
**Ethylene for industrial use —
Sampling in the liquid and the gaseous
phase**

*Éthylène à usage industriel — Échantillonnage en phase liquide et en
phase gazeuse*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 47, *Chemistry*.

This second edition cancels and replaces the first edition (ISO 7382:1986), which has been technically revised.

The main changes are as follows:

- the Scope has been expanded to apply to sampling for the determination of trace polar compounds in ethylene products;
- [Clauses 2](#) and [3](#) have been added;
- content from [Clauses 4](#) and [7](#), including safety precaution and maintenance of sampling apparatus, has been moved elsewhere in the document;
- in [Clause 4](#), the critical pressure for ethylene has been corrected to 5,04 MPa;
- in [Clause 5](#), explanations regarding apparatus have been added;
- in [Clause 5](#), some specific parameters, including volume of sampling cylinder, size of connecting pipe and time to purge sampling cylinder, have been deleted;
- in [5.2.1](#), specially passivated sampling apparatus has been recommended, especially when sampling for the determination of trace polar compounds in ethylene products.
- [Annex A](#), and [Figures 1](#), [5](#) and [A.1](#) have been revised.
- in [5.2.2](#): the procedure of purging and sampling for non-closed sampling apparatus has been revised;

- sampling apparatus -no.2 in the first edition and its procedure have been deleted and a new sampling apparatus was introduced as closed sampling apparatus no.2;
- in [5.3](#), [5.4](#), [5.5](#), two closed-sampling apparatuses for liquefied ethylene and a sampling apparatus with heated pressure regulator have been added.
- in [6.2](#), the connecting pipes for non-closed sampling of gaseous ethylene has been revised;
- in [6.3](#), the closed-sampling apparatuses for gaseous ethylene has been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Ethylene for industrial use — Sampling in the liquid and the gaseous phase

WARNING — The use of this document can involve hazardous material, operation and equipment. This document does not purport to address all of the safety problems associated with its use. It is the responsibility of the users of this document to take appropriate measures to ensure the safety, health of personnel prior to application of the document and fulfil other applicable requirement for this purpose.

1 Scope

This document describes the procedures and the precautions to be taken in drawing representative samples of ethylene in the liquid phase stored at -100 °C and in the gaseous phase, for the purpose of their analysis.

[Annex A](#) sets out a diagrammatic representation of a system for the disposal of the portion of the sample which is not used in the analysis.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 3165:1976, *Sampling of chemical products for industrial use — Safety in sampling*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

closed sampling apparatus

set of apparatus assembled by a sampling cylinder and connecting pipes to take samples under closed conditions, by which the sampling process does not permit the release of any sample or vapour to the surrounding environment

3.2

non-closed sampling apparatus

set of apparatus assembled by a sampling cylinder and connecting pipes to take samples in open air, by which the sampling process permits the release of sample or vapour to the surrounding environment

4 Safety precautions

The safety precautions in all sampling and testing operations with liquefied and gaseous ethylene shall be carefully followed in accordance with ISO 3165:1976. Relevant legal and statutory regulations to ensure the safety, health and environmental protection in the procedure of the sampling methods can apply.

The ethylene shall be stored and transported in the liquid phase at a temperature below - 100 °C.

The critical temperature of ethylene is 9,5 °C and its critical pressure is 5,04 MPa. As the boiling temperature of ethylene at atmospheric pressure is -103,9 °C, it follows that ethylene sampled in the liquid phase cannot be kept in the state at room temperature, without taking account of the pressure.

All sampling equipment shall be capable of resisting the sample pressure after complete vaporization. It is presupposed that the use of the vessels, the plant and the equipment conform to the legal regulations in force. Users shall have the vessels periodically pressure tested by an approved organization.

The construction materials shall be capable of withstanding rapid changes in temperature, for example, rising from - 100 °C to +20 °C in 1 to 2 min. Passivated stainless steel should be selected for preference.

