	921,04	920,28	919,52	918,75	917,99	917,22	916,45	915,69	914,92	60
61	920,36	919,60	918,84	918,07	917,31	916,54	915,77	915,00	914,23	913,46	912,69	61
62	918,15	917,39	916,62	915,85	915,08	914,31	913,54	912,77	912,00	911,22	910,45	62
63	915,93	915,16	914,39	913,62	912,85	912,08	911,30	910,53	909,75	908,98	908,20	63
64	913,69	912,92	912,15	911,38	910,61	909,83	909,06	908,28	907,50	906,72	905,94	64
65	911,45	910,67	909,90	909,13	908,35	907,57	906,80	906,02	905,23	904,45	903,67	65
66	909,19	908,41	907,64	906,86	906,08	905,31	904,52	903,74	902,96	902,18	901,39	66
67	906,92	906,14	905,37	904,59	903,81	903,03	902,24	901,46	900,68	899,89	899,10	67
68	904,64	903,86	903,08	902,30	901,52	900,74	899,95	899,17	898,38	897,59	896,80	68
69	902,35	901,57	900,79	900,01	899,23	898,44	897,65	896,87	896,08	895,29	894,50	69
70	900,05	899,27	898,49	897,71	896,92	896,13	895,35	894,56	893,76	892,97	892,18	70
71	897,74	896,96	896,18	895,39	894,61	893,82	893,03	892,24	891,44	890,65	889,85	71
72	895,43	894,64	893,86	893,07	892,28	891,49	890,70	889,91	889,11	888,32	887,52	72
73	893,11	892,32	891,53	890,74	889,95	889,16	888,37	887,57	886,78	885,98	885,18	73
74	890,78	889,99	889,20	888,41	887,62	886,82	886,03	885,23	884,43	883,63	882,83	74
75	888,44	887,65	886,86	886,07	885,27	884,47	883,68	882,88	882,07	881,27	880,47	75
76	886,10	885,30	884,51	883,71	882,92	882,12	881,32	880,51	879,71	878,91	878,10	76
77	883,75	882,95	882,15	881,35	880,55	879,75	878,95	878,14	877,34	876,53	875,72	77
78	881,39	880,59	879,79	878,99	878,18	877,38	876,57	875,76	874,95	874,15	873,33	78
79	879,02	878,21	877,41	876,61	875,80	874,99	874,18	873,37	872,56	871,75	870,93	79
80	876,64	875,83	875,02	874,21	873,40	872,59	871,78	870,97	870,15	869,34	868,52	80
81	874,24	873,43	872,62	871,81	871,00	870,18	869,37	868,55	867,73	866,92	866,10	81
82	871,83	871,02	870,21	869,39	868,57	867,76	866,94	866,12	865,30	864,48	863,66	82
83	869,40	868,59	867,77	866,95	866,13	865,31	864,49	863,67	862,85	862,02	861,20	83
84	866,95	866,13	865,31	864,49	863,67	862,85	862,02	861,20	860,37	859,55	858,72	84
85	864,48	863,65	862,83	862,01	861,18	860,36	859,53	858,70	857,88	857,05	856,22	85
86	861,97	861,15	860,32	859,49	858,67	857,84	857,01	856,18	855,36	854,53	853,70	86
87	859,43	858,61	857,78	856,95	856,12	855,30	854,47	853,64	852,81	851,98	851,15	87
88	856,86	856,03	855,20	854,38	853,55	852,72	851,89	851,06	850,23	849,40	848,57	88
89	854,24	853,42	852,59	851,76	850,94	850,11	849,28	848,45	847,62	846,79	845,96	89
90	851,59	850,76	849,94	849,11	848,29	847,46	846,63	845,80	844,97	844,14	843,31	90
91	848,89	848,07	847,24	846,42	845,60	844,77	843,95	843,12	842,29	841,46	840,63	91
92	846,14	845,33	844,51	843,69	842,87	842,04	841,22	840,40	839,57	838,74	837,91	92
93	843,35	842,54	841,73	840,91	840,09	839,28	838,46	837,63	836,81	835,98	835,16	93
94	840,52	839,72	838,91	838,10	837,28	836,47	835,65	834,83	834,01	833,19	832,36	94
95	837,66	836,86	836,05	835,24	834,43	833,62	832,80	831,98	831,17	830,34	829,52	95
96	834,76	833,96	833,16	832,35	831,54	830,73	829,92	829,10	828,28	827,46	826,64	96
97	831,85	831,05	830,24	829,43	828,62	827,81	826,99	826,18	825,36	824,54	823,71	97
98	828,93	828,12	827,30	826,49	825,67	824,86	824,04	823,22	822,39	821,57	820,74	98
99	826,01	825,19	824,36	823,54	822,71	821,88	821,05	820,22	819,39	818,56	817,73	99
100	823,12	822,27	821,43	820,58	819,73	818,89	818,04	817,19	816,35	815,50	814,66	100

TABLE I $\varrho = \varrho\,(p, t)$

p \ t	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	
0											999,84	0
1											997,94	1
2											996,14	2
3										994,37	994,43	3
4										992,75	992,81	4
5									991,14	991,22	991,27	5
6									989,70	989,77	989,82	6
7								988,27	988,34	988,40	988,44	7
8								987,00	987,06	987,11	987,14	8
9								985,81	985,86	985,89	985,91	9
10							984,65	984,70	984,74	984,75	984,75	10
11							983,64	983,67	983,68	983,68	983,66	11
12						982,66	982,69	982,69	982,69	982,66	982,62	12
13					981,78	981,79	981,80	981,78	981,75	981,70	981,64	13
14					980,99	980,98	980,96	980,92	980,86	980,79	980,71	14
15				980,28	980,26	980,22	980,17	980,10	980,01	979,92	979,81	15
16				979,62	979,56	979,49	979,41	979,31	979,20	979,07	978,94	16
17			979,05	978,98	978,89	978,79	978,68	978,55	978,41	978,25	978,09	17
18		978,57	978,47	978,36	978,24	978,10	977,96	977,80	977,63	977,44	977,25	18
19	978,14	978,03	977,89	977,75	977,59	977,42	977,24	977,05	976,85	976,64	976,41	19
20	977,64	977,48	977,31	977,13	976,94	976,74	976,53	976,30	976,07	975,82	975,57	20
21	977,12	976,92	976,72	976,50	976,28	976,04	975,79	975,54	975,27	975,00	974,71	21
22	976,57	976,34	976,10	975,85	975,59	975,32	975,04	974,75	974,45	974,15	973,83	22
23	975,99	975,72	975,45	975,16	974,86	974,56	974,25	973,93	973,60	973,26	972,92	23
24	975,37	975,06	974,75	974,43	974,10	973,77	973,42	973,07	972,71	972,35	971,97	24
25	974,69	974,35	974,01	973,65	973,29	972,92	972,55	972,17	971,78	971,38	970,98	25
26	973,96	973,58	973,21	972,82	972,43	972,03	971,62	971,21	970,80	970,37	969,95	26
27	973,16	972,75	972,34	971,93	971,50	971,08	970,64	970,20	969,76	969,31	968,85	27
28	972,29	971,85	971,41	970,97	970,52	970,06	969,60	969,14	968,66	968,19	967,71	28
29	971,34	970,88	970,41	969,94	969,46	968,98	968,50	968,00	967,51	967,01	966,50	29
30	970,32	969,84	969,34	968,84	968,34	967,84	967,32	966,81	966,29	965,77	965,24	30
31	969,23	968,72	968,20	967,68	967,15	966,62	966,09	965,55	965,01	964,46	963,91	31
32	968,05	967,52	966,98	966,43	965,89	965,33	964,78	964,22	963,66	963,09	962,52	32
33	966,80	966,25	965,68	965,12	964,55	963,98	963,41	962,83	962,25	961,66	961,07	33
34	965,48	964,90	964,32	963,74	963,15	962,56	961,97	961,37	960,77	960,17	959,56	34
35	964,08	963,48	962,88	962,28	961,68	961,07	960,46	959,85	959,23	958,62	958,00	35
36	962,60	961,99	961,38	960,76	960,14	959,52	958,89	958,27	957,64	957,00	956,37	36
37	961,06	960,44	959,81	959,18	958,54	957,91	957,27	956,63	955,98	955,34	954,69	37
38	959,46	958,82	958,18	957,53	956,88	956,24	955,58	954,93	954,27	953,61	952,95	38
39	957,79	957,14	956,48	955,83	955,17	954,51	953,85	953,18	952,51	951,84	951,17	39
40	956,06	955,40	954,74	954,07	953,40	952,73	952,06	951,38	950,70	950,02	949,34	40
41	954,29	953,62	952,94	952,26	951,59	950,91	950,22	949,54	948,85	948,16	947,47	41
42	952,46	951,78	951,10	950,41	949,72	949,04	948,34	947,65	946,95	946,26	945,55	42
43	950,59	949,90	949,21	948,52	947,82	947,12	946,42	945,72	945,02	944,31	943,61	43
44	948,68	947,98	947,28	946,58	945,88	945,18	944,47	943,76	943,05	942,34	941,62	44
45	946,73	946,03	945,32	944,62	943,91	943,20	942,48	941,77	941,05	940,33	939,61	45
46	944,75	944,04	943,33	942,62	941,90	941,18	940,46	939,74	939,02	938,29	937,57	46
47	942,74	942,02	941,31	940,59	939,87	939,14	938,42	937,69	936,96	936,23	935,50	47
48	940,70	939,98	939,26	938,53	937,81	937,08	936,35	935,62	934,88	934,15	933,41	48
49	938,64	937,92	937,19	936,46	935,73	934,99	934,26	933,52	932,78	932,04	931,30	49
50	936,56	935,83	935,10	934,36	933,63	932,89	932,15	931,41	930,66	929,92	929,17	50

TABLE I $\varrho = \varrho\,(p, t)$

p \ t	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	
50	936,56	935,83	935,10	934,36	933,63	932,89	932,15	931,41	930,66	929,92	929,17	50
51	934,46	933,72	932,99	932,25	931,51	930,76	930,02	929,27	928,53	927,78	927,03	51
52	932,34	931,60	930,86	930,12	929,37	928,62	927,88	927,13	926,37	925,62	924,87	52
53	930,21	929,46	928,72	927,97	927,22	926,47	925,72	924,96	924,21	923,45	922,69	53
54	928,06	927,31	926,56	925,81	925,06	924,30	923,55	922,79	922,03	921,27	920,51	54
55	925,90	925,15	924,39	923,64	922,88	922,12	921,36	920,60	919,84	919,07	918,31	55
56	923,72	922,97	922,21	921,45	920,69	919,93	919,16	918,40	917,63	916,87	916,10	56
57	921,54	920,78	920,02	919,25	918,49	917,72	916,96	916,19	915,42	914,65	913,88	57
58	919,34	918,58	917,81	917,05	916,28	915,51	914,74	913,97	913,20	912,42	911,65	58
59	917,13	916,37	915,60	914,83	914,06	913,29	912,51	911,74	910,96	910,18	909,41	59
60	914,92	914,15	913,37	912,60	911,83	911,05	910,28	909,50	908,72	907,94	907,16	60
61	912,69	911,91	911,14	910,36	909,59	908,81	908,03	907,25	906,47	905,68	904,90	61
62	910,45	909,67	908,89	908,12	907,34	906,55	905,77	904,99	904,20	903,42	902,63	62
63	908,20	907,42	906,64	905,86	905,07	904,29	903,51	902,72	901,93	901,14	900,35	63
64	905,94	905,16	904,37	903,59	902,80	902,02	901,23	900,44	899,65	898,86	898,07	64
65	903,67	902,89	902,10	901,31	900,53	899,74	898,95	898,15	897,36	896,57	895,77	65
66	901,39	900,60	899,82	899,03	898,24	897,45	896,65	895,86	895,06	894,27	893,47	66
67	899,10	898,31	897,52	896,73	895,94	895,15	894,35	893,55	892,76	891,96	891,16	67
68	896,80	896,01	895,22	894,43	893,63	892,84	892,04	891,24	890,44	889,64	888,84	68
69	894,50	893,70	892,91	892,11	891,32	890,52	889,72	888,92	888,12	887,31	886,51	69
70	892,18	891,38	890,59	889,79	888,99	888,19	887,39	886,59	885,78	884,98	884,17	70
71	889,85	889,06	888,26	887,46	886,66	885,86	885,05	884,25	883,44	882,63	881,82	71
72	887,52	886,72	885,92	885,12	884,32	883,51	882,71	881,90	881,09	880,28	879,47	72
73	885,18	884,38	883,58	882,77	881,97	881,16	880,35	879,54	878,73	877,92	877,11	73
74	882,83	882,03	881,22	880,42	879,61	878,80	877,99	877,18	876,37	875,55	874,74	74
75	880,47	879,66	878,86	878,05	877,24	876,43	875,62	874,80	873,99	873,17	872,35	75
76	878,10	877,29	876,48	875,67	874,86	874,05	873,24	872,42	871,60	870,79	869,97	76
77	875,72	874,91	874,10	873,29	872,48	871,66	870,84	870,03	869,21	868,39	867,57	77
78	873,33	872,52	871,71	870,89	870,08	869,26	868,44	867,62	866,80	865,98	865,16	78
79	870,93	870,12	869,30	868,49	867,67	866,85	866,03	865,21	864,38	863,56	862,73	79
80	868,52	867,71	866,89	866,07	865,25	864,43	863,60	862,78	861,95	861,13	860,30	80
81	866,10	865,28	864,46	863,63	862,81	861,99	861,16	860,34	859,51	858,68	857,85	81
82	863,66	862,83	862,01	861,19	860,36	859,54	858,71	857,88	857,05	856,22	855,39	82
83	861,20	860,37	859,55	858,72	857,89	857,07	856,24	855,41	854,58	853,74	852,91	83
84	858,72	857,89	857,07	856,24	855,41	854,58	853,75	852,92	852,08	851,25	850,41	84
85	856,22	855,39	854,56	853,73	852,90	852,07	851,24	850,40	849,57	848,73	847,90	85
86	853,70	852,87	852,03	851,20	850,37	849,54	848,70	847,87	847,03	846,20	845,36	86
87	851,15	850,31	849,48	848,65	847,82	846,98	846,15	845,31	844,47	843,64	842,80	87
88	848,57	847,73	846,90	846,07	845,23	844,40	843,56	842,73	841,89	841,05	840,21	88
89	845,96	845,12	844,29	843,46	842,62	841,79	840,95	840,11	839,28	838,44	837,60	89
90	843,31	842,48	841,65	840,81	839,98	839,14	838,31	837,47	836,63	835,79	834,95	90
91	840,63	839,80	838,97	838,14	837,30	836,47	835,63	834,80	833,96	833,12	832,28	91
92	837,91	837,09	836,25	835,42	834,59	833,76	832,92	832,09	831,25	830,41	829,57	92
93	835,16	834,33	833,50	832,67	831,84	831,01	830,17	829,34	828,50	827,66	826,82	93
94	832,36	831,54	830,71	829,88	829,05	828,22	827,38	826,55	825,71	824,88	824,04	94
95	829,52	828,70	827,87	827,04	826,21	825,38	824,55	823,72	822,88	822,05	821,21	95
96	826,64	825,82	824,99	824,16	823,34	822,51	821,67	820,84	820,00	819,17	818,33	96
97	823,71	822,89	822,06	821,24	820,41	819,58	818,74	817,91	817,07	816,24	815,40	97
98	820,74	819,92	819,09	818,26	817,43	816,59	815,76	814,92	814,09	813,25	812,41	98
99	817,73	816,89	816,06	815,22	814,39	813,55	812,71	811,87	811,03	810,19	809,35	99
100	814,66	813,81	812,97	812,12	811,28	810,44	809,59	808,75	807,90	807,06	806,22	100

