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**Liquefied petroleum gases — Calculation  
method for density and vapour pressure**

*Gaz de pétrole liquéfiés — Méthode de calcul de la masse volumique et de  
la pression de vapeur*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 8973 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*.

Annex A forms an integral part of this International Standard. Annex B is for information only.

ISO 8973:1997

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Printed in Switzerland

# Liquefied petroleum gases — Calculation method for density and vapour pressure

## 1 Scope

This International Standard describes a simplified method for the calculation of density and vapour pressure of liquefied petroleum gases (LPG) based on compositional data and density and vapour pressure factors for individual LPG components. A list of factors is provided in this International Standard. This method is intended for application in specifications of product quality and is not intended for application to quantity measurement in custody transfer (see ISO 6578).

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6578:1991, *Refrigerated hydrocarbon liquids — Static measurement — Calculation procedure*.

ISO 7941:1988, *Commercial propane and butane — Analysis by gas chromatography*.

## 3 Definitions

For the purpose of this International Standard the following definitions apply.

**3.1 liquefied petroleum gas (LPG):** Hydrocarbon gas that can be stored and/or handled in the liquid phase under moderate conditions of pressure and at ambient temperature. It consists essentially of C<sub>3</sub> and C<sub>4</sub> alkanes or alkenes, or a mixture of these, contains generally less than 5 % by liquid volume of material of higher carbon number, and has a gauge vapour pressure not exceeding approximately 1 600 kPa at 40 °C.

**3.2 density factor:** Density, expressed in kilograms per cubic metre, of a component in the liquid phase under its own vapour pressure at a temperature of 15 °C.

**3.3 vapour pressure:** Vapour pressure, expressed in kilopascals on an absolute basis, i.e. the gauge pressure plus local ambient pressure.

**3.4 vapour pressure factor:** Absolute vapour pressure, expressed in kilopascals, of a component of the liquid at temperature of 37,8 °C, 40 °C, 50 °C or 70 °C.

## 4 Principle

The molar composition of the LPG is determined by gas chromatography in accordance with ISO 7941. This analysis is used to calculate the liquid density and vapour pressure by using, for each component, the liquid density and vapour pressure factors provided in this International Standard.

## 5 Procedure

Determine the molar composition in accordance with ISO 7941.

## 6 Calculation

6.1 Use the LPG component relative molecular mass, density and pressure factors given in table A.1 in the equations shown below.

### 6.2 Density

6.2.1 Calculate the mass fraction,  $W$ , of each component of the mixture as follows:

$$W_i = \frac{X_i M_i}{\sum_1^n X_i M_i}$$

where

$i$  is the number of the specific component;

$n$  is the total number of components;

$W_i$  is the mass fraction of component  $i$  in the mixture;

$X_i$  is the mole fraction of component  $i$  in the mixture;

$M_i$  is the relative molecular mass of component  $i$  in the mixture;

$\sum_1^n X_i M_i$  is the sum of the products of  $X$  and  $M$  for each component.

6.2.2 Calculate the density of the LPG,  $\rho$ , in kilograms per cubic metre at 15 °C, as follows:

$$\rho = \frac{1}{\sum_1^n \frac{W_i}{\rho_i}}$$

where

$\rho_i$  is the density factor of component  $i$  in the mixture, expressed in kilograms per cubic metre at 15 °C;

$\sum_1^n \frac{W_i}{\rho_i}$  is the sum of  $\frac{W_i}{\rho_i}$  for each component in the mixture.