Owing to the low temperatures of the product and its associated equipment, operators shall wear well-insulating, non-cracking plastics or rubber-coated gloves to protect themselves from burns. They shall also wear close-fitting protective goggles.

Ethylene is extremely flammable, and all precautions shall be taken to avoid forming an explosive atmosphere. Suitable ventilation is essential, particularly during the purging operations.

Also, the sampling apparatus shall always be electrically grounded.

The safety precautions shall be taken when cleaning apparatus, discharging ethylene, wastes liquid and steam. The discharging site shall be equipped with safety devices. It is expected that the sites meet relevant safety, health and environmental protection requirements.

If the container is to be transported, it is expected to conform to specifications of applicable legislation regarding transportation for hazardous materials.

5 Sampling from a container filled with ethylene in the liquid phase

5.1 General

Given the wide variation in the sampling apparatus for ethylene, it is difficult to specify a uniform method for obtaining representative samples of heterogeneous mixtures. The four examples of non-closed and closed sampling apparatus described in [5.2](#) and [5.3](#) have been found satisfactory and are available commercially. Any other sampling apparatus may be used, however, it is presupposed that they conform to the relevant official decrees and regulations. The apparatus shall be capable of sampling ethylene.

5.2 Non-closed sampling apparatus and procedure

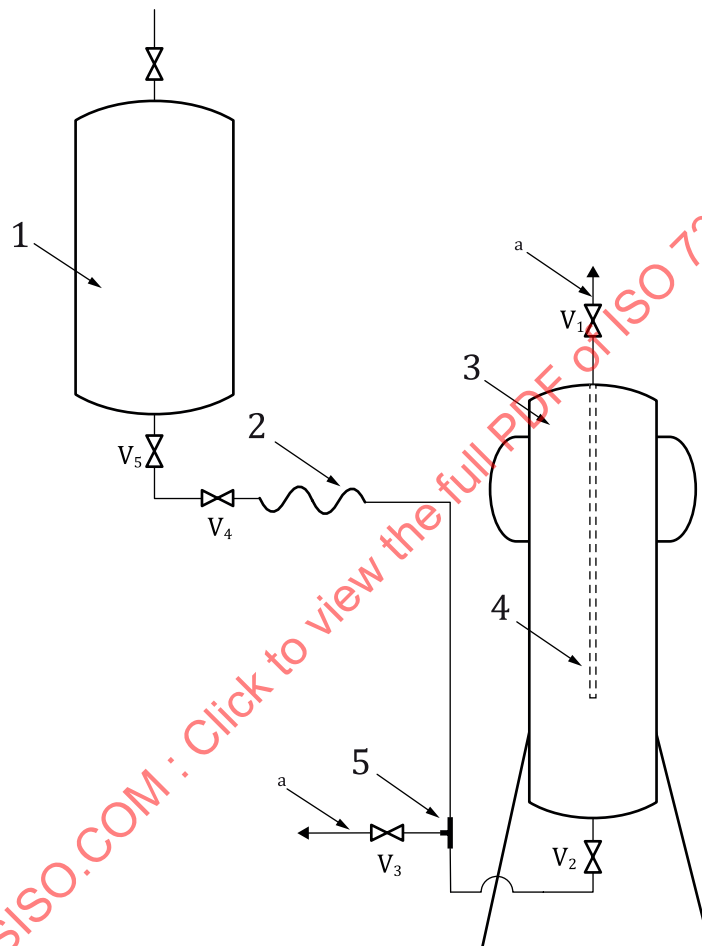
5.2.1 Sampling apparatus

The apparatus shown in [Figure 1](#) is an example of non-closed sampling apparatus and is composed of the following parts.

