

This is a preview of DS/ISO 27913:2024. [Click here to purchase the full version from the ANSI store.](#)

# Fangst, transport og geologisk lagring af carbondioxid – Rørledningssystemer

Carbon dioxide capture, transportation and geological  
storage – Pipeline transportation systems

**DANSK STANDARD**  
Danish Standards Association

Göteborg Plads 1  
DK-2150 Nordhavn

Tel: +45 39 96 61 01  
[dansk.standard@ds.dk](mailto:dansk.standard@ds.dk)  
[www.ds.dk](http://www.ds.dk)

This is a preview of DS/ISO 27913:2024. [Click here to purchase the full version from the ANSI store.](#)

DS projekt: M376442  
ICS: 13.020.40

**Første del af denne publikations betegnelse er:  
DS/ISO, hvilket betyder, at det er en international standard, der har status som dansk standard.**

**Denne publikations overensstemmelse er:  
IDT med: ISO 27913:2024**

**DS-publikationen er på engelsk.**

---

I tilfælde af redaktionelle fejl i DS-publikationen kan der skrives til:  
[editorial-mistakes@ds.dk](mailto:editorial-mistakes@ds.dk)

**ADVARSEL:** DS-publikationer revideres over tid. Derudover kan sådanne publikationer ændres ved rettelserblade og/eller tillæg. Der kan også udgives rettelserblade, der udelukkende angår oversættelsen af en publikation. Det er derfor vigtigt at sikre sig, at man benytter en gældende udgave, medmindre fx lovgivning kræver andet. Den enkelte publikations status fremgår af <https://webshop.ds.dk/>. Her kan man desuden tilmelde sig en gratis notifikationservice og følge en udgivet DS-publikations udvikling ved at klikke på "Følg standarden".

En oversigt over forskellige DS-publikationstyper og -betegnelser findes her:  
<https://www.ds.dk/publikationstyper>.

Second edition  
2024-10

---

---

# **Carbon dioxide capture, transportation and geological storage — Pipeline transportation systems**

*Captage, transport et stockage géologique du dioxyde de carbone —  
Systèmes de transport par conduites*



Reference number  
ISO 27913:2024(E)

© ISO 2024



## **COPYRIGHT PROTECTED DOCUMENT**

© ISO 2024, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Ch. de Blandonnet 8 • CP 401  
CH-1214 Vernier, Geneva, Switzerland  
Tel. +41 22 749 01 11  
Fax +41 22 749 09 47  
[copyright@iso.org](mailto:copyright@iso.org)  
[www.iso.org](http://www.iso.org)

This is a preview of DS/ISO 27913:2024. [Click here to purchase the full version from the ANSI store.](#)

## Contents

Page

<b>Foreword</b> .....	<b>vi</b>
<b>Introduction</b> .....	<b>vii</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Symbols and abbreviated terms</b> .....	<b>5</b>
4.1 Symbols.....	5
4.2 Abbreviated terms.....	5
<b>5 Properties of CO<sub>2</sub>, CO<sub>2</sub> streams and the mixing of CO<sub>2</sub> streams that influence pipeline transportation</b> .....	<b>6</b>
5.1 General.....	6
5.2 Pure CO <sub>2</sub> .....	6
5.2.1 Thermodynamics .....	6
5.2.2 Chemical reactions and corrosion .....	7
5.3 CO <sub>2</sub> streams.....	7
5.3.1 Thermodynamics .....	7
5.3.2 Chemical reactions .....	7
<b>6 Concept development and design criteria</b> .....	<b>7</b>
6.1 General.....	7
6.2 Safety philosophy .....	8
6.3 Reliability and availability of CO <sub>2</sub> stream pipeline systems.....	8
6.4 Short-term storage reserve .....	8
6.5 Access to the pipeline system.....	9
6.6 System design principles.....	9
6.6.1 General.....	9
6.6.2 CO <sub>2</sub> stream specification.....	9
6.6.3 Pressure control and protection system .....	10
6.7 General principles to avoid internal pipeline corrosion .....	11
6.7.1 Particular aspects related to CO <sub>2</sub> streams.....	11
6.7.2 Maximum water content.....	11
6.7.3 Avoidance of hydrate formation .....	11
6.7.4 Measurement of water content in the CO <sub>2</sub> stream .....	11
6.8 Flow assurance .....	11
6.8.1 General.....	11
6.8.2 Operation under single-phase flow conditions during normal operation .....	12
6.8.3 Pipeline operation under multi-phase flow conditions during transient operations .....	12
6.8.4 Planned and unscheduled pipeline pressure release .....	13
6.8.5 Reduced flow capacity .....	14
6.8.6 Available transport capacity.....	14
6.8.7 Flow coating .....	14
6.8.8 External thermal insulation.....	14
6.8.9 Leak detection .....	14
6.8.10 Fugitive emissions .....	15
6.8.11 Impurities.....	15
6.9 Pipeline layout .....	15
6.9.1 Vent stations.....	15
6.9.2 Block valve stations.....	15
6.9.3 Pumping and compressor stations.....	15
6.9.4 In-line inspection .....	16
6.9.5 Onshore vent facility design.....	16
6.9.6 Offshore vent facilities .....	17