TABLE I $\varrho = \varrho(p, t)$

p \ t	0	1	2	3	4	5	6	7	8	9	10	
0	999,84	999,90	999,94	999,96	999,97	999,96	999,94	999,90	999,84	999,78	999,70	0
1	997,94	998,00	998,04	998,06	998,06	998,06	998,03	997,99	997,94	997,87	997,79	1
2	996,14	996,19	996,23	996,25	996,26	996,25	996,22	996,18	996,13	996,06	995,98	2
3	994,43	994,48	994,52	994,53	994,54	994,52	994,49	994,45	994,39	994,32	994,24	3
4	992,81	992,86	992,89	992,90	992,90	992,88	992,85	992,80	992,74	992,67	992,58	4
5	991,27	991,31	991,34	991,34	991,34	991,31	991,27	991,22	991,16	991,08	990,98	5
6	989,82	989,85	989,86	989,86	989,85	989,82	989,77	989,72	989,64	989,56	989,46	6
7	988,44	988,46	988,47	988,46	988,43	988,40	988,34	988,27	988,19	988,10	987,99	7
8	987,14	987,15	987,14	987,12	987,09	987,04	986,98	986,90	986,81	986,70	986,58	8
9	985,91	985,91	985,89	985,86	985,81	985,75	985,67	985,58	985,48	985,36	985,23	9
10	984,75	984,73	984,70	984,65	984,59	984,51	984,42	984,32	984,20	984,07	983,93	10
11	983,66	983,62	983,57	983,51	983,43	983,34	983,23	983,11	982,98	982,83	982,68	11
12	982,62	982,57	982,50	982,42	982,32	982,21	982,09	981,95	981,80	981,64	981,46	12
13	981,64	981,57	981,48	981,37	981,26	981,13	980,98	980,83	980,66	980,48	980,29	13
14	980,71	980,61	980,49	980,37	980,23	980,08	979,91	979,74	979,55	979,35	979,14	14
15	979,81	979,68	979,55	979,40	979,24	979,06	978,88	978,68	978,47	978,25	978,02	15
16	978,94	978,79	978,62	978,45	978,26	978,07	977,86	977,64	977,41	977,16	976,91	16
17	978,09	977,91	977,72	977,52	977,31	977,09	976,85	976,61	976,36	976,09	975,82	17
18	977,25	977,04	976,83	976,60	976,36	976,11	975,86	975,59	975,31	975,02	974,72	18
19	976,41	976,18	975,93	975,68	975,41	975,14	974,86	974,56	974,26	973,95	973,63	19
20	975,57	975,31	975,03	974,75	974,46	974,16	973,85	973,53	973,20	972,86	972,52	20
21	974,71	974,42	974,12	973,81	973,49	973,16	972,82	972,48	972,13	971,76	971,40	21
22	973,83	973,51	973,18	972,84	972,49	972,14	971,78	971,41	971,03	970,64	970,25	22
23	972,92	972,57	972,21	971,84	971,47	971,09	970,70	970,31	969,90	969,49	969,07	23
24	971,97	971,59	971,21	970,81	970,41	970,01	969,59	969,17	968,74	968,31	967,87	24
25	970,98	970,58	970,16	969,74	969,31	968,88	968,44	968,00	967,55	967,09	966,62	25
26	969,95	969,51	969,07	968,62	968,17	967,71	967,25	966,78	966,31	965,82	965,34	26
27	968,85	968,39	967,93	967,46	966,98	966,50	966,01	965,52	965,02	964,52	964,01	27
28	967,71	967,22	966,73	966,24	965,74	965,23	964,72	964,21	963,69	963,16	962,63	28
29	966,50	965,99	965,48	964,96	964,44	963,91	963,38	962,84	962,30	961,76	961,21	29
30	965,24	964,71	964,17	963,63	963,09	962,54	961,99	961,43	960,87	960,30	959,73	30
31	963,91	963,36	962,80	962,24	961,68	961,11	960,54	959,96	959,38	958,80	958,21	31
32	962,52	961,95	961,38	960,80	960,21	959,63	959,04	958,44	957,84	957,24	956,64	32
33	961,07	960,48	959,89	959,29	958,69	958,09	957,48	956,87	956,25	955,64	955,01	33
34	959,56	958,96	958,35	957,73	957,11	956,49	955,87	955,24	954,61	953,98	953,34	34
35	958,00	957,37	956,74	956,12	955,48	954,85	954,21	953,57	952,92	952,27	951,62	35
36	956,37	955,73	955,09	954,45	953,80	953,15	952,50	951,84	951,18	950,52	949,86	36
37	954,69	954,04	953,38	952,72	952,06	951,40	950,74	950,07	949,40	948,72	948,05	37
38	952,95	952,29	951,62	950,95	950,28	949,61	948,93	948,25	947,57	946,88	946,20	38
39	951,17	950,49	949,82	949,14	948,46	947,77	947,08	946,39	945,70	945,00	944,31	39
40	949,34	948,66	947,97	947,28	946,59	945,89	945,19	944,49	943,79	943,09	942,38	40
41	947,47	946,77	946,08	945,38	944,68	943,97	943,27	942,56	941,85	941,13	940,42	41
42	945,55	944,85	944,15	943,44	942,73	942,02	941,30	940,59	939,87	939,15	938,42	42
43	943,61	942,90	942,18	941,47	940,75	940,03	939,31	938,59	937,86	937,13	936,40	43
44	941,62	940,91	940,19	939,46	938,74	938,01	937,29	936,55	935,82	935,09	934,35	44
45	939,61	938,89	938,16	937,43	936,70	935,97	935,23	934,50	933,76	933,02	932,27	45
46	937,57	936,84	936,11	935,37	934,64	933,90	933,16	932,42	931,67	930,92	930,17	46
47	935,50	934,77	934,03	933,29	932,55	931,81	931,06	930,31	929,56	928,81	928,05	47
48	933,41	932,67	931,93	931,19	930,44	929,69	928,94	928,19	927,43	926,68	925,92	48
49	931,30	930,56	929,81	929,06	928,31	927,56	926,80	926,05	925,29	924,52	923,76	49
50	929,17	928,42	927,67	926,92	926,17	925,41	924,65	923,89	923,12	922,36	921,59	50

TABLE I $\varrho = \varrho(p, t)$

p \ t	0	1	2	3	4	5	6	7	8	9	10	
50	929,17	928,42	927,67	926,92	926,17	925,41	924,65	923,89	923,12	922,36	921,59	50
51	927,03	926,27	925,52	924,76	924,00	923,24	922,48	921,71	920,95	920,18	919,40	51
52	924,87	924,11	923,35	922,59	921,83	921,06	920,30	919,53	918,76	917,98	917,21	52
53	922,69	921,93	921,17	920,40	919,64	918,87	918,10	917,33	916,55	915,77	915,00	53
54	920,51	919,74	918,98	918,21	917,44	916,67	915,89	915,12	914,34	913,56	912,77	54
55	918,31	917,54	916,77	916,00	915,22	914,45	913,67	912,89	912,11	911,33	910,54	55
56	916,10	915,33	914,55	913,78	913,00	912,22	911,44	910,66	909,87	909,09	908,30	56
57	913,88	913,10	912,33	911,55	910,77	909,99	909,20	908,42	907,63	906,84	906,05	57
58	911,65	910,87	910,09	909,31	908,52	907,74	906,95	906,16	905,37	904,58	903,78	58
59	909,41	908,62	907,84	907,06	906,27	905,48	904,69	903,90	903,11	902,31	901,51	59
60	907,16	906,37	905,59	904,80	904,01	903,22	902,43	901,63	900,83	900,04	899,23	60
61	904,90	904,11	903,32	902,53	901,74	900,95	900,15	899,35	898,55	897,75	896,95	61
62	902,63	901,84	901,05	900,25	899,46	898,66	897,87	897,06	896,26	895,46	894,65	62
63	900,35	899,56	898,77	897,97	897,17	896,37	895,57	894,77	893,96	893,16	892,35	63
64	898,07	897,27	896,47	895,68	894,88	894,07	893,27	892,46	891,66	890,85	890,03	64
65	895,77	894,97	894,17	893,37	892,57	891,77	890,96	890,15	889,34	888,53	887,71	65
66	893,47	892,67	891,87	891,06	890,26	889,45	888,64	887,83	887,02	886,20	885,38	66
67	891,16	890,35	889,55	888,74	887,94	887,13	886,31	885,50	884,68	883,87	883,05	67
68	888,84	888,03	887,22	886,42	885,61	884,79	883,98	883,16	882,35	881,53	880,70	68
69	886,51	885,70	884,89	884,08	883,27	882,45	881,64	880,82	880,00	879,18	878,35	69
70	884,17	883,36	882,55	881,74	880,92	880,10	879,29	878,46	877,64	876,82	875,99	70
71	881,82	881,01	880,20	879,38	878,57	877,75	876,93	876,10	875,28	874,45	873,62	71
72	879,47	878,66	877,84	877,02	876,20	875,38	874,56	873,73	872,91	872,08	871,25	72
73	877,11	876,29	875,47	874,65	873,83	873,01	872,18	871,36	870,53	869,70	868,87	73
74	874,74	873,92	873,10	872,28	871,45	870,63	869,80	868,97	868,14	867,31	866,47	74
75	872,35	871,53	870,71	869,89	869,06	868,24	867,41	866,58	865,75	864,91	864,07	75
76	869,97	869,14	868,32	867,49	866,67	865,84	865,01	864,18	863,34	862,50	861,67	76
77	867,57	866,74	865,92	865,09	864,26	863,43	862,60	861,76	860,93	860,09	859,25	77
78	865,16	864,33	863,50	862,67	861,84	861,01	860,18	859,34	858,50	857,66	856,82	78
79	862,73	861,91	861,08	860,25	859,41	858,58	857,74	856,91	856,07	855,23	854,38	79
80	860,30	859,47	858,64	857,81	856,97	856,14	855,30	854,46	853,62	852,78	851,93	80
81	857,85	857,02	856,19	855,35	854,52	853,68	852,84	852,00	851,16	850,32	849,47	81
82	855,39	854,56	853,72	852,89	852,05	851,21	850,37	849,53	848,69	847,84	846,99	82
83	852,91	852,08	851,24	850,40	849,56	848,72	847,88	847,04	846,20	845,35	844,50	83
84	850,41	849,58	848,74	847,90	847,06	846,22	845,38	844,53	843,69	842,84	841,99	84
85	847,90	847,06	846,22	845,38	844,54	843,70	842,86	842,01	841,16	840,32	839,47	85
86	845,36	844,52	843,68	842,84	842,00	841,16	840,31	839,46	838,62	837,77	836,92	86
87	842,80	841,96	841,12	840,28	839,43	838,59	837,74	836,90	836,05	835,20	834,35	87
88	840,21	839,37	838,53	837,69	836,84	836,00	835,15	834,31	833,46	832,61	831,75	88
89	837,60	836,76	835,92	835,07	834,23	833,38	832,54	831,69	830,84	829,99	829,14	89
90	834,95	834,11	833,27	832,43	831,58	830,74	829,89	829,04	828,19	827,34	826,49	90
91	832,28	831,44	830,60	829,75	828,91	828,06	827,21	826,36	825,51	824,66	823,81	91
92	829,57	828,73	827,89	827,04	826,20	825,35	824,50	823,65	822,80	821,95	821,10	92
93	826,82	825,98	825,14	824,30	823,45	822,60	821,76	820,91	820,06	819,21	818,35	93
94	824,04	823,20	822,35	821,51	820,67	819,82	818,97	818,12	817,27	816,42	815,57	94
95	821,21	820,37	819,52	818,68	817,84	816,99	816,14	815,29	814,44	813,59	812,74	95
96	818,33	817,49	816,65	815,80	814,96	814,11	813,27	812,42	811,57	810,72	809,86	96
97	815,40	814,56	813,72	812,87	812,03	811,18	810,34	809,49	808,64	807,79	806,94	97
98	812,41	811,57	810,73	809,88	809,04	808,19	807,35	806,50	805,65	804,80	803,95	98
99	809,35	808,51	807,67	806,82	805,98	805,13	804,29	803,44	802,59	801,74	800,89	99
100	806,22	805,37	804,53	803,68	802,84	801,99	801,14	800,30	799,45	798,60	797,76	100

TABLE I $\varrho = \varrho\,(p, t)$

p \ t	10	11	12	13	14	15	16	17	18	19	20	
0	999,70	999,60	999,49	999,37	999,24	999,10	998,94	998,77	998,59	998,40	998,20	0
1	997,79	997,70	997,59	997,47	997,34	997,20	997,04	996,88	996,70	996,51	996,31	1
2	995,98	995,88	995,77	995,66	995,52	995,38	995,22	995,06	994,88	994,69	994,49	2
3	994,24	994,14	994,03	993,91	993,78	993,63	993,47	993,30	993,12	992,93	992,73	3
4	992,58	992,48	992,36	992,24	992,10	991,95	991,79	991,61	991,43	991,23	991,02	4
5	990,98	990,88	990,76	990,63	990,49	990,33	990,16	989,98	989,79	989,59	989,38	5
6	989,46	989,34	989,22	989,08	988,93	988,77	988,59	988,41	988,21	988,00	987,78	6
7	987,99	987,87	987,73	987,59	987,43	987,26	987,08	986,88	986,68	986,46	986,24	7
8	986,58	986,45	986,31	986,15	985,98	985,80	985,61	985,41	985,19	984,97	984,73	8
9	985,23	985,09	984,93	984,77	984,59	984,40	984,19	983,98	983,75	983,52	983,27	9
10	983,93	983,77	983,61	983,43	983,23	983,03	982,82	982,59	982,35	982,11	981,85	10
11	982,68	982,51	982,32	982,13	981,92	981,71	981,48	981,24	980,99	980,73	980,46	11
12	981,46	981,28	981,08	980,87	980,65	980,42	980,17	979,92	979,66	979,38	979,10	12
13	980,29	980,08	979,87	979,64	979,40	979,16	978,90	978,63	978,35	978,06	977,76	13
14	979,14	978,92	978,68	978,44	978,19	977,92	977,64	977,36	977,06	976,75	976,44	14
15	978,02	977,78	977,52	977,26	976,99	976,70	976,41	976,10	975,79	975,47	975,13	15
16	976,91	976,65	976,38	976,09	975,80	975,49	975,18	974,86	974,53	974,18	973,83	16
17	975,82	975,53	975,24	974,93	974,62	974,29	973,96	973,62	973,27	972,91	972,54	17
18	974,72	974,42	974,10	973,77	973,44	973,09	972,74	972,38	972,01	971,63	971,24	18
19	973,63	973,30	972,96	972,61	972,25	971,89	971,51	971,13	970,74	970,34	969,93	19
20	972,52	972,17	971,80	971,43	971,05	970,67	970,27	969,87	969,45	969,03	968,61	20
21	971,40	971,02	970,63	970,24	969,84	969,43	969,01	968,59	968,15	967,71	967,27	21
22	970,25	969,85	969,44	969,02	968,60	968,17	967,73	967,28	966,83	966,37	965,90	22
23	969,07	968,65	968,22	967,78	967,33	966,88	966,42	965,95	965,48	965,00	964,51	23
24	967,87	967,42	966,97	966,50	966,04	965,56	965,08	964,59	964,10	963,60	963,09	24
25	966,62	966,15	965,68	965,19	964,70	964,21	963,71	963,20	962,68	962,16	961,63	25
26	965,34	964,84	964,35	963,84	963,33	962,81	962,29	961,76	961,23	960,69	960,14	26
27	964,01	963,49	962,97	962,45	961,92	961,38	960,84	960,29	959,74	959,18	958,61	27
28	962,63	962,10	961,56	961,01	960,46	959,90	959,34	958,78	958,20	957,63	957,05	28
29	961,21	960,65	960,09	959,53	958,96	958,38	957,80	957,22	956,63	956,03	955,44	29
30	959,73	959,16	958,58	958,00	957,41	956,82	956,22	955,62	955,01	954,40	953,78	30
31	958,21	957,62	957,02	956,42	955,82	955,21	954,59	953,97	953,35	952,72	952,09	31
32	956,64	956,03	955,41	954,80	954,17	953,55	952,92	952,29	951,65	951,00	950,36	32
33	955,01	954,39	953,76	953,12	952,49	951,85	951,20	950,55	949,90	949,24	948,58	33
34	953,34	952,70	952,06	951,41	950,76	950,10	949,44	948,78	948,11	947,44	946,77	34
35	951,62	950,97	950,31	949,65	948,98	948,31	947,64	946,97	946,29	945,61	944,92	35
36	949,86	949,19	948,52	947,84	947,17	946,48	945,80	945,11	944,42	943,73	943,03	36
37	948,05	947,37	946,68	946,00	945,31	944,62	943,92	943,22	942,52	941,82	941,11	37
38	946,20	945,50	944,81	944,11	943,41	942,71	942,00	941,30	940,58	939,87	939,15	38
39	944,31	943,60	942,90	942,19	941,48	940,77	940,05	939,34	938,61	937,89	937,16	39
40	942,38	941,67	940,95	940,24	939,52	938,80	938,07	937,34	936,61	935,88	935,15	40
41	940,42	939,70	938,97	938,25	937,52	936,79	936,06	935,32	934,59	933,84	933,10	41
42	938,42	937,69	936,96	936,23	935,50	934,76	934,02	933,28	932,53	931,78	931,03	42
43	936,40	935,66	934,93	934,19	933,44	932,70	931,95	931,20	930,45	929,69	928,94	43
44	934,35	933,61	932,86	932,12	931,37	930,62	929,86	929,11	928,35	927,59	926,82	44
45	932,27	931,52	930,77	930,02	929,27	928,51	927,75	926,99	926,22	925,46	924,69	45
46	930,17	929,42	928,66	927,91	927,15	926,38	925,62	924,85	924,08	923,31	922,53	46
47	928,05	927,30	926,54	925,77	925,01	924,24	923,47	922,70	921,92	921,15	920,37	47
48	925,92	925,15	924,39	923,62	922,85	922,08	921,30	920,53	919,75	918,97	918,18	48
49	923,76	922,99	922,22	921,45	920,68	919,90	919,12	918,34	917,56	916,77	915,98	49
50	921,59	920,82	920,05	919,27	918,49	917,71	916,93	916,14	915,35	914,56	913,77	50