- a) A sampling cylinder tested at 34,5 MPa. Any sampling cylinder that meets sampling requirements can be used. It is presupposed that sampling cylinders also comply with any applicable national safety regulations. This sampling cylinder shall be fitted with one dip pipe, marked on the cylinder, ending at 30 % of the distance from the base, and ensuring that the sampling cylinder can be filled to only 30 % of its capacity. If relative national regulations stipulate otherwise, it is expected that the maximum fill capacity is adjusted accordingly. An inlet valve (V_2) is fitted to the sampling cylinder, and a drainage valve (V_1) to the dip pipe.
- b) Fluorocarbon lined sampling cylinders that have been specially passivated are recommended, especially when sampling to determine trace levels of polar compounds. Otherwise, determinations of these polar compounds can be misleading. Internal surfaces of sample containers and associated

lines and fittings may be surface coated to reduce bare metal surfaces reacting with trace reactive components.

- c) A passivated stainless-steel connecting pipe, with threaded joints, is joined to the ethylene tank (via sampling valves (V_4) and discharge valve for sampling capacity (V_5)) and to the inlet valve (V_2) of the cylinder.
- d) A T-union is fitted into the above pipe as close as possible to inlet valve (V_2) of the sampling cylinder, to connect a stainless-steel vent line to a discharge valve for sampling line (V_3).



Key

- 1 storage of liquid ethylene
- 2 connecting pipe
- 3 sampling cylinder
- 4 dip pipe
- 5 T-union
- V_1 drainage valve
- V_2 inlet valve
- V_3 discharge valve for sampling line
- V_4 sampling valve
- V_5 discharge valve for sampling capacity
- ^a Vent line.

Figure 1 — Example of non-closed sampling apparatus for ethylene in the liquid phase (non-closed sampling apparatus)

A stainless-steel vent line with appropriate length is fitted to the drainage valve (V_1) of the sampling cylinder.

5.2.2 Procedure

Connect the sampling cylinder with the sampling lines in vertical position. Close drainage valve (V_1) and inlet valve (V_2), open the discharge valve for sampling capacity (V_5) and then open sampling valve (V_4) at the point of sampling and slowly open the discharge valve for sampling line (V_3) to purge the sampling line.

Avoid excessive purging, which would cause ice formation at the outside or on the internal parts of the valve and also a pollution of the atmosphere.

As soon as the liquid ethylene appears at the vent line of discharge valve line (V_3), close discharge valve for sampling line (V_3).

Open drainage valve (V_1) completely. Open inlet valve (V_2) slowly and allow the sampling cylinder to fill. As soon as the liquid ethylene appears at the vent line of drainage valve (V_1), close drainage valve (V_1), inlet valve (V_2) and sampling valve (V_4). Shake the sampling cylinder slightly, then open inlet valve (V_2) and discharge valve for sampling line (V_3). Empty the sampling cylinder, then close discharge valve for sampling line (V_3) and inlet valve (V_2). Repeat this operation until purging thoroughly.

To sample, open sampling valve (V_4), inlet valve (V_2) and drainage valve (V_1) in turn. As soon as the liquid ethylene appears at the vent line of drainage valve (V_1), close inlet valve (V_2), then drainage valve (V_1) and afterwards close sampling valve (V_4) and discharge valve for sampling capacity (V_5).

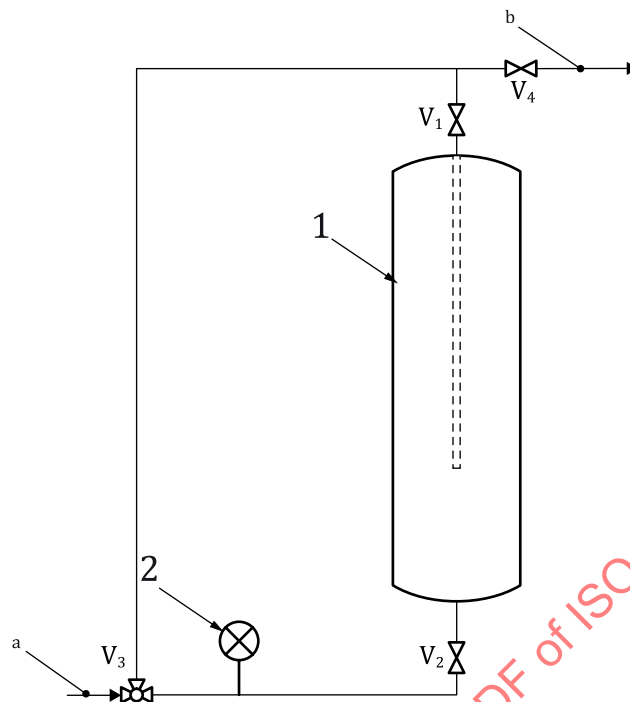
Open discharge valve for sampling line (V_3) to vent the remaining sample, relieve the pressure, then disconnect the sampling cylinder from transfer line, and close discharge valve for sampling line (V_3).