This is a preview of DS/ISO 27913:2024. [Click here to purchase the full version from the ANSI store.](#)

<b>7</b>	<b>Materials and pipeline design</b> .....	<b>17</b>
7.1	General .....	17
7.2	Internal corrosion.....	17
7.3	Pipeline system materials.....	17
7.3.1	Steel selection.....	17
7.3.2	External coating.....	18
7.3.3	Non-metallic materials .....	18
7.3.4	Lubricants .....	18
<b>8</b>	<b>Wall thickness calculations</b> .....	<b>18</b>
8.1	Calculation principles .....	18
8.1.1	Design loads .....	18
8.1.2	Minimum wall thickness.....	19
8.1.3	Minimum wall thickness against internal pressure.....	19
8.1.4	Minimum wall thickness against dynamic pressure alterations .....	19
8.1.5	Minimum wall thickness, $t_{\min DF}$ , against running ductile fracture for gas phase pipelines .....	19
8.1.6	Minimum wall thickness, $t_{\min DF}$ , against running ductile fracture for dense phase pipelines.....	20
8.1.7	Fracture toughness.....	20
8.1.8	Overview of the different aspects of wall thickness determination.....	20
8.2	Additional measures.....	23
8.2.1	Dynamic loads due to operation (alternating operation pressure).....	23
8.2.2	Topographical profile .....	23
8.2.3	Fracture arrestors.....	23
8.2.4	Offshore pipelines.....	23
<b>9</b>	<b>Construction</b> .....	<b>23</b>
9.1	General .....	23
9.2	Pipeline pre-commissioning.....	24
9.2.1	Overview.....	24
9.2.2	Pipeline dewatering and drying .....	24
9.2.3	Preservation before pipeline commissioning.....	24
<b>10</b>	<b>Operation</b> .....	<b>24</b>
10.1	General .....	24
10.2	Pipeline commissioning.....	24
10.2.1	Initial filling and pressurization with product .....	24
10.2.2	Initial or baseline inspection.....	25
10.3	Pipeline shutdown .....	25
10.4	Pipeline system depressurization .....	25
10.4.1	General.....	25
10.4.2	Pipeline depressurization .....	26
10.4.3	Vent facilities.....	26
10.5	Inspection, monitoring and testing.....	26
10.5.1	General.....	26
10.5.2	In-line inspection procedure.....	27
10.5.3	Monitoring of water content and dew point .....	27
10.5.4	Network code or equivalent set of operational terms and conditions.....	27
10.5.5	Measurement of CO <sub>2</sub> stream at each custody transfer point .....	27
10.5.6	Measurement of impurities .....	28
10.5.7	Action to be taken in the event of an exceedance of impurities.....	28
10.5.8	Measurement of CO <sub>2</sub> mass flow rate.....	28
<b>11</b>	<b>Re-qualification of existing pipelines for CO<sub>2</sub> service</b> .....	<b>29</b>
	<b>Annex A (informative) Examples of CO<sub>2</sub> stream compositions</b> .....	<b>30</b>
	<b>Annex B (informative) CO<sub>2</sub> characteristics</b> .....	<b>34</b>
	<b>Annex C (informative) Internal corrosion and erosion</b> .....	<b>36</b>

This is a preview of DS/ISO 27913:2024. [Click here to purchase the full version from the ANSI store.](#)

**Annex D (informative) Avoidance of running ductile fracture: Approach for the evaluation of fracture arrest .....38**

**Annex E (informative) Data requirements for an integrity management plan .....40**

**Annex F (informative) Depressurization of a dense phase CO<sub>2</sub> stream avoiding low pipeline temperature issues .....41**

**Bibliography .....43**

This is a preview of DS/ISO 27913:2024. [Click here to purchase the full version from the ANSI store.](#)

## 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](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 265, *Carbon dioxide capture, transportation, and geological storage*.