TABLE I $\varrho = \varrho(p, t)$

p \ t	10	11	12	13	14	15	16	17	18	19	20	
50	921,59	920,82	920,05	919,27	918,49	917,71	916,93	916,14	915,35	914,56	913,77	50
51	919,40	918,63	917,85	917,07	916,29	915,51	914,72	913,93	913,14	912,34	911,55	51
52	917,21	916,43	915,65	914,86	914,08	913,29	912,50	911,71	910,91	910,11	909,31	52
53	915,00	914,21	913,43	912,64	911,85	911,06	910,27	909,47	908,67	907,87	907,07	53
54	912,77	911,99	911,20	910,41	909,62	908,82	908,03	907,23	906,42	905,62	904,81	54
55	910,54	909,75	908,96	908,17	907,37	906,58	905,77	904,97	904,17	903,36	902,55	55
56	908,30	907,51	906,71	905,92	905,12	904,32	903,51	902,71	901,90	901,09	900,28	56
57	906,05	905,25	904,45	903,66	902,85	902,05	901,24	900,43	899,62	898,81	897,99	57
58	903,78	902,99	902,19	901,39	900,58	899,77	898,96	898,15	897,34	896,52	895,70	58
59	901,51	900,71	899,91	899,11	898,30	897,49	896,68	895,86	895,05	894,23	893,40	59
60	899,23	898,43	897,63	896,82	896,01	895,20	894,38	893,56	892,74	891,92	891,10	60
61	896,95	896,14	895,33	894,52	893,71	892,89	892,08	891,26	890,43	889,61	888,78	61
62	894,65	893,84	893,03	892,22	891,40	890,58	889,76	888,94	888,12	887,29	886,46	62
63	892,35	891,53	890,72	889,91	889,09	888,27	887,44	886,62	885,79	884,96	884,13	63
64	890,03	889,22	888,40	887,58	886,76	885,94	885,12	884,29	883,46	882,63	881,79	64
65	887,71	886,90	886,08	885,26	884,43	883,61	882,78	881,95	881,12	880,28	879,45	65
66	885,38	884,57	883,74	882,92	882,09	881,27	880,44	879,60	878,77	877,93	877,09	66
67	883,05	882,23	881,40	880,58	879,75	878,92	878,09	877,25	876,41	875,57	874,73	67
68	880,70	879,88	879,05	878,22	877,39	876,56	875,73	874,89	874,05	873,21	872,37	68
69	878,35	877,52	876,70	875,87	875,03	874,20	873,36	872,52	871,68	870,84	869,99	69
70	875,99	875,16	874,33	873,50	872,66	871,83	870,99	870,15	869,30	868,46	867,61	70
71	873,62	872,79	871,96	871,13	870,29	869,45	868,61	867,76	866,92	866,07	865,22	71
72	871,25	870,42	869,58	868,74	867,90	867,06	866,22	865,38	864,53	863,68	862,83	72
73	868,87	868,03	867,19	866,35	865,51	864,67	863,83	862,98	862,13	861,28	860,43	73
74	866,47	865,64	864,80	863,96	863,12	862,27	861,42	860,57	859,72	858,87	858,02	74
75	864,07	863,24	862,40	861,55	860,71	859,86	859,01	858,16	857,31	856,46	855,60	75
76	861,67	860,83	859,98	859,14	858,29	857,45	856,59	855,74	854,89	854,03	853,17	76
77	859,25	858,41	857,56	856,72	855,87	855,02	854,17	853,31	852,46	851,60	850,74	77
78	856,82	855,98	855,13	854,29	853,44	852,58	851,73	850,88	850,02	849,16	848,30	78
79	854,38	853,54	852,69	851,84	850,99	850,14	849,29	848,43	847,57	846,71	845,85	79
80	851,93	851,09	850,24	849,39	848,54	847,68	846,83	845,97	845,11	844,25	843,39	80
81	849,47	848,62	847,77	846,92	846,07	845,21	844,36	843,50	842,64	841,78	840,91	81
82	846,99	846,15	845,29	844,44	843,59	842,73	841,88	841,02	840,15	839,29	838,43	82
83	844,50	843,65	842,80	841,95	841,09	840,24	839,38	838,52	837,66	836,79	835,93	83
84	841,99	841,14	840,29	839,44	838,58	837,72	836,86	836,00	835,14	834,28	833,41	84
85	839,47	838,61	837,76	836,91	836,05	835,19	834,33	833,47	832,61	831,74	830,88	85
86	836,92	836,07	835,21	834,36	833,50	832,64	831,78	830,92	830,06	829,19	828,32	86
87	834,35	833,50	832,64	831,79	830,93	830,07	829,21	828,35	827,48	826,62	825,75	87
88	831,75	830,90	830,05	829,19	828,33	827,47	826,61	825,75	824,89	824,02	823,15	88
89	829,14	828,28	827,43	826,57	825,71	824,85	823,99	823,13	822,26	821,40	820,53	89
90	826,49	825,63	824,78	823,92	823,06	822,20	821,34	820,48	819,62	818,75	817,88	90
91	823,81	822,96	822,10	821,24	820,38	819,52	818,66	817,80	816,94	816,07	815,21	91
92	821,10	820,24	819,39	818,53	817,67	816,81	815,95	815,09	814,23	813,36	812,49	92
93	818,35	817,50	816,64	815,78	814,93	814,07	813,21	812,34	811,48	810,62	809,75	93
94	815,57	814,71	813,86	813,00	812,14	811,28	810,42	809,56	808,70	807,83	806,97	94
95	812,74	811,88	811,03	810,17	809,31	808,45	807,59	806,73	805,87	805,01	804,14	95
96	809,86	809,01	808,15	807,30	806,44	805,58	804,72	803,86	803,00	802,14	801,27	96
97	806,94	806,08	805,23	804,37	803,52	802,66	801,80	800,94	800,08	799,22	798,36	97
98	803,95	803,10	802,24	801,39	800,53	799,68	798,82	797,96	797,10	796,24	795,38	98
99	800,89	800,04	799,19	798,34	797,48	796,63	795,77	794,92	794,06	793,20	792,35	99
100	797,76	796,91	796,06	795,21	794,36	793,51	792,65	791,80	790,95	790,09	789,24	100

TABLE I $\varrho = \varrho\,(p, t)$

p \ t	20	21	22	23	24	25	26	27	28	29	30	
0	998,20	997,99	997,77	997,54	997,29	997,04	996,78	996,51	996,23	995,94	995,65	0
1	996,31	996,10	995,88	995,64	995,40	995,15	994,89	994,62	994,34	994,05	993,75	1
2	994,49	994,27	994,05	993,82	993,57	993,32	993,06	992,78	992,50	992,21	991,90	2
3	992,73	992,51	992,29	992,05	991,80	991,55	991,28	991,00	990,72	990,42	990,12	3
4	991,02	990,81	990,58	990,34	990,09	989,83	989,56	989,28	988,99	988,69	988,38	4
5	989,38	989,15	988,92	988,68	988,42	988,15	987,88	987,59	987,30	986,99	986,68	5
6	987,78	987,55	987,31	987,06	986,80	986,53	986,25	985,95	985,65	985,34	985,02	6
7	986,24	986,00	985,75	985,49	985,22	984,94	984,65	984,36	984,05	983,73	983,40	7
8	984,73	984,49	984,23	983,96	983,68	983,40	983,10	982,79	982,48	982,15	981,82	8
9	983,27	983,01	982,75	982,47	982,18	981,89	981,58	981,26	980,94	980,60	980,26	9
10	981,85	981,58	981,30	981,01	980,71	980,41	980,09	979,76	979,43	979,08	978,73	10
11	980,46	980,18	979,89	979,58	979,27	978,95	978,63	978,29	977,94	977,59	977,22	11
12	979,10	978,80	978,50	978,18	977,86	977,53	977,18	976,83	976,47	976,11	975,73	12
13	977,76	977,45	977,13	976,80	976,46	976,12	975,76	975,40	975,02	974,64	974,25	13
14	976,44	976,11	975,78	975,43	975,08	974,72	974,35	973,97	973,58	973,19	972,78	14
15	975,13	974,79	974,44	974,08	973,71	973,33	972,94	972,55	972,15	971,74	971,32	15
16	973,83	973,47	973,11	972,73	972,34	971,95	971,54	971,13	970,71	970,29	969,85	16
17	972,54	972,16	971,77	971,38	970,97	970,56	970,14	969,71	969,28	968,83	968,38	17
18	971,24	970,84	970,44	970,02	969,60	969,17	968,73	968,29	967,83	967,37	966,90	18
19	969,93	969,51	969,09	968,66	968,22	967,77	967,31	966,85	966,38	965,90	965,41	19
20	968,61	968,17	967,73	967,28	966,82	966,35	965,88	965,40	964,91	964,41	963,91	20
21	967,27	966,81	966,35	965,88	965,40	964,91	964,42	963,92	963,42	962,90	962,38	21
22	965,90	965,43	964,94	964,45	963,96	963,45	962,94	962,43	961,90	961,37	960,83	22
23	964,51	964,02	963,51	963,01	962,49	961,97	961,44	960,90	960,36	959,81	959,26	23
24	963,09	962,58	962,05	961,53	960,99	960,45	959,91	959,35	958,79	958,23	957,66	24
25	961,63	961,10	960,56	960,02	959,46	958,91	958,34	957,77	957,19	956,61	956,02	25
26	960,14	959,59	959,03	958,47	957,90	957,32	956,74	956,16	955,56	954,96	954,36	26
27	958,61	958,04	957,47	956,89	956,30	955,71	955,11	954,51	953,90	953,28	952,66	27
28	957,05	956,46	955,86	955,27	954,66	954,05	953,44	952,82	952,20	951,57	950,93	28
29	955,44	954,83	954,22	953,61	952,99	952,36	951,73	951,10	950,46	949,82	949,17	29
30	953,78	953,16	952,54	951,91	951,27	950,63	949,99	949,34	948,69	948,03	947,37	30
31	952,09	951,46	950,82	950,17	949,52	948,87	948,21	947,55	946,88	946,21	945,53	31
32	950,36	949,71	949,05	948,39	947,73	947,06	946,39	945,72	945,04	944,35	943,67	32
33	948,58	947,92	947,25	946,58	945,90	945,22	944,54	943,85	943,16	942,47	941,77	33
34	946,77	946,09	945,41	944,73	944,04	943,35	942,65	941,95	941,25	940,54	939,83	34
35	944,92	944,23	943,54	942,84	942,14	941,44	940,73	940,02	939,31	938,59	937,87	35
36	943,03	942,33	941,63	940,92	940,21	939,49	938,78	938,06	937,33	936,61	935,88	36
37	941,11	940,40	939,68	938,96	938,24	937,52	936,79	936,06	935,33	934,59	933,86	37
38	939,15	938,43	937,71	936,98	936,25	935,51	934,78	934,04	933,30	932,55	931,81	38
39	937,16	936,43	935,70	934,96	934,22	933,48	932,74	931,99	931,24	930,49	929,73	39
40	935,15	934,41	933,66	932,92	932,17	931,42	930,67	929,92	929,16	928,40	927,64	40
41	933,10	932,35	931,60	930,85	930,10	929,34	928,58	927,82	927,06	926,29	925,52	41
42	931,03	930,28	929,52	928,76	928,00	927,24	926,47	925,70	924,93	924,16	923,38	42
43	928,94	928,18	927,41	926,65	925,88	925,11	924,34	923,56	922,79	922,01	921,22	43
44	926,82	926,06	925,29	924,52	923,74	922,96	922,19	921,41	920,62	919,84	919,05	44
45	924,69	923,92	923,14	922,36	921,58	920,80	920,02	919,23	918,44	917,65	916,86	45
46	922,53	921,76	920,98	920,19	919,41	918,62	917,83	917,04	916,25	915,45	914,65	46
47	920,37	919,58	918,80	918,01	917,22	916,43	915,64	914,84	914,04	913,24	912,44	47
48	918,18	917,39	916,60	915,81	915,02	914,22	913,42	912,62	911,82	911,01	910,21	48
49	915,98	915,19	914,40	913,60	912,80	912,00	911,20	910,39	909,59	908,78	907,96	49
50	913,77	912,98	912,18	911,38	910,57	909,77	908,96	908,15	907,34	906,53	905,71	50

TABLE I $\varrho = \varrho\,(p, t)$

p \ t	20	21	22	23	24	25	26	27	28	29	30	
50	913,77	912,98	912,18	911,38	910,57	909,77	908,96	908,15	907,34	906,53	905,71	50
51	911,55	910,75	909,95	909,14	908,34	907,53	906,72	905,90	905,09	904,27	903,45	51
52	909,31	908,51	907,70	906,90	906,09	905,27	904,46	903,64	902,82	902,00	901,18	52
53	907,07	906,26	905,45	904,64	903,83	903,01	902,19	901,37	900,55	899,73	898,90	53
54	904,81	904,00	903,19	902,38	901,56	900,74	899,92	899,10	898,27	897,44	896,61	54
55	902,55	901,74	900,92	900,10	899,28	898,46	897,64	896,81	895,98	895,15	894,31	55
56	900,28	899,46	898,64	897,82	897,00	896,17	895,35	894,52	893,68	892,85	892,01	56
57	897,99	897,18	896,35	895,53	894,70	893,88	893,05	892,21	891,38	890,54	889,70	57
58	895,70	894,88	894,06	893,23	892,40	891,57	890,74	889,90	889,06	888,22	887,38	58
59	893,40	892,58	891,75	890,93	890,09	889,26	888,42	887,59	886,74	885,90	885,06	59
60	891,10	890,27	889,44	888,61	887,78	886,94	886,10	885,26	884,42	883,57	882,72	60
61	888,78	887,95	887,12	886,29	885,45	884,61	883,77	882,93	882,08	881,23	880,38	61
62	886,46	885,63	884,79	883,96	883,12	882,28	881,43	880,59	879,74	878,89	878,04	62
63	884,13	883,30	882,46	881,62	880,78	879,94	879,09	878,24	877,39	876,54	875,68	63
64	881,79	880,96	880,12	879,28	878,43	877,59	876,74	875,89	875,04	874,18	873,32	64
65	879,45	878,61	877,77	876,92	876,08	875,23	874,38	873,53	872,67	871,82	870,96	65
66	877,09	876,25	875,41	874,56	873,72	872,87	872,01	871,16	870,30	869,44	868,58	66
67	874,73	873,89	873,04	872,20	871,35	870,50	869,64	868,78	867,93	867,07	866,20	67
68	872,37	871,52	870,67	869,82	868,97	868,12	867,26	866,40	865,54	864,68	863,82	68
69	869,99	869,14	868,29	867,44	866,59	865,73	864,88	864,02	863,15	862,29	861,42	69
70	867,61	866,76	865,91	865,06	864,20	863,34	862,48	861,62	860,76	859,89	859,02	70
71	865,22	864,37	863,52	862,66	861,80	860,94	860,08	859,22	858,35	857,49	856,62	71
72	862,83	861,97	861,12	860,26	859,40	858,54	857,68	856,81	855,94	855,07	854,20	72
73	860,43	859,57	858,71	857,85	856,99	856,13	855,26	854,40	853,53	852,66	851,78	73
74	858,02	857,16	856,30	855,44	854,58	853,71	852,84	851,98	851,11	850,23	849,36	74
75	855,60	854,74	853,88	853,02	852,15	851,29	850,42	849,55	848,68	847,80	846,93	75
76	853,17	852,31	851,45	850,59	849,72	848,85	847,98	847,11	846,24	845,36	844,49	76
77	850,74	849,88	849,02	848,15	847,28	846,41	845,54	844,67	843,79	842,92	842,04	77
78	848,30	847,44	846,57	845,71	844,84	843,97	843,09	842,22	841,34	840,46	839,58	78
79	845,85	844,98	844,12	843,25	842,38	841,51	840,63	839,76	838,88	838,00	837,12	79
80	843,39	842,52	841,65	840,78	839,91	839,04	838,17	837,29	836,41	835,53	834,65	80
81	840,91	840,05	839,18	838,31	837,44	836,56	835,69	834,81	833,93	833,05	832,16	81
82	838,43	837,56	836,69	835,82	834,95	834,07	833,20	832,32	831,44	830,55	829,67	82
83	835,93	835,06	834,19	833,32	832,44	831,57	830,69	829,81	828,93	828,05	827,16	83
84	833,41	832,54	831,67	830,80	829,93	829,05	828,17	827,29	826,41	825,53	824,64	84
85	830,88	830,01	829,14	828,26	827,39	826,51	825,64	824,76	823,87	822,99	822,10	85
86	828,32	827,45	826,58	825,71	824,84	823,96	823,08	822,20	821,32	820,44	819,55	86
87	825,75	824,88	824,01	823,14	822,26	821,39	820,51	819,63	818,75	817,87	816,98	87
88	823,15	822,28	821,41	820,54	819,67	818,79	817,92	817,04	816,16	815,27	814,39	88
89	820,53	819,66	818,79	817,92	817,05	816,17	815,30	814,42	813,54	812,66	811,77	89
90	817,88	817,01	816,15	815,27	814,40	813,53	812,65	811,77	810,90	810,02	809,13	90
91	815,21	814,34	813,47	812,60	811,73	810,85	809,98	809,10	808,23	807,35	806,47	91
92	812,49	811,63	810,76	809,89	809,02	808,15	807,27	806,40	805,52	804,65	803,77	92
93	809,75	808,88	808,02	807,15	806,28	805,41	804,54	803,66	802,79	801,91	801,04	93
94	806,97	806,10	805,23	804,37	803,50	802,63	801,76	800,89	800,02	799,15	798,27	94
95	804,14	803,28	802,41	801,55	800,68	799,81	798,94	798,07	797,21	796,34	795,47	95
96	801,27	800,41	799,55	798,68	797,82	796,95	796,08	795,22	794,35	793,48	792,61	96
97	798,36	797,49	796,63	795,77	794,90	794,04	793,17	792,31	791,44	790,58	789,71	97
98	795,38	794,52	793,66	792,80	791,94	791,07	790,21	789,35	788,48	787,62	786,76	98
99	792,35	791,49	790,63	789,77	788,91	788,05	787,19	786,33	785,46	784,60	783,74	99
100	789,24	788,38	787,53	786,67	785,81	784,95	784,09	783,23	782,37	781,51	780,65	100

