



BSI Standards Publication

**Carbon dioxide capture, transportation,  
and geological storage — Cross Cutting  
Issues — CO<sub>2</sub> stream composition**

---

## National foreword

This Published Document is the UK implementation of ISO/TR 27921:2020.

The UK participation in its preparation was entrusted to Technical Committee PSE/265, Carbon Capture Transportation and Storage.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2020  
Published by BSI Standards Limited 2020

ISBN 978 0 580 98747 2

ICS 13.020.40

**Compliance with a British Standard cannot confer immunity from legal obligations.**

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 May 2020.

### Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

---

TECHNICAL  
REPORT

**ISO/TR**  
**27921**

First edition  
2020-05

---

---

**Carbon dioxide capture,  
transportation, and geological  
storage — Cross Cutting Issues — CO<sub>2</sub>  
stream composition**

*Captage, transport et stockage géologique du dioxyde de carbone —  
Questions transversales — Composition du flux de CO<sub>2</sub>*



Reference number  
ISO/TR 27921:2020(E)

© ISO 2020



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, 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  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Fax: +41 22 749 09 47  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

<b>Foreword</b> .....	<b>v</b>
<b>Introduction</b> .....	<b>vi</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>2</b>
<b>5 Overview of chemical composition of CO<sub>2</sub> streams</b> .....	<b>4</b>
5.1 Overview.....	4
5.1.1 Types of impurities.....	4
5.1.2 Measurements and estimates.....	4
5.1.3 Data sources.....	5
5.2 Ranges of impurity concentrations for coal fired power plants.....	5
5.2.1 Gaseous components.....	5
5.2.2 Trace elements.....	8
5.2.3 Particulate matter.....	9
5.3 Ranges of impurity concentrations from industrial emitters.....	10
5.3.1 Cement industry.....	10
5.3.2 Iron and Steel industry.....	11
5.3.3 H <sub>2</sub> production.....	11
5.4 Discussion and interpretation.....	11
5.4.1 Variability among processes and industries.....	11
5.4.2 Compositional stability and potential chemical reactions within CO <sub>2</sub> streams.....	12
<b>6 Impacts of impurities</b> .....	<b>12</b>
6.1 Physical impacts.....	13
6.1.1 Overview.....	13
6.1.2 Effect on transportation (pipeline and ship transportation).....	13
6.1.3 Effect on geological storage.....	15
6.2 Chemical impacts.....	18
6.2.1 Corrosion of metallic materials.....	18
6.2.2 Impacts on geological storage system.....	20
6.3 Impacts on microbial communities in the storage complex.....	23
6.4 Toxic and economic effects of impurities in case of leakage.....	24
6.4.1 General statement.....	24
6.4.2 Acute toxic effects.....	24
6.4.3 Chronic effects.....	25
<b>7 Parameters to monitor and measurement methods</b> .....	<b>26</b>
7.1 Monitoring and thresholds.....	26
7.2 Relevant parameters to monitor and measurement methods.....	26
7.2.1 Sampling of the CO <sub>2</sub> stream.....	27
7.2.2 Determining the physical properties and phase.....	27
7.2.3 Flow measurement.....	27
7.2.4 Impurity concentration measurements.....	28
<b>8 Relationship of CO<sub>2</sub> stream emissions and quantification</b> .....	<b>28</b>
<b>9 Integration issues</b> .....	<b>29</b>
9.1 Constraints on CO <sub>2</sub> stream composition.....	29
9.2 Optimisation of CO <sub>2</sub> stream composition based on techno-economic assessments.....	30
9.3 Mixing CO <sub>2</sub> streams before injection: Challenges in larger CCS infrastructures.....	30
<b>10 Conclusions</b> .....	<b>31</b>
<b>Annex A (informative) Dense phase CO<sub>2</sub> corrosion</b> .....	<b>33</b>

<b>Annex B (informative) Composition of CO<sub>2</sub> streams (Source ISO 27913:2016)</b> .....	<b>36</b>
<b>Bibliography</b> .....	<b>39</b>

Currently in preview, click buy full version

## 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 documents 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)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

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*.

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).

## Introduction

ISO Technical Committee (TC) 265 is developing standards and technical reports related to carbon dioxide (CO<sub>2</sub>) capture, transportation and geological storage (CCS). This technology is a technically viable solution to reduce CO<sub>2</sub> emissions of large stationary point sources and therefore to limit future global temperature increases. A special report by the International Panel on Climate Change (IPCC, 2005) extensively described the fundamental technical, scientific, environmental, economic and societal dimensions of CCS and its potential role in the portfolio of climate change mitigation measures.