This second edition cancels and replaces the first edition ([ISO 27913:2016](#)), which has been technically revised.

The main changes are as follows:

- the entire text has been editorially revised;
- normative references have been updated;
- a subclause about CO<sub>2</sub> stream flowrate and impurity measurement has been added;
- the level of impurities has been limited to 5 % and a set of 17 requirements are defined to ensure CO<sub>2</sub> stream pipeline integrity;
- [Annex A](#) has been added to show example compositions of CO<sub>2</sub> streams for gaseous and dense phase CO<sub>2</sub> streams which fulfil the requirements of this document;
- the latest findings in fracture arrest design have been included in [Annex D](#);
- [Annex F](#) has been added to describe the decompression effects on pressure and temperature versus time.

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](http://www.iso.org/members.html).

This is a preview of DS/ISO 27913:2024. [Click here to purchase the full version from the ANSI store.](#)

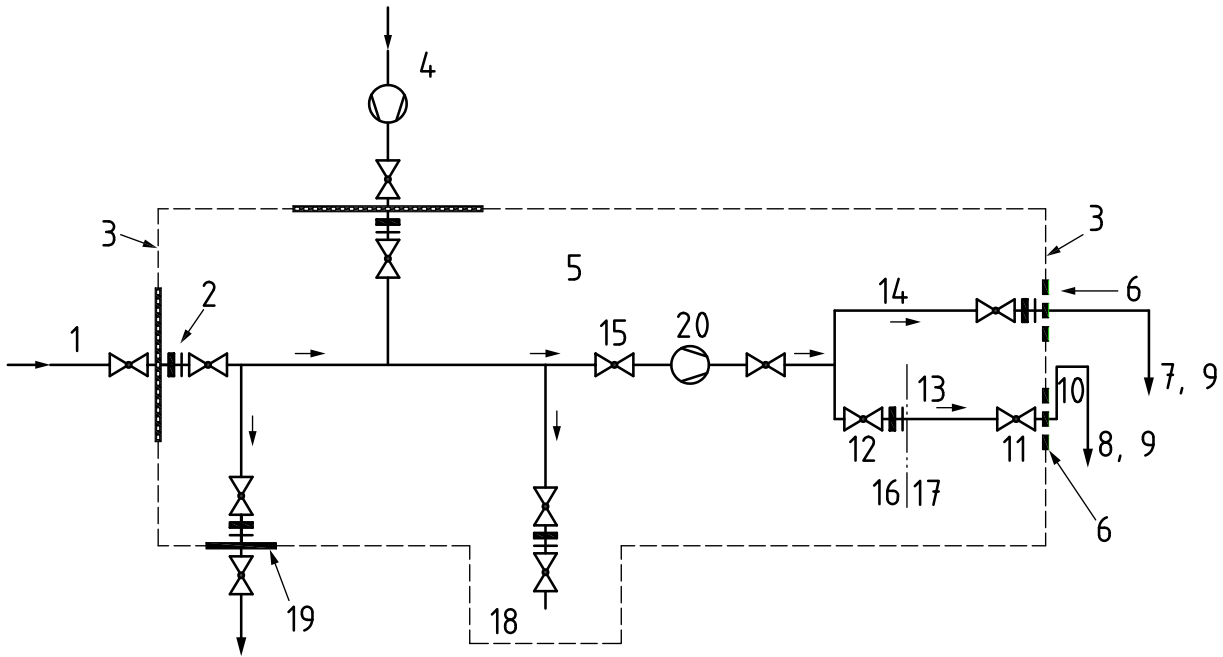
## Introduction

Carbon dioxide (CO<sub>2</sub>) capture, carbon dioxide use (CCU) and carbon dioxide storage (CCS) have been identified as key abatement technologies for achieving a significant reduction in CO<sub>2</sub> emissions to the atmosphere. Pipelines are likely to be the primary means of transporting CO<sub>2</sub> from the point-of-capture to storage sites (e.g. depleted hydrocarbon formations, deep saline aquifers), or to usage points (e.g. enhanced oil recovery or utilization) to avoid its release to the atmosphere. While there is a perception that transporting CO<sub>2</sub> via pipelines does not represent a significant barrier to implementing large-scale CCS, there is significantly less industry experience than there is for hydrocarbon service (e.g. natural gas). Furthermore, there are a number of issues that need to be adequately understood and associated risks that need to be effectively managed to ensure safe transport of CO<sub>2</sub>. In a CCS or CCU context, there is a need for larger CO<sub>2</sub> pipeline systems in more densely populated areas and with CO<sub>2</sub> coming from multiple sources. Also, offshore pipelines for the transportation of CO<sub>2</sub> to offshore storage sites are likely to become common.