TABLE I $\varrho = \varrho(p, t)$

p \ t	30	31	32	33	34	35	36	37	38	39	40	
0	995,65	995,34	995,02	994,70	994,37	994,03	993,68	993,33	992,96	992,59	992,21	0
1	993,75	993,44	993,12	992,79	992,46	992,11	991,76	991,40	991,03	990,65	990,26	1
2	991,90	991,59	991,27	990,94	990,60	990,25	989,90	989,53	989,16	988,77	988,38	2
3	990,12	989,80	989,48	989,14	988,80	988,45	988,09	987,72	987,34	986,95	986,56	3
4	988,38	988,06	987,73	987,39	987,05	986,69	986,33	985,95	985,57	985,18	984,79	4
5	986,68	986,36	986,02	985,68	985,33	984,97	984,61	984,23	983,85	983,45	983,05	5
6	985,02	984,70	984,36	984,01	983,66	983,29	982,92	982,54	982,15	981,76	981,36	6
7	983,40	983,07	982,73	982,37	982,01	981,64	981,27	980,88	980,49	980,09	979,68	7
8	981,82	981,48	981,13	980,77	980,40	980,02	979,64	979,25	978,85	978,45	978,03	8
9	980,26	979,91	979,55	979,18	978,81	978,43	978,03	977,64	977,23	976,82	976,40	9
10	978,73	978,37	978,00	977,62	977,24	976,85	976,45	976,04	975,63	975,21	974,78	10
11	977,22	976,85	976,47	976,08	975,69	975,28	974,87	974,46	974,03	973,60	973,17	11
12	975,73	975,35	974,95	974,55	974,15	973,73	973,31	972,88	972,45	972,01	971,56	12
13	974,25	973,85	973,45	973,04	972,62	972,19	971,76	971,31	970,87	970,41	969,95	13
14	972,78	972,37	971,95	971,52	971,09	970,65	970,20	969,75	969,29	968,82	968,35	14
15	971,32	970,89	970,46	970,01	969,57	969,11	968,65	968,18	967,70	967,22	966,73	15
16	969,85	969,41	968,96	968,50	968,04	967,57	967,09	966,61	966,12	965,62	965,12	16
17	968,38	967,92	967,46	966,98	966,50	966,02	965,52	965,02	964,52	964,01	963,49	17
18	966,90	966,43	965,95	965,46	964,96	964,46	963,95	963,43	962,91	962,38	961,85	18
19	965,41	964,92	964,42	963,92	963,40	962,88	962,36	961,82	961,28	960,74	960,19	19
20	963,91	963,40	962,88	962,36	961,83	961,29	960,75	960,20	959,64	959,08	958,51	20
21	962,38	961,85	961,32	960,78	960,23	959,68	959,12	958,56	957,98	957,41	956,82	21
22	960,83	960,29	959,74	959,18	958,62	958,05	957,47	956,89	956,30	955,71	955,11	22
23	959,26	958,70	958,13	957,56	956,98	956,39	955,80	955,20	954,60	953,99	953,37	23
24	957,66	957,08	956,49	955,90	955,31	954,71	954,10	953,49	952,87	952,24	951,61	24
25	956,02	955,43	954,83	954,22	953,61	952,99	952,37	951,74	951,11	950,47	949,83	25
26	954,36	953,75	953,13	952,51	951,89	951,25	950,62	949,97	949,33	948,67	948,01	26
27	952,66	952,04	951,41	950,77	950,13	949,48	948,83	948,18	947,51	946,85	946,18	27
28	950,93	950,29	949,65	949,00	948,34	947,68	947,02	946,35	945,67	945,00	944,31	28
29	949,17	948,51	947,85	947,19	946,52	945,85	945,17	944,49	943,80	943,11	942,42	29
30	947,37	946,70	946,03	945,35	944,67	943,99	943,30	942,60	941,91	941,20	940,50	30
31	945,53	944,85	944,17	943,48	942,79	942,09	941,39	940,69	939,98	939,27	938,55	31
32	943,67	942,97	942,28	941,58	940,88	940,17	939,46	938,74	938,02	937,30	936,58	32
33	941,77	941,06	940,36	939,65	938,93	938,21	937,49	936,77	936,04	935,31	934,57	33
34	939,83	939,12	938,40	937,68	936,96	936,23	935,50	934,77	934,03	933,29	932,55	34
35	937,87	937,15	936,42	935,69	934,96	934,22	933,48	932,74	931,99	931,25	930,50	35
36	935,88	935,14	934,41	933,67	932,93	932,18	931,44	930,69	929,93	929,18	928,42	36
37	933,86	933,11	932,37	931,62	930,87	930,12	929,37	928,61	927,85	927,08	926,32	37
38	931,81	931,06	930,31	929,55	928,79	928,03	927,27	926,51	925,74	924,97	924,20	38
39	929,73	928,98	928,22	927,46	926,69	925,92	925,15	924,38	923,61	922,83	922,05	39
40	927,64	926,87	926,11	925,34	924,57	923,79	923,02	922,24	921,46	920,68	919,89	40
41	925,52	924,75	923,97	923,20	922,42	921,64	920,86	920,08	919,29	918,50	917,71	41
42	923,38	922,60	921,82	921,04	920,26	919,47	918,68	917,89	917,10	916,31	915,51	42
43	921,22	920,44	919,65	918,87	918,08	917,29	916,49	915,70	914,90	914,10	913,30	43
44	919,05	918,26	917,47	916,68	915,88	915,08	914,28	913,48	912,68	911,88	911,07	44
45	916,86	916,06	915,27	914,47	913,67	912,87	912,06	911,26	910,45	909,64	908,83	45
46	914,65	913,85	913,05	912,25	911,44	910,64	909,83	909,01	908,20	907,39	906,57	46
47	912,44	911,63	910,83	910,02	909,21	908,39	907,58	906,76	905,94	905,12	904,30	47
48	910,21	909,40	908,59	907,77	906,96	906,14	905,32	904,50	903,68	902,85	902,02	48
49	907,96	907,15	906,33	905,52	904,70	903,88	903,05	902,23	901,40	900,57	899,74	49
50	905,71	904,89	904,07	903,25	902,43	901,60	900,77	899,94	899,11	898,28	897,44	50

TABLE I $\varrho = \varrho\,(p, t)$

p \ t	30	31	32	33	34	35	36	37	38	39	40	
50	905,71	904,89	904,07	903,25	902,43	901,60	900,77	899,94	899,11	898,28	897,44	50
51	903,45	902,63	901,80	900,98	900,15	899,32	898,49	897,65	896,82	895,98	895,14	51
52	901,18	900,35	899,53	898,69	897,86	897,03	896,19	895,35	894,51	893,67	892,82	52
53	898,90	898,07	897,24	896,40	895,57	894,73	893,89	893,05	892,20	891,35	890,50	53
54	896,61	895,78	894,94	894,11	893,27	892,42	891,58	890,73	889,88	889,03	888,18	54
55	894,31	893,48	892,64	891,80	890,96	890,11	889,26	888,41	887,56	886,70	885,85	55
56	892,01	891,17	890,33	889,49	888,64	887,79	886,94	886,09	885,23	884,37	883,51	56
57	889,70	888,86	888,01	887,17	886,32	885,46	884,61	883,75	882,89	882,03	881,17	57
58	887,38	886,54	885,69	884,84	883,99	883,13	882,27	881,41	880,55	879,69	878,82	58
59	885,06	884,21	883,36	882,50	881,65	880,79	879,93	879,07	878,20	877,34	876,46	59
60	882,72	881,87	881,02	880,16	879,31	878,45	877,58	876,72	875,85	874,98	874,11	60
61	880,38	879,53	878,68	877,82	876,96	876,10	875,23	874,36	873,49	872,62	871,74	61
62	878,04	877,18	876,32	875,46	874,60	873,74	872,87	872,00	871,13	870,25	869,37	62
63	875,68	874,83	873,97	873,10	872,24	871,37	870,50	869,63	868,76	867,88	867,00	63
64	873,32	872,46	871,60	870,74	869,87	869,00	868,13	867,26	866,38	865,50	864,62	64
65	870,96	870,10	869,23	868,37	867,50	866,63	865,75	864,88	864,00	863,12	862,23	65
66	868,58	867,72	866,85	865,99	865,12	864,24	863,37	862,49	861,61	860,73	859,84	66
67	866,20	865,34	864,47	863,60	862,73	861,86	860,98	860,10	859,22	858,33	857,45	67
68	863,82	862,95	862,08	861,21	860,34	859,46	858,58	857,70	856,82	855,93	855,04	68
69	861,42	860,55	859,68	858,81	857,94	857,06	856,18	855,30	854,41	853,52	852,63	69
70	859,02	858,15	857,28	856,41	855,53	854,65	853,77	852,89	852,00	851,11	850,22	70
71	856,62	855,74	854,87	853,99	853,12	852,24	851,35	850,47	849,58	848,69	847,80	71
72	854,20	853,33	852,45	851,58	850,70	849,82	848,93	848,05	847,16	846,26	845,37	72
73	851,78	850,91	850,03	849,15	848,27	847,39	846,50	845,61	844,72	843,83	842,93	73
74	849,36	848,48	847,60	846,72	845,84	844,95	844,07	843,18	842,29	841,39	840,49	74
75	846,93	846,05	845,17	844,29	843,40	842,51	841,63	840,73	839,84	838,94	838,04	75
76	844,49	843,61	842,72	841,84	840,95	840,07	839,18	838,28	837,39	836,49	835,59	76
77	842,04	841,16	840,27	839,39	838,50	837,61	836,72	835,82	834,93	834,03	833,12	77
78	839,58	838,70	837,82	836,93	836,04	835,15	834,25	833,36	832,46	831,56	830,65	78
79	837,12	836,24	835,35	834,46	833,57	832,68	831,78	830,88	829,98	829,08	828,17	79
80	834,65	833,76	832,87	831,98	831,09	830,20	829,30	828,40	827,50	826,59	825,68	80
81	832,16	831,28	830,39	829,50	828,60	827,71	826,81	825,91	825,00	824,10	823,19	81
82	829,67	828,78	827,89	827,00	826,11	825,21	824,31	823,41	822,50	821,59	820,68	82
83	827,16	826,27	825,38	824,49	823,60	822,70	821,80	820,89	819,99	819,08	818,17	83
84	824,64	823,75	822,86	821,97	821,07	820,18	819,27	818,37	817,46	816,55	815,64	84
85	822,10	821,22	820,33	819,43	818,54	817,64	816,74	815,83	814,93	814,02	813,10	85
86	819,55	818,66	817,77	816,88	815,99	815,09	814,19	813,28	812,38	811,47	810,55	86
87	816,98	816,09	815,20	814,31	813,42	812,52	811,62	810,72	809,81	808,90	807,99	87
88	814,39	813,50	812,61	811,72	810,83	809,93	809,04	808,14	807,23	806,33	805,42	88
89	811,77	810,89	810,00	809,11	808,22	807,33	806,43	805,53	804,63	803,73	802,82	89
90	809,13	808,25	807,37	806,48	805,59	804,70	803,81	802,91	802,01	801,11	800,21	90
91	806,47	805,59	804,70	803,82	802,93	802,04	801,15	800,26	799,37	798,47	797,57	91
92	803,77	802,89	802,01	801,13	800,25	799,36	798,47	797,59	796,70	795,80	794,91	92
93	801,04	800,16	799,29	798,41	797,53	796,65	795,76	794,88	793,99	793,11	792,22	93
94	798,27	797,40	796,52	795,65	794,77	793,90	793,02	792,14	791,26	790,37	789,49	94
95	795,47	794,59	793,72	792,85	791,98	791,10	790,23	789,35	788,48	787,60	786,72	95
96	792,61	791,74	790,88	790,01	789,14	788,27	787,39	786,52	785,65	784,78	783,90	96
97	789,71	788,85	787,98	787,11	786,24	785,38	784,51	783,64	782,77	781,90	781,02	97
98	786,76	785,89	785,03	784,16	783,29	782,43	781,56	780,69	779,82	778,95	778,08	98
99	783,74	782,87	782,01	781,14	780,28	779,41	778,54	777,67	776,80	775,93	775,05	99
100	780,65	779,78	778,92	778,05	777,18	776,31	775,44	774,57	773,69	772,81	771,93	100

TABLE II $\varrho = \varrho\,(q, t)$

q \ t	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	
0												0
1												1
2												2
3												3
4												4
5												5
6												6
7												7
8												8
9												9
10												10
11												11
12												12
13												13
14												14
15												15
16												16
17												17
18												18
19												19
20												20
21												21
22												22
23											978,29	23
24											977,87	24
25										977,60	977,44	25
26									977,37	977,19	977,00	26
27									976,97	976,76	976,54	27
28								976,78	976,55	976,30	976,05	28
29								976,36	976,09	975,81	975,52	29
30							976,18	975,89	975,59	975,28	974,96	30
31						976,01	975,70	975,38	975,05	974,71	974,36	31
32					975,85	975,51	975,17	974,81	974,45	974,09	973,71	32
33				975,68	975,32	974,95	974,58	974,20	973,81	973,41	973,01	33
34			975,50	975,12	974,73	974,33	973,93	973,52	973,10	972,68	972,25	34
35		975,30	974,90	974,49	974,07	973,65	973,22	972,78	972,34	971,89	971,43	35
36	975,08	974,66	974,23	973,79	973,35	972,90	972,44	971,98	971,51	971,04	970,56	36
37	974,38	973,94	973,48	973,02	972,55	972,07	971,59	971,11	970,62	970,12	969,62	37
38	973,61	973,14	972,66	972,17	971,68	971,18	970,68	970,17	969,66	969,14	968,62	38
39	972,75	972,26	971,76	971,25	970,73	970,21	969,69	969,16	968,63	968,09	967,55	39
40	971,82	971,30	970,78	970,25	969,71	969,18	968,63	968,08	967,53	966,97	966,41	40
41	970,80	970,27	969,72	969,18	968,62	968,06	967,50	966,94	966,37	965,79	965,22	41
42	969,71	969,15	968,59	968,03	967,46	966,88	966,30	965,72	965,13	964,54	963,95	42
43	968,54	967,96	967,39	966,81	966,22	965,63	965,04	964,44	963,84	963,23	962,62	43
44	967,29	966,70	966,11	965,51	964,91	964,31	963,70	963,09	962,47	961,85	961,23	44
45	965,97	965,37	964,76	964,15	963,54	962,92	962,30	961,67	961,04	960,41	959,78	45
46	964,57	963,96	963,34	962,72	962,09	961,46	960,83	960,20	959,56	958,91	958,27	46
47	963,11	962,49	961,86	961,23	960,59	959,95	959,30	958,66	958,01	957,35	956,70	47
48	961,59	960,95	960,32	959,67	959,02	958,37	957,72	957,06	956,40	955,74	955,07	48
49	960,01	959,36	958,71	958,06	957,40	956,74	956,08	955,41	954,74	954,07	953,40	49
50	958,36	957,71	957,05	956,39	955,72	955,05	954,38	953,71	953,03	952,35	951,67	50

TABLE II $\varrho = \varrho(q, t)$

q \ t	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	
50	958,36	957,71	957,05	956,39	955,72	955,05	954,38	953,71	953,03	952,35	951,67	50
51	956,67	956,00	955,34	954,67	953,99	953,32	952,64	951,96	951,27	950,58	949,89	51
52	954,92	954,25	953,57	952,90	952,22	951,53	950,85	950,16	949,46	948,77	948,07	52
53	953,12	952,45	951,77	951,08	950,39	949,70	949,01	948,31	947,61	946,91	946,21	53
54	951,29	950,60	949,91	949,22	948,53	947,83	947,13	946,43	945,72	945,02	944,31	54
55	949,40	948,71	948,02	947,32	946,62	945,92	945,21	944,50	943,79	943,08	942,37	55
56	947,49	946,79	946,09	945,38	944,68	943,97	943,26	942,54	941,83	941,11	940,39	56
57	945,53	944,83	944,12	943,41	942,70	941,98	941,26	940,55	939,82	939,10	938,38	57
58	943,54	942,83	942,12	941,40	940,68	939,96	939,24	938,52	937,79	937,06	936,33	58
59	941,52	940,80	940,08	939,36	938,64	937,91	937,19	936,46	935,73	934,99	934,26	59
60	939,46	938,74	938,02	937,29	936,56	935,83	935,10	934,37	933,63	932,89	932,15	60
61	937,38	936,65	935,92	935,19	934,46	933,72	932,98	932,25	931,51	930,76	930,02	61
62	935,26	934,53	933,80	933,06	932,32	931,58	930,84	930,10	929,35	928,61	927,86	62
63	933,12	932,38	931,64	930,90	930,16	929,42	928,67	927,92	927,17	926,42	925,67	63
64	930,95	930,21	929,46	928,72	927,97	927,22	926,47	925,72	924,96	924,21	923,45	64
65	928,75	928,00	927,25	926,50	925,75	925,00	924,24	923,49	922,73	921,97	921,21	65
66	926,52	925,77	925,01	924,26	923,50	922,75	921,99	921,23	920,47	919,70	918,94	66
67	924,26	923,50	922,75	921,99	921,23	920,47	919,70	918,94	918,18	917,41	916,64	67
68	921,97	921,21	920,45	919,69	918,92	918,16	917,39	916,62	915,86	915,09	914,32	68
69	919,65	918,88	918,12	917,35	916,59	915,82	915,05	914,28	913,51	912,74	911,96	69
70	917,29	916,53	915,76	914,99	914,22	913,45	912,68	911,91	911,13	910,36	909,58	70
71	914,91	914,14	913,37	912,60	911,83	911,05	910,28	909,50	908,73	907,95	907,17	71
72	912,49	911,72	910,95	910,18	909,40	908,63	907,85	907,07	906,29	905,51	904,73	72
73	910,04	909,27	908,50	907,72	906,94	906,17	905,39	904,60	903,82	903,04	902,25	73
74	907,56	906,79	906,01	905,23	904,45	903,67	902,89	902,11	901,32	900,54	899,75	74
75	905,05	904,27	903,49	902,71	901,93	901,15	900,37	899,58	898,79	898,01	897,22	75
76	902,50	901,72	900,94	900,16	899,38	898,59	897,81	897,02	896,23	895,44	894,65	76
77	899,92	899,14	898,36	897,58	896,79	896,01	895,22	894,43	893,64	892,84	892,05	77
78	897,31	896,53	895,75	894,96	894,17	893,38	892,59	891,80	891,01	890,21	889,42	78
79	894,67	893,88	893,10	892,31	891,52	890,73	889,94	889,14	888,35	887,55	886,75	79
80	891,99	891,20	890,41	889,62	888,83	888,04	887,24	886,45	885,65	884,85	884,05	80
81	889,28	888,49	887,70	886,90	886,11	885,31	884,52	883,72	882,92	882,12	881,31	81
82	886,53	885,74	884,94	884,15	883,35	882,55	881,75	880,95	880,15	879,34	878,54	82
83	883,75	882,95	882,15	881,35	880,55	879,75	878,95	878,14	877,34	876,53	875,72	83
84	880,92	880,12	879,32	878,52	877,72	876,91	876,10	875,30	874,49	873,68	872,86	84
85	878,06	877,25	876,45	875,64	874,83	874,02	873,21	872,40	871,59	870,77	869,96	85
86	875,14	874,33	873,52	872,71	871,90	871,08	870,27	869,46	868,64	867,82	867,00	86
87	872,16	871,35	870,54	869,72	868,91	868,09	867,27	866,45	865,63	864,81	863,99	87
88	869,13	868,31	867,49	866,67	865,85	865,03	864,21	863,39	862,57	861,74	860,92	88
89	866,01	865,19	864,37	863,55	862,73	861,90	861,08	860,25	859,43	858,60	857,77	89
90	862,81	861,99	861,17	860,34	859,51	858,69	857,86	857,03	856,20	855,38	854,55	90
91	859,51	858,69	857,86	857,04	856,21	855,38	854,55	853,72	852,89	852,06	851,23	91
92	856,10	855,27	854,45	853,62	852,79	851,96	851,13	850,30	849,47	848,64	847,81	92
93	852,55	851,73	850,91	850,08	849,25	848,43	847,60	846,77	845,94	845,11	844,28	93
94	848,86	848,04	847,22	846,40	845,57	844,75	843,92	843,10	842,27	841,44	840,61	94
95	845,01	844,20	843,38	842,56	841,74	840,92	840,10	839,27	838,45	837,62	836,80	95
96	840,98	840,18	839,37	838,55	837,74	836,92	836,10	835,28	834,46	833,64	832,82	96
97	836,78	835,97	835,17	834,36	833,55	832,74	831,92	831,11	830,29	829,47	828,65	97
98	832,39	831,59	830,78	829,97	829,16	828,35	827,54	826,72	825,90	825,08	824,26	98
99	827,83	827,02	826,20	825,38	824,56	823,74	822,92	822,10	821,27	820,44	819,62	99
100	823,12	822,27	821,43	820,58	819,73	818,89	818,04	817,19	816,35	815,50	814,66	100