Depending among other things on the feedstock and the CO<sub>2</sub> generating and capture processes, CO<sub>2</sub> streams captured from industrial sources or power generation contain various impurities (that is, stream components other than CO<sub>2</sub>). The impurities differ in their concentrations but also in their physical and chemical properties. Therefore, the composition of the originally captured CO<sub>2</sub> stream is a key starting point in ensuring the safety and reliability of the transport and geological storage of CO<sub>2</sub>. Compositional information may assist operators in evaluating the need for treating a CO<sub>2</sub> stream, based on the intended transportation options (including mixing with other CO<sub>2</sub> streams), usage options (EOR or other), or dedicated storage in geologic formations.

Understanding CO<sub>2</sub> stream composition is also important for the commerciality of CCS activities because additional purification of the CO<sub>2</sub> stream increases CO<sub>2</sub> capture costs. In addition, CO<sub>2</sub> stream composition is an important input factor in quantifying the amount of CO<sub>2</sub> stored, for the purpose of greenhouse gas emissions reporting and crediting. Because capture and purification processes are continuously evolving, it is relevant to expose the range of impurities in CO<sub>2</sub> streams and their concentrations, including recent publications.

This document provides up-to-date consideration of CO<sub>2</sub> stream quality issues for operators, regulators and stakeholders based on research results and the experience of various pilot and industrial scale CCS projects. The first part of this report summarises existing information related to CO<sub>2</sub> stream composition that generally results from particular capture processes. Then this report describes possible impacts and effects of the various impurities that may occur in the CO<sub>2</sub> stream on various downstream elements of a CCS chain, including operational aspects, potential implications for health, safety and environmental issues, and quantification of greenhouse gas emissions.

# Carbon dioxide capture, transportation, and geological storage — Cross Cutting Issues — CO<sub>2</sub> stream composition

## 1 Scope

The primary aim of this document is to describe the main compositional characteristics of the CO<sub>2</sub> stream downstream of the capture unit, taking into account common purification options. Accordingly, this document will characterize the different types of impurities and present examples of concentrations determined in recent capture pilot projects as well as through literature review. It identifies ranges of concentrations, giving priority to in situ measurements when available.

The second aim of this document is to identify potential impacts of impurities on all components of the CCS chain, from surface installations (including transport) to the storage complex. For example, impurities can have a significant effect on the phase behaviour of CO<sub>2</sub> streams in relation to their concentration. Chemical effects also include the corrosion of metals. The composition of the CO<sub>2</sub> stream can also influence the injectivity and the storage capacity, due to physical effects (such as density or viscosity changes) and geochemical reactions in the reservoir. In case of a leakage, toxic and ecotoxic effects of impurities contained in the leaking CO<sub>2</sub> stream could also impact the environment surrounding the storage complex.

In order to ensure energy efficiency, proper operation of the whole CCS chain and not to affect its surrounding environment, operators usually limit the concentrations of some impurities, which can, in turn, influence the design of the capture equipment and purification steps. Such limits are case specific and cannot be described in this report; however, some examples of CO<sub>2</sub> stream specifications discussed in the literature are presented in [Annex A](#).

The required purity of the CO<sub>2</sub> stream delivered from the capture plant will to a large degree depend on the impurity levels that can be accepted and managed by the transport, injection and storage operations. The capture plant operators will therefore most probably need to purify the CO<sub>2</sub> stream to comply with the required transport, injection, storage specifications or with legal requirements.

Monitoring of the CO<sub>2</sub> stream composition plays an important role in the management of the entire CCS process. Methods of measuring the composition of the CO<sub>2</sub> stream and in particular the concentrations of impurities are described and other parameters relevant for monitoring at the various steps of the CCS chain are described.

The interplay between the set CO<sub>2</sub> stream specifications and the efficiency of the entire CCS process is also explained. Finally, the mixing of CO<sub>2</sub> streams coming from different sources before transport or storage is addressed, and the main benefits, risks and operational constraints are presented.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

### 3.1

#### CO<sub>2</sub> stream

stream consisting overwhelmingly of carbon dioxide

Note 1 to entry: The CO<sub>2</sub> stream typically includes impurities and may include substances added to the stream to improve performance of CCS and/or to enable CO<sub>2</sub> detection.

[SOURCE: ISO 27917:2017, 3.2.10]