5.3 Closed sampling apparatus no.1 and procedure

5.3.1 Sampling apparatus

The apparatus no.1 shown in [Figure 2](#) is one example of closed sampling apparatus and is composed of the following parts.

- a) The sampling cylinder is of same type of that in the non-closed sampling apparatus and is specially passivated.



Key

- 1 sampling cylinder
- 2 pressure gauge
- V_1 drainage valve
- V_2 inlet valve
- V_3 sampling valve
- V_4 discharge valve
- a From sample capacity.
- b To low pressure system.

Figure 2 — Example of closed sampling for ethylene in the liquid phase (Closed sampling apparatus no. 1)

- b) The connecting pipes are made of stainless-steel tubing and equipped with two valves (sampling valve (V_3) and discharge valve (V_4)) and a pressure gauge. The sampling valve (V_3) is a three-way valve and discharge valve (V_4) is an ordinary two-way valve.

5.3.2 Procedure

Connect the sampling cylinder with the sampling lines, in vertical position. Close inlet valve (V_2) and drainage valve (V_1). Switch sampling valve (V_3) to bypass position (flow to discharge valve (V_4)), then open the discharge valve (V_4), and purge the bypass pipelines and sampling line.

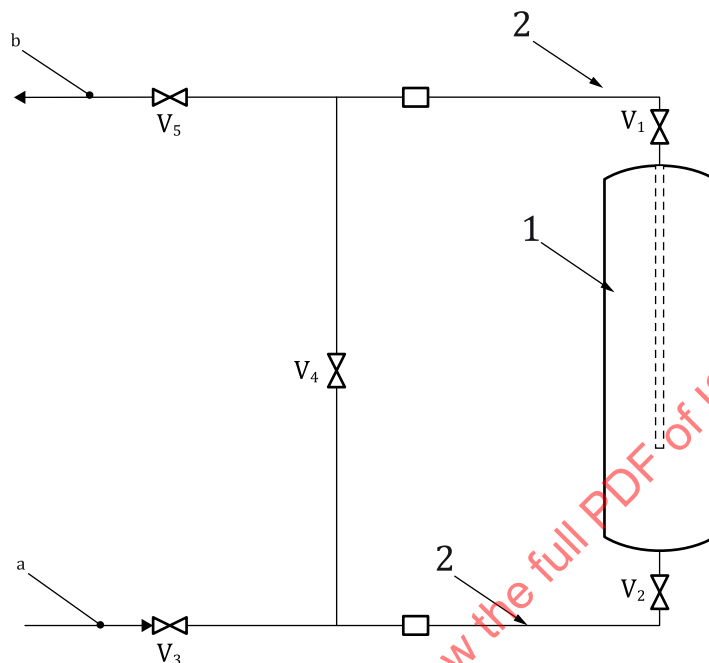
Open drainage valve (V_1) and inlet valve (V_2), switch sampling valve (V_3) from bypass position to sampling position, obtain a purge of sample through the sampling cylinder. Wait for a while for the sampling cylinder to purge thoroughly. Regulate drainage valve (V_1) to slow down the purge and obtain the appropriate amount of liquefied sample in the sampling cylinder.