TABLE II $\varrho = \varrho\,(q, t)$

q \ t	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	
0											999,84	0
1											998,33	1
2											996,87	2
3										995,41	995,48	3
4										994,07	994,13	4
5										992,78	992,84	5
6									991,47	991,54	991,60	6
7									990,28	990,35	990,41	7
8									989,15	989,22	989,26	8
9								988,00	988,07	988,13	988,17	9
10								986,98	987,04	987,09	987,12	10
11								986,01	986,06	986,10	986,12	11
12							985,04	985,09	985,13	985,15	985,16	12
13							984,18	984,22	984,25	984,25	984,24	13
14						983,33	983,37	983,39	983,40	983,39	983,37	14
15						982,58	982,60	982,61	982,60	982,57	982,53	15
16					981,85	981,87	981,87	981,86	981,83	981,78	981,72	16
17					981,20	981,19	981,17	981,14	981,09	981,03	980,95	17
18				980,59	980,58	980,55	980,51	980,45	980,38	980,30	980,20	18
19				980,02	979,99	979,94	979,87	979,79	979,70	979,59	979,47	19
20			979,53	979,48	979,42	979,34	979,25	979,15	979,03	978,90	978,75	20
21		979,09	979,03	978,95	978,86	978,76	978,64	978,51	978,37	978,22	978,05	21
22		978,63	978,54	978,44	978,32	978,19	978,05	977,89	977,72	977,54	977,35	22
23	978,29	978,18	978,06	977,93	977,78	977,62	977,45	977,27	977,08	976,87	976,66	23
24	977,87	977,73	977,58	977,42	977,24	977,05	976,85	976,65	976,43	976,20	975,96	24
25	977,44	977,27	977,09	976,89	976,69	976,47	976,25	976,01	975,77	975,51	975,24	25
26	977,00	976,80	976,58	976,36	976,13	975,88	975,63	975,36	975,09	974,81	974,52	26
27	976,54	976,30	976,06	975,80	975,54	975,27	974,99	974,70	974,40	974,09	973,77	27
28	976,05	975,78	975,51	975,22	974,93	974,63	974,32	974,00	973,68	973,35	973,01	28
29	975,52	975,23	974,93	974,61	974,29	973,96	973,63	973,28	972,93	972,57	972,21	29
30	974,96	974,64	974,31	973,96	973,62	973,26	972,90	972,53	972,15	971,77	971,38	30
31	974,36	974,01	973,65	973,28	972,90	972,52	972,13	971,73	971,33	970,93	970,51	31
32	973,71	973,33	972,94	972,54	972,14	971,73	971,32	970,90	970,47	970,04	969,61	32
33	973,01	972,60	972,18	971,76	971,33	970,90	970,46	970,02	969,57	969,12	968,66	33
34	972,25	971,81	971,37	970,93	970,48	970,02	969,56	969,09	968,62	968,14	967,66	34
35	971,43	970,97	970,51	970,04	969,56	969,09	968,60	968,11	967,62	967,12	966,62	35
36	970,56	970,07	969,59	969,09	968,60	968,10	967,59	967,08	966,57	966,05	965,53	36
37	969,62	969,11	968,60	968,09	967,57	967,05	966,52	965,99	965,46	964,92	964,38	37
38	968,62	968,09	967,56	967,03	966,49	965,95	965,40	964,85	964,30	963,74	963,18	38
39	967,55	967,00	966,45	965,90	965,34	964,78	964,22	963,65	963,08	962,51	961,93	39
40	966,41	965,85	965,28	964,71	964,14	963,56	962,98	962,40	961,81	961,22	960,63	40
41	965,22	964,63	964,05	963,46	962,87	962,28	961,68	961,09	960,48	959,88	959,27	41
42	963,95	963,36	962,76	962,15	961,55	960,94	960,33	959,72	959,10	958,48	957,86	42
43	962,62	962,01	961,40	960,78	960,16	959,54	958,92	958,29	957,66	957,03	956,39	43
44	961,23	960,61	959,98	959,35	958,72	958,08	957,45	956,81	956,16	955,52	954,87	44
45	959,78	959,14	958,50	957,86	957,22	956,57	955,92	955,27	954,62	953,96	953,30	45
46	958,27	957,62	956,97	956,32	955,66	955,00	954,34	953,68	953,02	952,35	951,68	46
47	956,70	956,04	955,38	954,72	954,05	953,38	952,71	952,04	951,37	950,69	950,01	47
48	955,07	954,41	953,74	953,06	952,39	951,71	951,03	950,35	949,67	948,98	948,30	48
49	953,40	952,72	952,04	951,36	950,68	949,99	949,31	948,62	947,92	947,23	946,53	49
50	951,67	950,99	950,30	949,61	948,92	948,23	947,53	946,83	946,13	945,43	944,73	50

TABLE II $\varrho = \varrho\,(q, t)$

q \ t	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	q
50	951,67	950,99	950,30	949,61	948,92	948,23	947,53	946,83	946,13	945,43	944,73	50
51	949,89	949,20	948,51	947,81	947,11	946,41	945,71	945,01	944,30	943,59	942,88	51
52	948,07	947,38	946,67	945,97	945,27	944,56	943,85	943,14	942,43	941,71	941,00	52
53	946,21	945,51	944,80	944,09	943,38	942,67	941,95	941,23	940,52	939,79	939,07	53
54	944,31	943,60	942,88	942,17	941,45	940,73	940,01	939,29	938,57	937,84	937,11	54
55	942,37	941,65	940,93	940,21	939,49	938,76	938,04	937,31	936,58	935,85	935,12	55
56	940,39	939,67	938,94	938,22	937,49	936,76	936,03	935,30	934,56	933,83	933,09	56
57	938,38	937,65	936,92	936,19	935,46	934,73	933,99	933,25	932,51	931,77	931,03	57
58	936,33	935,60	934,87	934,13	933,40	932,66	931,92	931,18	930,43	929,69	928,94	58
59	934,26	933,52	932,78	932,04	931,30	930,56	929,82	929,07	928,32	927,57	926,82	59
60	932,15	931,41	930,67	929,93	929,18	928,43	927,69	926,94	926,18	925,43	924,68	60
61	930,02	929,27	928,53	927,78	927,03	926,28	925,53	924,77	924,02	923,26	922,50	61
62	927,86	927,11	926,36	925,61	924,85	924,10	923,34	922,58	921,83	921,06	920,30	62
63	925,67	924,92	924,16	923,41	922,65	921,89	921,13	920,37	919,61	918,84	918,07	63
64	923,45	922,70	921,94	921,18	920,42	919,66	918,89	918,13	917,36	916,59	915,82	64
65	921,21	920,45	919,69	918,92	918,16	917,39	916,63	915,86	915,09	914,32	913,54	65
66	918,94	918,18	917,41	916,64	915,88	915,11	914,33	913,56	912,79	912,01	911,24	66
67	916,64	915,87	915,11	914,34	913,56	912,79	912,02	911,24	910,46	909,69	908,91	67
68	914,32	913,55	912,77	912,00	911,22	910,45	909,67	908,89	908,11	907,33	906,55	68
69	911,96	911,19	910,41	909,64	908,86	908,08	907,30	906,52	905,73	904,95	904,16	69
70	909,58	908,80	908,02	907,24	906,46	905,68	904,90	904,11	903,33	902,54	901,75	70
71	907,17	906,39	905,61	904,82	904,04	903,26	902,47	901,68	900,89	900,10	899,31	71
72	904,73	903,94	903,16	902,37	901,59	900,80	900,01	899,22	898,43	897,63	896,84	72
73	902,25	901,47	900,68	899,89	899,11	898,31	897,52	896,73	895,94	895,14	894,34	73
74	899,75	898,96	898,17	897,38	896,59	895,80	895,00	894,21	893,41	892,61	891,81	74
75	897,22	896,43	895,64	894,84	894,05	893,25	892,46	891,66	890,86	890,06	889,25	75
76	894,65	893,86	893,06	892,27	891,47	890,67	889,87	889,07	888,27	887,47	886,66	76
77	892,05	891,26	890,46	889,66	888,86	888,06	887,26	886,46	885,65	884,85	884,04	77
78	889,42	888,62	887,82	887,02	886,22	885,42	884,62	883,81	883,00	882,19	881,38	78
79	886,75	885,95	885,15	884,35	883,55	882,74	881,94	881,13	880,32	879,51	878,69	79
80	884,05	883,25	882,45	881,64	880,84	880,03	879,22	878,41	877,60	876,78	875,97	80
81	881,31	880,51	879,70	878,90	878,09	877,28	876,47	875,66	874,84	874,03	873,21	81
82	878,54	877,73	876,92	876,11	875,30	874,49	873,68	872,86	872,05	871,23	870,41	82
83	875,72	874,91	874,10	873,29	872,48	871,66	870,85	870,03	869,21	868,39	867,57	83
84	872,86	872,05	871,24	870,42	869,61	868,79	867,97	867,15	866,33	865,51	864,68	84
85	869,96	869,14	868,33	867,51	866,69	865,87	865,05	864,23	863,40	862,58	861,75	85
86	867,00	866,19	865,37	864,54	863,72	862,90	862,08	861,25	860,42	859,60	858,77	86
87	863,99	863,17	862,35	861,52	860,70	859,87	859,05	858,22	857,39	856,56	855,73	87
88	860,92	860,09	859,27	858,44	857,61	856,78	855,96	855,13	854,29	853,46	852,63	88
89	857,77	856,94	856,12	855,29	854,46	853,63	852,79	851,96	851,13	850,29	849,46	89
90	854,55	853,72	852,89	852,05	851,22	850,39	849,56	848,72	847,89	847,05	846,21	90
91	851,23	850,40	849,57	848,73	847,90	847,07	846,23	845,39	844,56	843,72	842,88	91
92	847,81	846,98	846,15	845,31	844,48	843,64	842,81	841,97	841,13	840,29	839,45	92
93	844,28	843,44	842,61	841,78	840,94	840,11	839,27	838,43	837,60	836,76	835,92	93
94	840,61	839,78	838,95	838,11	837,28	836,45	835,61	834,77	833,94	833,10	832,26	94
95	836,80	835,97	835,14	834,31	833,47	832,64	831,81	830,97	830,13	829,29	828,45	95
96	832,82	831,99	831,16	830,33	829,50	828,67	827,84	827,00	826,17	825,33	824,49	96
97	828,65	827,82	827,00	826,17	825,34	824,51	823,68	822,84	822,01	821,17	820,33	97
98	824,26	823,44	822,61	821,78	820,95	820,12	819,29	818,46	817,62	816,78	815,95	98
99	819,62	818,79	817,96	817,13	816,29	815,46	814,62	813,79	812,95	812,11	811,27	99
100	814,66	813,81	812,97	812,12	811,28	810,44	809,59	808,75	807,90	807,06	806,22	100

TABLE II $\varrho = \varrho\,(q, t)$

q \ t	0	1	2	3	4	5	6	7	8	9	10	
0	999,84	999,90	999,94	999,96	999,97	999,96	999,94	999,90	999,84	999,78	999,70	0
1	998,33	998,38	998,42	998,45	998,45	998,44	998,42	998,38	998,33	998,26	998,18	1
2	996,87	996,93	996,97	996,99	996,99	996,98	996,96	996,92	996,87	996,80	996,72	2
3	995,48	995,53	995,57	995,58	995,59	995,58	995,55	995,51	995,45	995,39	995,30	3
4	994,13	994,18	994,22	994,23	994,23	994,22	994,19	994,15	994,09	994,02	993,93	4
5	992,84	992,89	992,92	992,93	992,93	992,91	992,88	992,83	992,77	992,70	992,61	5
6	991,60	991,64	991,66	991,67	991,67	991,64	991,61	991,56	991,49	991,41	991,32	6
7	990,41	990,44	990,46	990,46	990,45	990,42	990,38	990,33	990,26	990,17	990,08	7
8	989,26	989,29	989,30	989,30	989,28	989,25	989,20	989,14	989,06	988,97	988,87	8
9	988,17	988,19	988,19	988,18	988,15	988,11	988,06	987,99	987,90	987,81	987,70	9
10	987,12	987,13	987,12	987,10	987,07	987,02	986,96	986,88	986,79	986,68	986,56	10
11	986,12	986,12	986,10	986,07	986,03	985,97	985,89	985,80	985,70	985,59	985,46	11
12	985,16	985,15	985,12	985,08	985,02	984,95	984,87	984,77	984,65	984,53	984,39	12
13	984,24	984,22	984,18	984,12	984,05	983,97	983,87	983,76	983,64	983,50	983,35	13
14	983,37	983,33	983,27	983,20	983,12	983,02	982,91	982,79	982,65	982,50	982,34	14
15	982,53	982,47	982,40	982,32	982,22	982,11	981,98	981,84	981,69	981,53	981,35	15
16	981,72	981,65	981,56	981,46	981,35	981,22	981,08	980,92	980,76	980,58	980,39	16
17	980,95	980,86	980,75	980,63	980,50	980,35	980,19	980,02	979,84	979,65	979,44	17
18	980,20	980,09	979,96	979,82	979,67	979,51	979,33	979,14	978,94	978,73	978,51	18
19	979,47	979,33	979,19	979,03	978,86	978,68	978,48	978,27	978,06	977,83	977,59	19
20	978,75	978,60	978,43	978,25	978,06	977,86	977,64	977,42	977,18	976,93	976,68	20
21	978,05	977,87	977,68	977,48	977,27	977,04	976,81	976,57	976,31	976,04	975,77	21
22	977,35	977,15	976,94	976,71	976,48	976,24	975,98	975,72	975,44	975,16	974,86	22
23	976,66	976,43	976,19	975,95	975,69	975,42	975,15	974,86	974,57	974,26	973,95	23
24	975,96	975,71	975,44	975,18	974,90	974,61	974,31	974,00	973,69	973,36	973,03	24
25	975,24	974,97	974,69	974,39	974,09	973,78	973,46	973,13	972,79	972,45	972,09	25
26	974,52	974,22	973,91	973,59	973,27	972,94	972,59	972,24	971,88	971,52	971,14	26
27	973,77	973,45	973,12	972,78	972,43	972,07	971,71	971,34	970,96	970,57	970,18	27
28	973,01	972,66	972,30	971,94	971,56	971,19	970,80	970,41	970,01	969,60	969,18	28
29	972,21	971,83	971,45	971,07	970,67	970,27	969,86	969,45	969,03	968,60	968,16	29
30	971,38	970,98	970,58	970,17	969,75	969,33	968,90	968,46	968,02	967,57	967,12	30
31	970,51	970,09	969,66	969,23	968,79	968,35	967,90	967,44	966,98	966,51	966,04	31
32	969,61	969,16	968,71	968,26	967,80	967,33	966,86	966,39	965,90	965,41	964,92	32
33	968,66	968,19	967,72	967,24	966,76	966,28	965,79	965,29	964,79	964,28	963,77	33
34	967,66	967,17	966,68	966,19	965,69	965,18	964,67	964,15	963,63	963,11	962,58	34
35	966,62	966,11	965,60	965,08	964,56	964,04	963,51	962,97	962,43	961,89	961,34	35
36	965,53	965,00	964,47	963,93	963,39	962,85	962,30	961,75	961,19	960,63	960,07	36
37	964,38	963,84	963,29	962,73	962,18	961,61	961,05	960,48	959,91	959,33	958,75	37
38	963,18	962,62	962,05	961,48	960,91	960,33	959,75	959,16	958,57	957,98	957,38	38
39	961,93	961,35	960,77	960,18	959,59	959,00	958,40	957,80	957,19	956,58	955,97	39
40	960,63	960,03	959,43	958,83	958,22	957,62	957,00	956,39	955,77	955,14	954,52	40
41	959,27	958,66	958,04	957,43	956,81	956,18	955,56	954,93	954,29	953,66	953,02	41
42	957,86	957,23	956,60	955,97	955,34	954,70	954,06	953,42	952,77	952,12	951,47	42
43	956,39	955,75	955,11	954,47	953,82	953,17	952,52	951,86	951,21	950,54	949,88	43
44	954,87	954,22	953,57	952,91	952,25	951,59	950,93	950,26	949,59	948,92	948,25	44
45	953,30	952,64	951,98	951,31	950,64	949,97	949,29	948,62	947,94	947,25	946,57	45
46	951,68	951,01	950,34	949,66	948,98	948,30	947,61	946,92	946,23	945,54	944,85	46
47	950,01	949,33	948,65	947,96	947,27	946,58	945,89	945,19	944,49	943,79	943,08	47
48	948,30	947,61	946,91	946,22	945,52	944,82	944,12	943,41	942,71	941,99	941,28	48
49	946,53	945,84	945,14	944,43	943,73	943,02	942,31	941,60	940,88	940,16	939,44	49
50	944,73	944,02	943,32	942,60	941,89	941,18	940,46	939,74	939,02	938,29	937,56	50