The objective of this document is to provide specific requirements and recommendations on certain aspects of safe and reliable design, construction and operation of pipelines intended for the large-scale transportation of CO<sub>2</sub> that are not already covered in existing pipeline standards such as [ISO 13623](#), [ASME B31.4](#), [ASME B31.8](#), [EN 1594](#), [AS 2885](#) or other standards listed in the Bibliography. Existing pipeline standards cover many of the issues related to the design and construction of CO<sub>2</sub> pipelines. However, there are some CO<sub>2</sub>-specific issues (e.g. fracture arrest, internal corrosion protection) that are not adequately covered in these standards but are addressed in this document. The purpose of this document is to cover these issues consistently. Hence, this document is not a standalone standard, but is written to be a supplement to other existing pipeline standards for natural gas or liquids for both onshore and offshore pipelines.

The system boundary (see [Figure 1](#)) between capture and transportation is the point at the inlet valve of the pipeline, where the composition, temperature and pressure of the CO<sub>2</sub> stream is within a certain specified range to meet the requirements for transportation as described in this document.

The boundary between transportation and storage or utilization is the point where the CO<sub>2</sub> stream leaves the transportation pipeline infrastructure and enters the downstream infrastructure, which can be permanent geological storage, utilization or buffer storage prior to shipping.



**Key**

- 1 source of CO<sub>2</sub> from capture (e.g. from power plant, industry; see [ISO/TR 27912](#))
- 2 isolating joint
- 3 boundary limit
- 4 other source of CO<sub>2</sub>
- 5 transportation system inside given in this document
- 6 boundary to storage facility or utilization
- 7 onshore storage facility
- 8 offshore storage facility
- 9 enhanced oil recovery
- 10 riser (outside transportation scope)
- 11 subsea valve (inside transportation scope)
- 12 beach valve
- 13 offshore pipeline
- 14 onshore pipeline
- 15 valve
- 16 landfall
- 17 open water
- 18 third party transport system
- 19 export to other uses than those of Keys 7, 8 and 9
- 20 intermediate compression or pumping

**Figure 1 — Schematic illustration of the system boundaries of this document**

This is a preview of DS/ISO 27913:2024. [Click here to purchase the full version from the ANSI store.](#)

# Carbon dioxide capture, transportation and geological storage — Pipeline transportation systems

## 1 Scope

This document specifies the requirements and recommendations for the transportation of CO<sub>2</sub> streams from the capture site to the storage facility where it is primarily stored in a geological formation or used for other purposes (e.g. for enhanced oil recovery or CO<sub>2</sub> use).

This document applies to the transportation of CO<sub>2</sub> streams by

- rigid metallic pipelines,
- pipeline systems,
- onshore and offshore pipelines for the transportation of CO<sub>2</sub> streams,
- conversion of existing pipelines for the transportation of CO<sub>2</sub> streams, and
- transportation of CO<sub>2</sub> streams in the gaseous and dense phases.

This document also includes aspects of CO<sub>2</sub> stream quality assurance, as well as converging CO<sub>2</sub> streams from different sources.

Health, safety and environment aspects specific to CO<sub>2</sub> transport and monitoring are also considered in this document.

Transportation of CO<sub>2</sub> via ship, rail or on road is not covered in this document.

## 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 3183](#), *Petroleum and natural gas industries — Steel pipe for pipeline transportation systems*

[ISO 20765-2](#), *Natural gas — Calculation of thermodynamic properties — Part 2: Single-phase properties (gas, liquid, and dense fluid) for extended ranges of application*

[ISO/TR 27925](#), *Carbon dioxide capture, transportation and geological storage — Cross cutting issues — Flow assurance*

[API SPEC 5L](#), *Line Pipe, 46th Edition, April 2018*