Close inlet valve (V_2) and drainage valve (V_1), then switch sampling valve (V_3) to the close position, relieve the pressure, then disconnect the sampling cylinder from transfer line, and close discharge valve (V_4).

5.4 Closed sampling apparatus no.2 and procedure

5.4.1 Sampling apparatus

The apparatus no.2 shown in [Figure 3](#) is an example for closed sampling apparatus and is composed of the following parts.



Key

- 1 sampling cylinder
- 2 metal hoses
- V_1 drainage valve
- V_2 inlet valve
- V_3 sampling valve
- V_4 pipeline valve
- V_5 discharge valve
- a From sample capacity.
- b To low pressure system.

Figure 3 — Example of closed sampling for ethylene in the liquid phase (Closed sampling apparatus no. 2)

- a) The sampling cylinder is of same type of that in the non-closed sampling apparatus no.1, and is specially passivated.
- b) The connecting pipes are made of stainless-steel tubing and metal hose equipped with three valves (sampling valve (V_3), pipeline valve (V_4) and discharge valve (V_5)).-Metal hose has threaded joints on one end to join to inlet valve (V_2) or drainage valve (V_1). Sampling valve (V_3), pipeline valve (V_4) and discharge valve (V_5) are all ordinary two-way valve.

5.4.2 Procedure

Connect the sampling cylinder with the sampling lines, in vertical position. Close inlet valve (V_2), and drainage valve (V_1). Open sampling valve (V_3), pipeline valve (V_4) and discharge valve (V_5) in sequence, purge through bypass pipelines and sampling line.

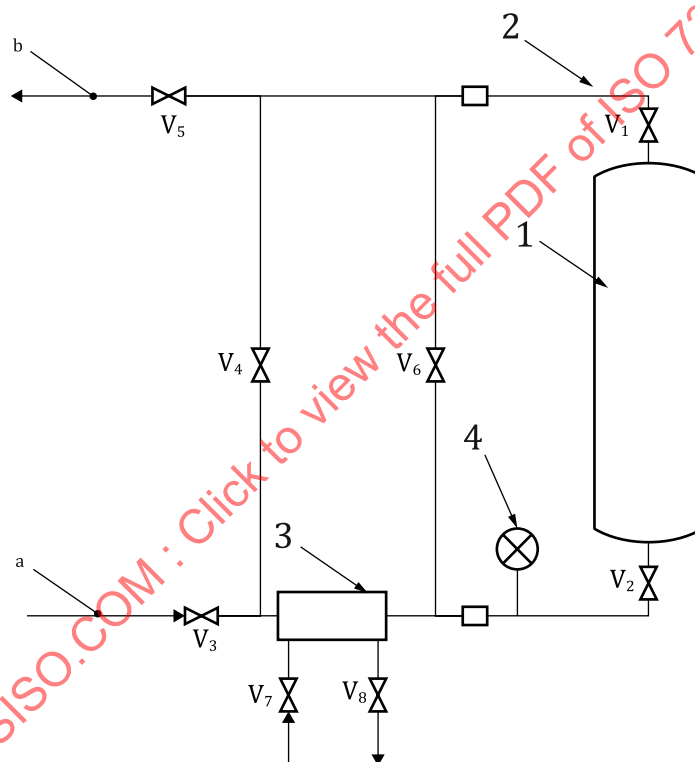
Open inlet valve (V_2) and drainage valve (V_1), close pipeline valve (V_4) and obtain a purge of sample through the sampling cylinder. Wait for a while for the sampling cylinder to purge thoroughly. Regulate drainage valve (V_1) to slow down the purge and obtain appropriate amount of sample in the sampling cylinder.

Close inlet valve (V_2) and drainage valve (V_1). Close sampling valve (V_3) then open pipeline valve (V_4) to relieve the pressure, close pipeline valve (V_4) and discharge valve (V_5), and disconnect sampling cylinder from transfer line.