TABLE II $\varrho = \varrho\,(q, t)$

q \ t	0	1	2	3	4	5	6	7	8	9	10	
50	944,73	944,02	943,32	942,60	941,89	941,18	940,46	939,74	939,02	938,29	937,56	50
51	942,88	942,17	941,45	940,74	940,02	939,30	938,57	937,84	937,12	936,38	935,65	51
52	941,00	940,28	939,56	938,83	938,11	937,38	936,65	935,91	935,18	934,44	933,70	52
53	939,07	938,35	937,62	936,89	936,16	935,42	934,69	933,95	933,21	932,46	931,72	53
54	937,11	936,38	935,65	934,91	934,18	933,44	932,69	931,95	931,20	930,46	929,70	54
55	935,12	934,38	933,64	932,90	932,16	931,42	930,67	929,92	929,17	928,42	927,66	55
56	933,09	932,35	931,61	930,86	930,11	929,36	928,61	927,86	927,10	926,35	925,59	56
57	931,03	930,28	929,54	928,79	928,04	927,28	926,53	925,77	925,01	924,25	923,48	57
58	928,94	928,19	927,44	926,69	925,93	925,17	924,41	923,65	922,89	922,12	921,35	58
59	926,82	926,07	925,31	924,56	923,80	923,03	922,27	921,51	920,74	919,97	919,19	59
60	924,68	923,92	923,16	922,40	921,63	920,87	920,10	919,33	918,56	917,79	917,01	60
61	922,50	921,74	920,98	920,21	919,45	918,68	917,91	917,13	916,36	915,58	914,80	61
62	920,30	919,54	918,77	918,00	917,23	916,46	915,68	914,91	914,13	913,35	912,57	62
63	918,07	917,31	916,54	915,76	914,99	914,22	913,44	912,66	911,88	911,09	910,31	63
64	915,82	915,05	914,28	913,50	912,72	911,95	911,16	910,38	909,60	908,81	908,02	64
65	913,54	912,77	911,99	911,21	910,43	909,65	908,87	908,08	907,29	906,50	905,71	65
66	911,24	910,46	909,68	908,90	908,11	907,33	906,54	905,75	904,96	904,17	903,37	66
67	908,91	908,12	907,34	906,56	905,77	904,98	904,19	903,40	902,60	901,81	901,01	67
68	906,55	905,76	904,98	904,19	903,40	902,61	901,81	901,02	900,22	899,42	898,62	68
69	904,16	903,38	902,59	901,80	901,00	900,21	899,41	898,61	897,81	897,01	896,20	69
70	901,75	900,96	900,17	899,37	898,58	897,78	896,98	896,18	895,38	894,57	893,76	70
71	899,31	898,52	897,72	896,92	896,13	895,32	894,52	893,72	892,91	892,10	891,29	71
72	896,84	896,04	895,25	894,45	893,64	892,84	892,04	891,23	890,42	889,61	888,79	72
73	894,34	893,54	892,74	891,94	891,13	890,33	889,52	888,71	887,90	887,08	886,27	73
74	891,81	891,01	890,21	889,40	888,59	887,79	886,97	886,16	885,35	884,53	883,71	74
75	889,25	888,45	887,64	886,83	886,02	885,21	884,40	883,58	882,77	881,95	881,13	75
76	886,66	885,86	885,05	884,24	883,42	882,61	881,79	880,98	880,16	879,33	878,51	76
77	884,04	883,23	882,42	881,61	880,79	879,97	879,16	878,33	877,51	876,69	875,86	77
78	881,38	880,57	879,76	878,94	878,13	877,31	876,48	875,66	874,84	874,01	873,18	78
79	878,69	877,88	877,06	876,25	875,43	874,60	873,78	872,96	872,13	871,30	870,47	79
80	875,97	875,15	874,33	873,51	872,69	871,87	871,04	870,21	869,38	868,55	867,72	80
81	873,21	872,39	871,57	870,74	869,92	869,09	868,27	867,44	866,60	865,77	864,93	81
82	870,41	869,59	868,76	867,94	867,11	866,28	865,45	864,62	863,79	862,95	862,11	82
83	867,57	866,74	865,92	865,09	864,26	863,43	862,60	861,76	860,93	860,09	859,25	83
84	864,68	863,86	863,03	862,20	861,37	860,53	859,70	858,86	858,03	857,19	856,34	84
85	861,75	860,92	860,09	859,26	858,43	857,59	856,76	855,92	855,08	854,24	853,39	85
86	858,77	857,94	857,10	856,27	855,44	854,60	853,76	852,92	852,08	851,24	850,39	86
87	855,73	854,90	854,06	853,23	852,39	851,55	850,71	849,87	849,03	848,18	847,33	87
88	852,63	851,79	850,96	850,12	849,28	848,44	847,60	846,76	845,91	845,07	844,22	88
89	849,46	848,62	847,78	846,95	846,11	845,26	844,42	843,58	842,73	841,88	841,03	89
90	846,21	845,38	844,54	843,70	842,85	842,01	841,17	840,32	839,47	838,62	837,77	90
91	842,88	842,04	841,20	840,36	839,52	838,67	837,83	836,98	836,13	835,28	834,43	91
92	839,45	838,61	837,77	836,93	836,09	835,24	834,39	833,55	832,70	831,85	830,99	92
93	835,92	835,08	834,23	833,39	832,55	831,70	830,85	830,00	829,16	828,30	827,45	93
94	832,26	831,42	830,57	829,73	828,88	828,04	827,19	826,34	825,49	824,64	823,79	94
95	828,45	827,61	826,77	825,93	825,08	824,24	823,39	822,54	821,69	820,84	819,98	95
96	824,49	823,65	822,81	821,96	821,12	820,27	819,42	818,58	817,72	816,87	816,02	96
97	820,33	819,49	818,65	817,81	816,96	816,12	815,27	814,42	813,57	812,72	811,87	97
98	815,95	815,11	814,26	813,42	812,58	811,73	810,88	810,04	809,19	808,33	807,48	98
99	811,27	810,43	809,59	808,74	807,90	807,05	806,21	805,36	804,51	803,66	802,81	99
100	806,22	805,37	804,53	803,68	802,84	801,99	801,14	800,30	799,45	798,60	797,76	100

TABLE II $\varrho = \varrho\,(q, t)$

q \ t	10	11	12	13	14	15	16	17	18	19	20	
0	999,70	999,60	999,49	999,37	999,24	999,10	998,94	998,77	998,59	998,40	998,20	0
1	998,18	998,09	997,98	997,86	997,73	997,59	997,43	997,26	997,09	996,90	996,70	1
2	996,72	996,62	996,52	996,40	996,27	996,12	995,97	995,80	995,62	995,43	995,23	2
3	995,30	995,21	995,10	994,98	994,85	994,70	994,55	994,38	994,20	994,01	993,81	3
4	993,93	993,84	993,73	993,60	993,47	993,32	993,16	992,99	992,81	992,62	992,41	4
5	992,61	992,51	992,39	992,27	992,13	991,98	991,82	991,64	991,46	991,26	991,06	5
6	991,32	991,22	991,10	990,97	990,83	990,67	990,51	990,33	990,14	989,94	989,73	6
7	990,08	989,97	989,84	989,71	989,56	989,40	989,23	989,05	988,85	988,65	988,43	7
8	988,87	988,75	988,62	988,48	988,33	988,16	987,99	987,80	987,60	987,39	987,16	8
9	987,70	987,57	987,44	987,29	987,13	986,96	986,77	986,58	986,37	986,15	985,92	9
10	986,56	986,43	986,29	986,13	985,96	985,78	985,59	985,39	985,17	984,95	984,71	10
11	985,46	985,32	985,17	985,00	984,82	984,64	984,43	984,22	984,00	983,77	983,52	11
12	984,39	984,24	984,08	983,90	983,71	983,52	983,31	983,08	982,85	982,61	982,35	12
13	983,35	983,19	983,02	982,83	982,63	982,42	982,20	981,97	981,73	981,47	981,21	13
14	982,34	982,17	981,98	981,78	981,57	981,35	981,12	980,87	980,62	980,36	980,08	14
15	981,35	981,16	980,97	980,75	980,53	980,30	980,05	979,80	979,53	979,26	978,97	15
16	980,39	980,19	979,97	979,75	979,51	979,26	979,01	978,74	978,46	978,17	977,87	16
17	979,44	979,22	979,00	978,76	978,51	978,24	977,97	977,69	977,40	977,10	976,79	17
18	978,51	978,28	978,03	977,78	977,51	977,24	976,95	976,65	976,35	976,03	975,71	18
19	977,59	977,34	977,08	976,81	976,53	976,23	975,93	975,62	975,30	974,97	974,63	19
20	976,68	976,41	976,13	975,84	975,55	975,24	974,92	974,59	974,26	973,91	973,56	20
21	975,77	975,48	975,19	974,88	974,57	974,24	973,91	973,57	973,21	972,85	972,48	21
22	974,86	974,56	974,24	973,92	973,59	973,24	972,89	972,53	972,16	971,79	971,40	22
23	973,95	973,62	973,29	972,95	972,60	972,24	971,87	971,49	971,11	970,72	970,31	23
24	973,03	972,68	972,33	971,97	971,60	971,22	970,84	970,44	970,04	969,63	969,21	24
25	972,09	971,73	971,36	970,98	970,59	970,20	969,79	969,38	968,96	968,53	968,10	25
26	971,14	970,76	970,37	969,97	969,57	969,15	968,73	968,30	967,86	967,42	966,97	26
27	970,18	969,77	969,36	968,95	968,52	968,09	967,65	967,20	966,75	966,28	965,81	27
28	969,18	968,76	968,33	967,89	967,45	967,00	966,54	966,08	965,60	965,13	964,64	28
29	968,16	967,72	967,27	966,82	966,36	965,89	965,41	964,93	964,44	963,94	963,44	29
30	967,12	966,65	966,19	965,71	965,23	964,74	964,25	963,75	963,24	962,73	962,21	30
31	966,04	965,56	965,07	964,58	964,08	963,57	963,06	962,54	962,02	961,49	960,95	31
32	964,92	964,42	963,92	963,40	962,89	962,36	961,84	961,30	960,76	960,21	959,66	32
33	963,77	963,25	962,73	962,20	961,66	961,12	960,58	960,03	959,47	958,91	958,34	33
34	962,58	962,04	961,50	960,95	960,40	959,84	959,28	958,71	958,14	957,56	956,98	34
35	961,34	960,79	960,23	959,67	959,10	958,53	957,95	957,37	956,78	956,18	955,59	35
36	960,07	959,50	958,92	958,34	957,76	957,17	956,58	955,98	955,37	954,77	954,15	36
37	958,75	958,16	957,57	956,97	956,37	955,77	955,16	954,55	953,93	953,31	952,69	37
38	957,38	956,78	956,17	955,56	954,95	954,33	953,71	953,08	952,45	951,82	951,18	38
39	955,97	955,36	954,74	954,11	953,48	952,85	952,22	951,58	950,93	950,28	949,63	39
40	954,52	953,89	953,25	952,62	951,97	951,33	950,68	950,03	949,37	948,71	948,05	40
41	953,02	952,37	951,73	951,08	950,42	949,76	949,10	948,44	947,77	947,10	946,42	41
42	951,47	950,81	950,16	949,49	948,83	948,16	947,48	946,81	946,13	945,44	944,76	42
43	949,88	949,21	948,54	947,87	947,19	946,51	945,83	945,14	944,45	943,75	943,06	43
44	948,25	947,57	946,88	946,20	945,51	944,82	944,13	943,43	942,73	942,02	941,32	44
45	946,57	945,88	945,19	944,49	943,79	943,09	942,39	941,68	940,97	940,26	939,54	45
46	944,85	944,15	943,45	942,74	942,04	941,32	940,61	939,90	939,18	938,46	937,73	46
47	943,08	942,38	941,67	940,95	940,24	939,52	938,80	938,07	937,35	936,62	935,88	47
48	941,28	940,57	939,85	939,13	938,40	937,68	936,95	936,22	935,48	934,74	934,00	48
49	939,44	938,72	937,99	937,26	936,53	935,80	935,06	934,32	933,58	932,84	932,09	49
50	937,56	936,83	936,10	935,36	934,63	933,89	933,14	932,40	931,65	930,90	930,14	50

TABLE II $\varrho = \varrho\,(q, t)$

q \ t	10	11	12	13	14	15	16	17	18	19	20	
50	937,56	936,83	936,10	935,36	934,63	933,89	933,14	932,40	931,65	930,90	930,14	50
51	935,65	934,91	934,17	933,43	932,69	931,94	931,19	930,44	929,68	928,92	928,16	51
52	933,70	932,96	932,21	931,46	930,71	929,96	929,20	928,45	927,69	926,92	926,16	52
53	931,72	930,97	930,22	929,47	928,71	927,95	927,19	926,43	925,66	924,89	924,12	53
54	929,70	928,95	928,19	927,44	926,67	925,91	925,14	924,38	923,61	922,83	922,06	54
55	927,66	926,90	926,14	925,38	924,61	923,84	923,07	922,30	921,52	920,74	919,96	55
56	925,59	924,82	924,06	923,29	922,52	921,75	920,97	920,19	919,41	918,63	917,84	56
57	923,48	922,72	921,95	921,17	920,40	919,62	918,84	918,06	917,28	916,49	915,70	57
58	921,35	920,58	919,81	919,03	918,25	917,47	916,69	915,90	915,11	914,32	913,53	58
59	919,19	918,42	917,64	916,86	916,08	915,30	914,51	913,72	912,93	912,13	911,33	59
60	917,01	916,23	915,45	914,67	913,88	913,09	912,30	911,51	910,71	909,92	909,11	60
61	914,80	914,02	913,23	912,45	911,66	910,87	910,07	909,28	908,48	907,67	906,87	61
62	912,57	911,78	910,99	910,20	909,41	908,61	907,82	907,02	906,21	905,41	904,60	62
63	910,31	909,52	908,73	907,93	907,14	906,34	905,54	904,73	903,93	903,12	902,31	63
64	908,02	907,23	906,43	905,64	904,84	904,04	903,23	902,43	901,62	900,81	899,99	64
65	905,71	904,91	904,12	903,32	902,51	901,71	900,90	900,09	899,28	898,47	897,65	65
66	903,37	902,57	901,77	900,97	900,16	899,36	898,55	897,74	896,92	896,10	895,28	66
67	901,01	900,21	899,40	898,60	897,79	896,98	896,17	895,35	894,53	893,72	892,89	67
68	898,62	897,82	897,01	896,20	895,39	894,58	893,76	892,94	892,12	891,30	890,48	68
69	896,20	895,40	894,59	893,78	892,96	892,15	891,33	890,51	889,68	888,86	888,03	69
70	893,76	892,95	892,14	891,33	890,51	889,69	888,87	888,05	887,22	886,39	885,56	70
71	891,29	890,48	889,66	888,85	888,03	887,21	886,38	885,56	884,73	883,90	883,06	71
72	888,79	887,98	887,16	886,34	885,52	884,69	883,87	883,04	882,21	881,37	880,54	72
73	886,27	885,45	884,63	883,81	882,98	882,15	881,33	880,49	879,66	878,82	877,99	73
74	883,71	882,89	882,07	881,24	880,41	879,59	878,75	877,92	877,08	876,24	875,40	74
75	881,13	880,30	879,48	878,65	877,82	876,99	876,15	875,32	874,48	873,64	872,79	75
76	878,51	877,68	876,85	876,02	875,19	874,36	873,52	872,68	871,84	871,00	870,15	76
77	875,86	875,03	874,20	873,37	872,53	871,70	870,86	870,02	869,17	868,33	867,48	77
78	873,18	872,35	871,52	870,68	869,84	869,00	868,16	867,32	866,47	865,63	864,78	78
79	870,47	869,63	868,80	867,96	867,12	866,28	865,44	864,59	863,74	862,89	862,04	79
80	867,72	866,88	866,05	865,21	864,36	863,52	862,67	861,83	860,98	860,12	859,27	80
81	864,93	864,10	863,26	862,41	861,57	860,72	859,88	859,03	858,17	857,32	856,46	81
82	862,11	861,27	860,43	859,59	858,74	857,89	857,04	856,19	855,34	854,48	853,62	82
83	859,25	858,41	857,56	856,72	855,87	855,02	854,17	853,32	852,46	851,60	850,74	83
84	856,34	855,50	854,65	853,81	852,96	852,11	851,25	850,40	849,54	848,68	847,82	84
85	853,39	852,55	851,70	850,85	850,00	849,15	848,29	847,44	846,58	845,72	844,85	85
86	850,39	849,54	848,70	847,84	846,99	846,14	845,28	844,42	843,56	842,70	841,84	86
87	847,33	846,49	845,64	844,78	843,93	843,07	842,22	841,36	840,50	839,63	838,77	87
88	844,22	843,37	842,52	841,66	840,81	839,95	839,09	838,23	837,37	836,51	835,64	88
89	841,03	840,18	839,33	838,48	837,62	836,76	835,90	835,04	834,18	833,31	832,45	89
90	837,77	836,92	836,07	835,21	834,36	833,50	832,64	831,78	830,91	830,05	829,18	90
91	834,43	833,58	832,73	831,87	831,01	830,15	829,29	828,43	827,57	826,70	825,83	91
92	830,99	830,14	829,29	828,43	827,57	826,71	825,85	824,99	824,13	823,26	822,39	92
93	827,45	826,60	825,74	824,89	824,03	823,17	822,31	821,44	820,58	819,71	818,85	93
94	823,79	822,93	822,08	821,22	820,36	819,50	818,64	817,78	816,91	816,05	815,18	94
95	819,98	819,13	818,27	817,42	816,56	815,70	814,84	813,97	813,11	812,25	811,38	95
96	816,02	815,17	814,31	813,45	812,59	811,73	810,87	810,01	809,15	808,28	807,42	96
97	811,87	811,01	810,16	809,30	808,44	807,58	806,72	805,86	805,00	804,14	803,27	97
98	807,48	806,63	805,77	804,92	804,06	803,20	802,34	801,48	800,62	799,76	798,90	98
99	802,81	801,96	801,11	800,25	799,40	798,54	797,68	796,83	795,97	795,11	794,25	99
100	797,76	796,91	796,06	795,21	794,36	793,51	792,65	791,80	790,95	790,09	789,24	100

TABLE II $\varrho = \varrho\,(q, t)$

q \ t	20	21	22	23	24	25	26	27	28	29	30
0	998,20	997,99	997,77	997,54	997,29	997,04	996,78	996,51	996,23	995,94	995,65
1	996,70	996,49	996,26	996,03	995,79	995,54	995,28	995,01	994,73	994,44	994,14
2	995,23	995,02	994,80	994,57	994,32	994,07	993,81	993,54	993,25	992,96	992,66
3	993,81	993,59	993,37	993,14	992,89	992,64	992,37	992,10	991,81	991,52	991,21
4	992,41	992,20	991,97	991,74	991,49	991,23	990,97	990,69	990,40	990,10	989,80
5	991,06	990,84	990,61	990,37	990,12	989,86	989,59	989,31	989,02	988,72	988,41
6	989,73	989,51	989,27	989,03	988,77	988,51	988,24	987,95	987,66	987,35	987,04
7	988,43	988,20	987,97	987,72	987,46	987,19	986,91	986,62	986,32	986,02	985,70
8	987,16	986,93	986,69	986,43	986,17	985,89	985,61	985,32	985,01	984,70	984,38
9	985,92	985,68	985,43	985,17	984,90	984,62	984,33	984,03	983,72	983,41	983,08
10	984,71	984,46	984,21	983,94	983,66	983,37	983,08	982,77	982,45	982,13	981,79
11	983,52	983,27	983,00	982,73	982,44	982,14	981,84	981,53	981,20	980,87	980,53
12	982,35	982,09	981,82	981,53	981,24	980,93	980,62	980,30	979,97	979,63	979,28
13	981,21	980,94	980,65	980,36	980,05	979,74	979,42	979,09	978,75	978,40	978,04
14	980,08	979,80	979,50	979,20	978,88	978,56	978,23	977,89	977,54	977,18	976,81
15	978,97	978,67	978,37	978,05	977,73	977,39	977,05	976,70	976,34	975,97	975,59
16	977,87	977,56	977,25	976,92	976,58	976,24	975,88	975,52	975,15	974,77	974,38
17	976,79	976,46	976,13	975,79	975,44	975,09	974,72	974,34	973,96	973,57	973,17
18	975,71	975,37	975,03	974,67	974,31	973,94	973,56	973,17	972,78	972,37	971,96
19	974,63	974,28	973,92	973,56	973,18	972,80	972,40	972,00	971,59	971,18	970,75
20	973,56	973,19	972,82	972,44	972,05	971,65	971,24	970,83	970,41	969,98	969,54
21	972,48	972,10	971,72	971,32	970,91	970,50	970,08	969,65	969,22	968,77	968,32
22	971,40	971,01	970,60	970,19	969,77	969,35	968,91	968,47	968,02	967,56	967,09
23	970,31	969,90	969,48	969,06	968,62	968,18	967,73	967,27	966,80	966,33	965,85
24	969,21	968,79	968,35	967,91	967,46	967,00	966,53	966,06	965,58	965,09	964,60
25	968,10	967,65	967,20	966,75	966,28	965,81	965,32	964,84	964,34	963,84	963,33
26	966,97	966,51	966,04	965,56	965,08	964,59	964,10	963,59	963,08	962,57	962,04
27	965,81	965,34	964,85	964,36	963,87	963,36	962,85	962,33	961,80	961,27	960,73
28	964,64	964,15	963,65	963,14	962,63	962,10	961,58	961,04	960,50	959,96	959,40
29	963,44	962,93	962,41	961,89	961,36	960,82	960,28	959,73	959,18	958,62	958,05
30	962,21	961,68	961,15	960,61	960,07	959,52	958,96	958,40	957,83	957,25	956,67
31	960,95	960,41	959,86	959,31	958,75	958,18	957,61	957,03	956,45	955,86	955,26
32	959,66	959,10	958,54	957,97	957,40	956,82	956,23	955,64	955,04	954,43	953,82
33	958,34	957,77	957,19	956,60	956,01	955,42	954,82	954,21	953,60	952,98	952,36
34	956,98	956,39	955,80	955,20	954,60	953,99	953,37	952,75	952,13	951,50	950,86
35	955,59	954,98	954,38	953,76	953,14	952,52	951,89	951,26	950,62	949,98	949,33
36	954,15	953,54	952,92	952,29	951,66	951,02	950,38	949,74	949,08	948,43	947,77
37	952,69	952,05	951,42	950,78	950,14	949,49	948,83	948,18	947,51	946,85	946,18
38	951,18	950,53	949,89	949,23	948,58	947,92	947,25	946,58	945,91	945,23	944,55
39	949,63	948,97	948,31	947,65	946,98	946,31	945,63	944,95	944,27	943,58	942,89
40	948,05	947,38	946,70	946,03	945,35	944,67	943,98	943,29	942,59	941,89	941,19
41	946,42	945,74	945,06	944,37	943,68	942,99	942,29	941,59	940,88	940,17	939,46
42	944,76	944,07	943,37	942,68	941,98	941,27	940,56	939,85	939,14	938,42	937,70
43	943,06	942,36	941,65	940,94	940,23	939,52	938,80	938,08	937,36	936,63	935,90
44	941,32	940,61	939,89	939,18	938,46	937,74	937,01	936,28	935,55	934,81	934,08
45	939,54	938,82	938,10	937,38	936,65	935,92	935,18	934,44	933,70	932,96	932,22
46	937,73	937,00	936,27	935,54	934,80	934,06	933,32	932,58	931,83	931,08	930,33
47	935,88	935,15	934,41	933,67	932,92	932,18	931,43	930,68	929,92	929,16	928,40
48	934,00	933,26	932,51	931,77	931,01	930,26	929,50	928,74	927,98	927,22	926,45
49	932,09	931,34	930,59	929,83	929,07	928,31	927,55	926,78	926,02	925,25	924,47
50	930,14	929,39	928,63	927,86	927,10	926,33	925,56	924,79	924,02	923,24	922,47

TABLE II $\varrho = \varrho\,(q, t)$

q \ t	20	21	22	23	24	25	26	27	28	29	30	
50	930,14	929,39	928,63	927,86	927,10	926,33	925,56	924,79	924,02	923,24	922,47	50
51	928,16	927,40	926,64	925,87	925,10	924,33	923,55	922,77	921,99	921,21	920,43	51
52	926,16	925,39	924,62	923,84	923,07	922,29	921,51	920,73	919,94	919,16	918,37	52
53	924,12	923,35	922,57	921,79	921,01	920,23	919,44	918,65	917,86	917,07	916,28	53
54	922,06	921,28	920,50	919,71	918,93	918,14	917,35	916,56	915,76	914,96	914,16	54
55	919,96	919,18	918,39	917,61	916,82	916,02	915,23	914,43	913,63	912,83	912,03	55
56	917,84	917,06	916,27	915,47	914,68	913,88	913,08	912,28	911,48	910,67	909,86	56
57	915,70	914,91	914,11	913,32	912,52	911,72	910,91	910,11	909,30	908,49	907,68	57
58	913,53	912,73	911,94	911,13	910,33	909,53	908,72	907,91	907,10	906,28	905,47	58
59	911,33	910,53	909,73	908,93	908,12	907,31	906,50	905,69	904,87	904,05	903,23	59
60	909,11	908,31	907,51	906,70	905,89	905,08	904,26	903,44	902,62	901,80	900,98	60
61	906,87	906,06	905,26	904,44	903,63	902,81	902,00	901,17	900,35	899,53	898,70	61
62	904,60	903,79	902,98	902,17	901,35	900,53	899,71	898,88	898,06	897,23	896,40	62
63	902,31	901,50	900,68	899,86	899,04	898,22	897,40	896,57	895,74	894,91	894,07	63
64	899,99	899,18	898,36	897,54	896,71	895,89	895,06	894,23	893,40	892,56	891,72	64
65	897,65	896,83	896,01	895,19	894,36	893,53	892,70	891,87	891,03	890,19	889,35	65
66	895,28	894,46	893,64	892,81	891,98	891,15	890,32	889,48	888,64	887,80	886,96	66
67	892,89	892,07	891,24	890,41	889,58	888,75	887,91	887,07	886,23	885,38	884,54	67
68	890,48	889,65	888,82	887,99	887,15	886,31	885,47	884,63	883,79	882,94	882,09	68
69	888,03	887,20	886,37	885,53	884,70	883,86	883,02	882,17	881,32	880,48	879,62	69
70	885,56	884,73	883,89	883,06	882,22	881,37	880,53	879,68	878,83	877,98	877,13	70
71	883,06	882,23	881,39	880,55	879,71	878,86	878,02	877,17	876,32	875,46	874,61	71
72	880,54	879,70	878,86	878,02	877,17	876,33	875,48	874,63	873,77	872,92	872,06	72
73	877,99	877,15	876,30	875,46	874,61	873,76	872,91	872,06	871,20	870,34	869,48	73
74	875,40	874,56	873,72	872,87	872,02	871,17	870,31	869,46	868,60	867,74	866,88	74
75	872,79	871,95	871,10	870,25	869,40	868,55	867,69	866,83	865,97	865,11	864,25	75
76	870,15	869,30	868,45	867,60	866,75	865,89	865,04	864,18	863,31	862,45	861,58	76
77	867,48	866,63	865,78	864,92	864,07	863,21	862,35	861,49	860,62	859,76	858,89	77
78	864,78	863,92	863,07	862,21	861,36	860,50	859,63	858,77	857,90	857,04	856,17	78
79	862,04	861,19	860,33	859,47	858,61	857,75	856,89	856,02	855,15	854,28	853,41	79
80	859,27	858,41	857,56	856,70	855,83	854,97	854,10	853,24	852,37	851,49	850,62	80
81	856,46	855,61	854,75	853,88	853,02	852,16	851,29	850,42	849,55	848,67	847,80	81
82	853,62	852,76	851,90	851,04	850,17	849,30	848,43	847,56	846,69	845,81	844,94	82
83	850,74	849,88	849,02	848,15	847,28	846,42	845,54	844,67	843,80	842,92	842,04	83
84	847,82	846,96	846,09	845,22	844,36	843,48	842,61	841,74	840,86	839,98	839,10	84
85	844,85	843,99	843,12	842,25	841,38	840,51	839,64	838,76	837,88	837,00	836,12	85
86	841,84	840,97	840,10	839,23	838,36	837,49	836,61	835,74	834,86	833,97	833,09	86
87	838,77	837,90	837,03	836,16	835,29	834,41	833,54	832,66	831,78	830,90	830,01	87
88	835,64	834,77	833,90	833,03	832,16	831,28	830,41	829,53	828,64	827,76	826,88	88
89	832,45	831,58	830,71	829,84	828,96	828,09	827,21	826,33	825,45	824,56	823,68	89
90	829,18	828,31	827,44	826,57	825,70	824,82	823,94	823,06	822,18	821,30	820,41	90
91	825,83	824,96	824,09	823,22	822,35	821,47	820,59	819,71	818,83	817,95	817,06	91
92	822,39	821,52	820,65	819,78	818,91	818,03	817,16	816,28	815,40	814,51	813,63	92
93	818,85	817,98	817,11	816,24	815,36	814,49	813,61	812,74	811,86	810,98	810,09	93
94	815,18	814,31	813,45	812,57	811,70	810,83	809,96	809,08	808,20	807,32	806,44	94
95	811,38	810,51	809,65	808,78	807,91	807,03	806,16	805,29	804,41	803,54	802,66	95
96	807,42	806,55	805,69	804,82	803,95	803,08	802,21	801,34	800,47	799,60	798,72	96
97	803,27	802,41	801,54	800,68	799,81	798,94	798,08	797,21	796,34	795,47	794,60	97
98	798,90	798,04	797,17	796,31	795,45	794,58	793,72	792,85	791,99	791,12	790,25	98
99	794,25	793,39	792,53	791,67	790,81	789,95	789,08	788,22	787,36	786,49	785,63	99
100	789,24	788,38	787,53	786,67	785,81	784,95	784,09	783,23	782,37	781,51	780,65	100

TABLE II $\varrho = \varrho\,(q, t)$

q \ t	30	31	32	33	34	35	36	37	38	39	40	
0	995,65	995,34	995,02	994,70	994,37	994,03	993,68	993,33	992,96	992,59	992,21	0
1	994,14	993,83	993,51	993,18	992,85	992,50	992,15	991,79	991,42	991,05	990,66	1
2	992,66	992,35	992,03	991,70	991,36	991,02	990,66	990,30	989,92	989,54	989,15	2
3	991,21	990,90	990,58	990,25	989,91	989,56	989,20	988,83	988,45	988,07	987,68	3
4	989,80	989,48	989,16	988,82	988,48	988,13	987,77	987,40	987,02	986,63	986,23	4
5	988,41	988,09	987,76	987,42	987,08	986,72	986,36	985,99	985,60	985,22	984,82	5
6	987,04	986,72	986,39	986,05	985,70	985,34	984,97	984,60	984,22	983,82	983,42	6
7	985,70	985,37	985,04	984,69	984,34	983,98	983,61	983,23	982,85	982,45	982,05	7
8	984,38	984,05	983,71	983,36	983,00	982,64	982,26	981,88	981,49	981,09	980,69	8
9	983,08	982,74	982,40	982,04	981,68	981,31	980,93	980,55	980,15	979,75	979,34	9
10	981,79	981,45	981,10	980,74	980,37	980,00	979,62	979,22	978,83	978,42	978,01	10
11	980,53	980,18	979,82	979,46	979,08	978,70	978,31	977,91	977,51	977,10	976,68	11
12	979,28	978,92	978,56	978,18	977,80	977,41	977,01	976,61	976,20	975,78	975,36	12
13	978,04	977,67	977,30	976,92	976,53	976,13	975,73	975,32	974,90	974,47	974,04	13
14	976,81	976,44	976,05	975,66	975,26	974,86	974,45	974,03	973,60	973,17	972,73	14
15	975,59	975,21	974,81	974,41	974,00	973,59	973,17	972,74	972,30	971,86	971,41	15
16	974,38	973,98	973,58	973,17	972,75	972,32	971,89	971,45	971,00	970,55	970,09	16
17	973,17	972,76	972,35	971,92	971,49	971,06	970,61	970,16	969,70	969,24	968,77	17
18	971,96	971,54	971,11	970,68	970,24	969,79	969,33	968,87	968,40	967,93	967,44	18
19	970,75	970,32	969,88	969,43	968,98	968,52	968,05	967,57	967,09	966,60	966,11	19
20	969,54	969,09	968,64	968,18	967,71	967,24	966,76	966,27	965,78	965,28	964,77	20
21	968,32	967,86	967,39	966,92	966,44	965,95	965,46	964,96	964,45	963,94	963,42	21
22	967,09	966,62	966,14	965,65	965,15	964,65	964,15	963,63	963,11	962,58	962,05	22
23	965,85	965,36	964,87	964,37	963,86	963,34	962,82	962,29	961,76	961,22	960,67	23
24	964,60	964,10	963,59	963,07	962,55	962,02	961,48	960,94	960,40	959,84	959,28	24
25	963,33	962,81	962,29	961,76	961,22	960,68	960,13	959,57	959,01	958,45	957,87	25
26	962,04	961,51	960,97	960,43	959,88	959,32	958,76	958,19	957,61	957,03	956,44	26
27	960,73	960,19	959,64	959,08	958,51	957,94	957,37	956,78	956,19	955,60	955,00	27
28	959,40	958,84	958,28	957,71	957,13	956,54	955,95	955,36	954,75	954,14	953,53	28
29	958,05	957,47	956,89	956,31	955,72	955,12	954,51	953,91	953,29	952,67	952,04	29
30	956,67	956,08	955,49	954,89	954,28	953,67	953,05	952,43	951,80	951,17	950,53	30
31	955,26	954,66	954,05	953,44	952,82	952,20	951,57	950,93	950,29	949,65	948,99	31
32	953,82	953,21	952,59	951,96	951,33	950,70	950,05	949,41	948,75	948,10	947,43	32
33	952,36	951,73	951,10	950,46	949,82	949,17	948,51	947,85	947,19	946,52	945,85	33
34	950,86	950,22	949,58	948,92	948,27	947,61	946,94	946,27	945,60	944,92	944,24	34
35	949,33	948,68	948,02	947,36	946,69	946,02	945,35	944,66	943,98	943,29	942,60	35
36	947,77	947,11	946,44	945,76	945,09	944,40	943,72	943,03	942,33	941,63	940,93	36
37	946,18	945,50	944,82	944,14	943,45	942,76	942,06	941,36	940,65	939,94	939,23	37
38	944,55	943,86	943,17	942,48	941,78	941,08	940,37	939,66	938,95	938,23	937,51	38
39	942,89	942,19	941,49	940,78	940,08	939,37	938,65	937,93	937,21	936,48	935,75	39
40	941,19	940,48	939,77	939,06	938,34	937,62	936,90	936,17	935,44	934,71	933,97	40
41	939,46	938,75	938,03	937,30	936,58	935,85	935,12	934,38	933,64	932,90	932,16	41
42	937,70	936,97	936,25	935,52	934,78	934,05	933,31	932,56	931,82	931,07	930,32	42
43	935,90	935,17	934,44	933,70	932,96	932,21	931,46	930,71	929,96	929,21	928,45	43
44	934,08	933,34	932,59	931,85	931,10	930,35	929,59	928,83	928,08	927,31	926,55	44
45	932,22	931,47	930,72	929,96	929,21	928,45	927,69	926,93	926,16	925,39	924,62	45
46	930,33	929,57	928,81	928,05	927,29	926,53	925,76	924,99	924,22	923,44	922,67	46
47	928,40	927,64	926,88	926,11	925,34	924,57	923,80	923,02	922,24	921,46	920,68	47
48	926,45	925,69	924,91	924,14	923,37	922,59	921,81	921,03	920,25	919,46	918,67	48
49	924,47	923,70	922,92	922,14	921,36	920,58	919,79	919,01	918,22	917,43	916,63	49
50	922,47	921,68	920,90	920,12	919,33	918,54	917,75	916,96	916,17	915,37	914,57	50