5.5 Closed sampling apparatus no.3 and procedure

5.5.1 Sampling apparatus

The apparatus no.3 shown in [Figure 4](#) is an example for closed sampling apparatus and is composed of the following parts.



Key

1	sampling cylinder	V_4	pipeline valve
2	metal hoses	V_5	discharge valve
3	steam heated pressure regulator	V_6	bypass valve
4	pressure gauge	V_7	steam inlet valve
V_1	drainage valve	V_8	steam outlet valve
V_2	inlet valve	a	From sample capacity.
V_3	sampling valve	b	To low pressure system.

Figure 4 — Example of closed sampling for ethylene in the liquid phase (Closed sampling apparatus no. 3)

- a) The sampling cylinder is of same type of that in the non-closed sampling apparatus, and is specially passivated. A dip pipe is not required for this sampling cylinder.

- b) The connecting pipes are made of stainless-steel tubing and metal hose equipped with six valves (sampling valve (V₃), pipeline valve (V₄), discharge valve (V₅), bypass valve (V₆), steam inlet valve (V₇) and steam outlet valve (V₈)). Metal hose has threaded joints on one end to join to inlet valve (V₂) or drainage valve (V₁). Sampling valve (V₃), pipeline valve (V₄), discharge valve (V₅), bypass valve (V₆), steam inlet valve (V₇) and steam outlet valve (V₈) are all ordinary two-way valve.
- c) Steam heated pressure regulator is made of stainless steel and designed to heat and vaporize the liquid sample to gaseous sample before entering sampling cylinder. It is heated by steam.

5.5.2 Procedure

Connect the sampling cylinder with the sampling lines. Choose appropriate temperature and pressure of the steam heated pressure regulator according to the manufacturer's recommend and make sure the sample can vaporize completely. Close inlet valve (V₂), and drainage valve (V₁). Open steam inlet valve (V₇) and steam outlet valve (V₈) and wait a while for the regulator to warm up. Open sampling valve (V₃), pipeline valve (V₄) and discharge valve (V₅) in sequence, purge through bypass pipelines and sampling line.

Open bypass valve (V₆) and close pipeline valve (V₄) and wait a while for the regulator to purge.

Open inlet valve (V₂) and drainage valve (V₁), close bypass valve (V₆) and obtain a purge of sample through the sampling cylinder for a few minutes. Close drainage valve (V₁) and wait a while for the sampling cylinder to fill and the pressure gauge shows a fixed number set by the regulator, then close inlet valve (V₂).

Close sampling valve (V₃), then open pipeline valve (V₄) and bypass valve (V₆) to relieve the pressure, close pipeline valve (V₄), discharge valve (V₅), bypass valve (V₆) and disconnect sampling cylinder from transfer line. Close steam inlet valve (V₇) and steam outlet valve (V₈).

6 Sampling of ethylene in the gaseous phase

6.1 General

Although the most widespread practice is to carry out the sampling in the liquid phase, it can sometimes be advantageous, when permitted by the safety regulations and when only a small portion of the sample is required, to draw a sample directly in the gaseous phase. The sampling apparatus described in [6.2](#) and [6.3](#) are examples of non-closed and closed apparatus for sampling ethylene in the gaseous phase.

6.2 Non-closed sampling apparatus and procedures

The non-closed sampling apparatus in [Figure 5](#) gives an example of sampling of ethylene in the gaseous phase. For this case, the procedure is as follows.

- a) Draw the sample with the aid of an adjustable valve, which should be mounted at the outlet of the gas sampling pipe in such a way that discharge is upwards.
- b) The gas sampling pipe should be connected to the ethylene tank by a silicone tube (or a polytetrafluoroethylene tube, or a stainless-steel tube) which is as short as possible. The use of connecting tube should avoid any transfer of traces of impurities in the samples, which would become non-representative.
- c) Before taking a representative sample, purge the sampling pipes thoroughly with an amount of sample gas to avoid all the potential contamination.