TABLE II $\varrho = \varrho(q, t)$

q \ t	30	31	32	33	34	35	36	37	38	39	40	
50	922,47	921,68	920,90	920,12	919,33	918,54	917,75	916,96	916,17	915,37	914,57	50
51	920,43	919,64	918,86	918,07	917,27	916,48	915,68	914,89	914,09	913,29	912,48	51
52	918,37	917,58	916,78	915,99	915,19	914,39	913,59	912,79	911,98	911,18	910,37	52
53	916,28	915,48	914,68	913,88	913,08	912,28	911,47	910,66	909,85	909,04	908,23	53
54	914,16	913,36	912,56	911,76	910,95	910,14	909,33	908,52	907,70	906,89	906,07	54
55	912,03	911,22	910,41	909,60	908,79	907,98	907,16	906,35	905,53	904,71	903,88	55
56	909,86	909,05	908,24	907,43	906,61	905,79	904,97	904,15	903,33	902,50	901,67	56
57	907,68	906,86	906,05	905,23	904,41	903,58	902,76	901,93	901,11	900,28	899,44	57
58	905,47	904,65	903,83	903,00	902,18	901,35	900,53	899,69	898,86	898,03	897,19	58
59	903,23	902,41	901,59	900,76	899,93	899,10	898,27	897,43	896,60	895,76	894,91	59
60	900,98	900,15	899,32	898,49	897,66	896,83	895,99	895,15	894,31	893,46	892,62	60
61	898,70	897,87	897,04	896,20	895,37	894,53	893,69	892,84	892,00	891,15	890,30	61
62	896,40	895,56	894,73	893,89	893,05	892,21	891,36	890,52	889,67	888,82	887,96	62
63	894,07	893,24	892,40	891,56	890,71	889,87	889,02	888,17	887,31	886,46	885,60	63
64	891,72	890,88	890,04	889,20	888,35	887,50	886,65	885,80	884,94	884,08	883,22	64
65	889,35	888,51	887,67	886,82	885,97	885,12	884,26	883,40	882,54	881,68	880,81	65
66	886,96	886,11	885,26	884,41	883,56	882,71	881,85	880,99	880,12	879,26	878,39	66
67	884,54	883,69	882,84	881,99	881,13	880,27	879,41	878,55	877,68	876,81	875,94	67
68	882,09	881,24	880,39	879,53	878,68	877,81	876,95	876,08	875,22	874,34	873,47	68
69	879,62	878,77	877,91	877,06	876,20	875,33	874,47	873,60	872,73	871,85	870,98	69
70	877,13	876,27	875,41	874,55	873,69	872,83	871,96	871,09	870,21	869,34	868,46	70
71	874,61	873,75	872,89	872,03	871,16	870,29	869,42	868,55	867,67	866,80	865,91	71
72	872,06	871,20	870,34	869,47	868,60	867,73	866,86	865,99	865,11	864,23	863,34	72
73	869,48	868,62	867,76	866,89	866,02	865,15	864,27	863,40	862,52	861,63	860,75	73
74	866,88	866,01	865,15	864,28	863,41	862,53	861,66	860,78	859,90	859,01	858,13	74
75	864,25	863,38	862,51	861,64	860,77	859,89	859,01	858,13	857,25	856,36	855,48	75
76	861,58	860,71	859,84	858,97	858,10	857,22	856,34	855,46	854,57	853,69	852,80	76
77	858,89	858,02	857,15	856,27	855,40	854,52	853,64	852,75	851,87	850,98	850,09	77
78	856,17	855,29	854,42	853,54	852,67	851,78	850,90	850,02	849,13	848,24	847,34	78
79	853,41	852,54	851,66	850,78	849,90	849,02	848,13	847,25	846,36	845,47	844,57	79
80	850,62	849,75	848,87	847,99	847,11	846,22	845,33	844,45	843,55	842,66	841,76	80
81	847,80	846,92	846,04	845,16	844,27	843,39	842,50	841,61	840,72	839,82	838,92	81
82	844,94	844,06	843,18	842,29	841,41	840,52	839,63	838,74	837,84	836,94	836,04	82
83	842,04	841,16	840,28	839,39	838,50	837,61	836,72	835,82	834,93	834,03	833,12	83
84	839,10	838,22	837,33	836,45	835,56	834,66	833,77	832,87	831,97	831,07	830,17	84
85	836,12	835,24	834,35	833,46	832,57	831,67	830,78	829,88	828,98	828,07	827,16	85
86	833,09	832,21	831,32	830,43	829,53	828,64	827,74	826,84	825,94	825,03	824,12	86
87	830,01	829,12	828,24	827,34	826,45	825,55	824,65	823,75	822,85	821,94	821,03	87
88	826,88	825,99	825,10	824,21	823,31	822,41	821,51	820,61	819,70	818,79	817,88	88
89	823,68	822,79	821,90	821,01	820,11	819,21	818,31	817,41	816,50	815,59	814,68	89
90	820,41	819,52	818,63	817,74	816,84	815,95	815,04	814,14	813,23	812,32	811,41	90
91	817,06	816,18	815,29	814,40	813,50	812,60	811,70	810,80	809,90	808,99	808,08	91
92	813,63	812,74	811,86	810,97	810,07	809,18	808,28	807,38	806,48	805,57	804,66	92
93	810,09	809,21	808,32	807,44	806,55	805,66	804,76	803,86	802,96	802,06	801,16	93
94	806,44	805,56	804,68	803,80	802,91	802,02	801,13	800,24	799,34	798,45	797,55	94
95	802,66	801,78	800,90	800,02	799,14	798,26	797,37	796,49	795,60	794,71	793,81	95
96	798,72	797,85	796,97	796,10	795,22	794,34	793,46	792,58	791,70	790,82	789,93	96
97	794,60	793,73	792,86	791,99	791,11	790,24	789,37	788,49	787,62	786,74	785,86	97
98	790,25	789,39	788,52	787,65	786,78	785,92	785,05	784,18	783,31	782,43	781,56	98
99	785,63	784,77	783,90	783,04	782,17	781,30	780,44	779,57	778,70	777,83	776,95	99
100	780,65	779,78	778,92	778,05	777,18	776,31	775,44	774,57	773,69	772,81	771,93	100

Annex B
(informative)

Interpretation of tables in Annex A

B.1.1 Table I — Specific gravity conversion table from t °C/20 °C to 20 °C/20 °C. This table gives specific gravity in vacuum at various temperatures (10 °C to 40 °C at intervals of every 0.5 °C) with respect to that of water at 20 °C for various percentages of ethanol (by volume at 20 °C).

B.1.2 With the help of this table, the specific gravity at a particular temperature t °C/ 20 °C found by the pyknometer method can be converted into the corresponding specific gravity at 20 °C/ 20 °C.

B.1.3 Table II — Conversion table for specific gravity data into ethanol content at specified temperature. This table gives data for specific gravity in vacuum and specific gravity in air at 20 °C for every 0.1 % by volume of ethanol content at 20 °C/20 °C.

B.2 Use of tables

B.2.1 The steps involved for the determination of ethanol content of a liquor preparation shall be as follows:

a) Dilution of 25 mL of the sample with fixed amount of water (depending on whether double, treble or quadruple bulk is desired) and distillation of a fixed quantity of the distillate.

b) Determination of specific gravity in air at ambient temperature (t °C/20 °C).

c) Conversion of specific gravity in air at ambient temperature WC / 15 °C to specific gravity in air at 15 °C /15 °C by the use of Table 1.

d) Conversion of specific gravity in air at 20 °C/20 °C to the specific gravity in vacuum at 20 °C/20 °C by the use of Table II.

e) Conversion of specific gravity in vacuum at 20 °C/20 °C to ethanol content at 20 °C by the use of Table II.

f) Conversion of ethanol content as obtained under (e) to ethanol content at 20 °C of the distillate at t °C by the use of Table 1 of OIML R22.

B.2.2 Table I. The first vertical line of this table gives the specific gravities at various temperatures for a given percentage of ethanol (by volume) at 20 °C.

The horizontal lines indicate the various specific gravities at a particular temperature for varying percentage of ethanol (by volume) at 20 °C/20 °C.

For instance; Specific gravity for 76.9 % ethanol at 26 °C/20°C = 0.86360 (see Table I). Then look for the value in the first horizontal line corresponding to 76.9 % ethanol, which is 0.87260 in this case. Therefore, if the observed specific gravity of 76.9 % ethanol at 26 °C/20 °C is 0.86360, the corresponding specific gravity at 20 °C/20 °C is 0.87260.

B.2.3 Table II. The first column of Table II gives the ethanol content, percent by volume, at 20°C.

The second column of Table 2 gives the specific gravity of alcoholic liquids at 20 °C/20 °C in vacuum. For instance; specific gravity in vacuum for 50.0 % of ethanol at 20 °C/20 °C = 0.93437 (see Table 2) which is the ratio of the respective densities of alcoholic liquid at 20°C in vacuum.

The third column of Table 2 gives the specific gravity in air at 20 °C, that is, the ratio of densities of alcoholic liquid in air at 20 °C and that of water at 20 °C in vacuum.

NOTE The values of specific gravity into air at 20°C are calculated by converting the specific gravities at t °C/20 °C in air found by the pyknometer method (which is standardized in vacuum at 20 °C) with the use of Table 1. For instance; specific gravity at 20 °C/20 °C for 78 % of ethanol = 0,86857 (see Table II) which gives the ratio between the densities of alcoholic liquids in air at 2 0°C and water in vacuum at 20 °C.

B.2.4 The corresponding specific gravities in vacuum are indicated in column 2 of Table B.1 and are calculated by multiplying with 0.999 126 which is the density of water in vacuum at 20°C. This gives the density of the alcoholic liquid in air at 20°C which is then converted into the specific gravity of the alcoholic liquid in vacuum at 20 °C by using the alcoholometric Table II of OIML R22. Similarly, any specification in vacuum at 20 °C can be converted into corresponding specific gravity in air at 20°C by first finding out from the alcoholometric Table II of OIML R22. The corresponding density in air 20 °C which is then divided by 0.999 126 (the density of water in vacuum at 20°C) gives the specific gravities in vacuum and specific gravities in air at 20 °C for every 0.1 % by volume of ethanol content at 20 °C/20 °C.

For instance; specific gravity in air at 20 °C /20 °C for 77.6 % ethanol content as determined by the pyknometer method = 0.86965 (see Table II).

The specific gravity value 0.869 65 in air at 20 °C when multiplied by 0.999 126, the density of water in vacuum at 20 °C gives 0.868 89, the density of the alcoholic liquid in air at 20 °C. From the alcoholometric Table II, corresponding to 0.868 89, the density of alcoholic liquid in air at 20 °C is thus obtained. The figure 0.870 73 is therefore, the specific gravity in vacuum at 20 °C corresponding to 0.869 65, the figure for specific gravity in air at 20 °C obtained by the pyknometer method.

B.2.5 The specific gravities in air at 20 °C are also independently converted into specific gravities in vacuum at 20 °C using the following formula:

$$M = \frac{(m-a)}{(r-a)} \times r = (m-a)\frac{r}{r-a} = (m-a) \times k$$

where

M is the density in air;

m is the density in vacuum;

a is the density of air at 20 °C and 760 mm pressure (which is equal to 0.001 225) and

r is the average density of cast iron weights, which has been taken as 7.3.

Density in air at 20 °C = specific gravity in air at 20 °C × 0.999 126

Density in vacuum at 20 °C = specific gravity in vacuum × 0.999 126

$\frac{r}{r-a}$ is a constant k which is equal to $\frac{7.3}{7.3-0.0012255} = 1.001679$

Hence *M* = (m - a) x 1.0001679

Specific gravity in air × 0.999126 = (Specific gravity in vacuum × 0.999126 - 0.0012255)×1.0001679

$$\text{Specific gravity in vacuum} = \frac{\text{specific gravity in air} \times 0.999126 + 0.001225 \times 1.0001679}{1.0001679 \times 0.999126}$$

$$= \frac{\text{specific gravity in air} \times 0.999126 + 0.0012257}{0.9992937}$$

In other words the specific gravity in air

$$= \frac{\text{specific gravity in vacuum} \times 0.9992937 - 0.0012257}{0.999126}$$

Using the above formula, any specific gravity in air as found by the pyknometer method can be converted into the corresponding specific gravity in vacuum and vice versa. For instance: specific gravity in air at 20°C for 78.2 % ethanol content as determined by the pyknometer method = 0.868 03 (see Table II).

Specific gravity in vacuum = $\frac{0.86803 \times 0.999126 + 0{,}001225}{0.9992937} = 0.86911$

(the same value as given in col.2 of Table II).

Thus the various specific gravities in vacuum at 20°C are also arrived at from the specific gravities in air at 20 °C by using the same formula.

B.2.6 *Examples and calculations*. For guidance, a few typical examples are given below.

Example 1
Observed specific gravity at 22 °C/20 °C for 76.5 % ethanol content = 0.868 02. This specific gravity is determined by the pyknometer method in air. To convert the specific gravity in air to specific gravity in vacuum, use Table II of this standard and obtain the value 0.869 11 as the specific gravity in vacuum corresponding to the specific gravity in air 0.868 02.

In Table I, follow the horizontal line indicated by 0.869 11 under the vertical temperature column of 22 °C until the vertical line headed by 20 °C is encountered. At this point, the figure 0.874 74 is found. The figure 0.874 74 is the specific gravity in vacuum at 20 °C/20 °C corresponding to the specific gravity of 0.868 03 in air at 22 °C/20 °C. By referring to Table II, it is found that the specific gravity (in vacuum) 0.874 74 corresponds to 76.1 % by volume of ethanol content at 20 °C. Then using Table I of OIML R22 following the horizontal line indicated by 22 °C (the observed temperature) until the vertical column indicated under 76.1 is encountered. At this point, the figure 73.40 is found which is the percentage by volume of ethanol at 20 °C corresponding to the specific gravity in air of the alcoholic liquid at 22 °C/20 °C. This means then that an observed volume of 100 L of the alcoholic liquid at 22 °C contains 73.40 litres of alcohol by volume at 20 °C.

NOTE 1 If the pyknometer is not standardized at 20 °C in vacuum, the specific gravity at t °C/t °C should be reduced to t °C/20 °C knowing the density of water at t °C at 20 °C.

NOTE 2 For routine type of work, the conversion of specific gravities in air at 20 °C, to the specific gravities in vacuum at 20 °C, correction factors as indicated below may be added.

Table B.1 – Correction factors

Specific gravity in air	Correction factor to be added
1.000 to 0.9600	0.00106
0.9601 to 0.9000	0.00107
0.9001 to 0.8200	0.00108
Below 0.8200	0.00109

Example 2
Specific gravity at 28 °C /20°C = 0.983 18. This specific gravity is in air. From Table II, the specific gravity in vacuum corresponding to specific gravity 0.983 18 in air is 0.984 24 (for routine type of work, the correction of 0.000 106 may be added to get the specific gravity in vacuum). Thus the specific gravity at 28 °C /20 °C in vacuum is 0.983 18 + 0.001 06 = 0.984 24. In Table I, follow the vertical line indicated by 0.984 24 under the horizontal temperature column of 28 °C until the horizontal line headed by 20°C is encountered. At this point the figure 0.98711 is found which is the specific gravity in vacuum at 20 °C/20 °C corresponding to the specific gravity 0.98318 in air at 28 °C/20 °C. From Table B.1, it is

found that the specific gravity (in vacuum) figure 0.98711 corresponds to 9.5 % by volume of ethanol content at 20 °C. Then using Table I of OIML R22 follow the horizontal line indicated by 28 °C (the observed temperature) until the vertical column indicated under 9.5 is encountered. At this point, the figure 7.25 is found which is the percentage by volume of ethanol at 20 °C corresponding to the specific gravity in air of 0.983 18 at 28 °C/20 °C. This means that an observed volume of 100 L of alcoholic liquid at 28 °C contains 7.25 L of ethanol by volume at 20 °C.

B.3 Double bulk, treble bulk and quadruple bulk

If double bulk, treble bulk and quadruple bulk methods are employed in the determination of specific gravity by the pyknometer method for want of sufficient amount of the liquid, the percentage of the ethanol by volume at 20 °C is found as detailed under 6.5, from the specific gravity obtained by pyknometer method. Then, the actual percentage of ethanol at 20 °C is calculated by multiplying it by 2, 3 or 4 depending upon whether double bulk, treble bulk or quadruple bulk method is employed.

Bibliography

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