

CO₂ Quality Specification



1. Introduction

Establishing an open access CO₂ transmission infrastructure relies on effective coordination among all stakeholders throughout the value chain, from Injection Site to sequestration or utilisation sites. A fundamental element of this collaboration is the clear definition of the CO₂ quality to be transported via the vapor pipeline network.

To promote a unified approach across the value chain, this document presents a CO₂ Specification for transmission of CO₂ by Fluxys c-grid.

The development of this CO₂ quality specification has been guided by several key considerations:

- **Network integrity:** Ensuring the safe and efficient transport of CO₂ by pipeline without compromising the system's integrity. Preserving the integrity of the entire value chain is crucial, and well-defined CO₂ specification plays a vital role in strengthening carbon capture and storage (CCS) reliability.
- **Interoperability:** Actively participating in the creation of future systems and infrastructures, with the aim of establishing a unified CO₂ baseline, supporting the development of a single European CO₂ market.
- **Operational safety:** Identifying and managing both direct and indirect risks to people and the environment, ensuring safe operations at all stages.

This document and the specifications herein supersede the Carbon Specification Proposal dated 09/03/2022 published on Fluxys' website.

2. Disclaimer

The specification for CO₂ presented in this document is reflecting the best knowledge available at the moment of the publication. This quality specification may be subject to evolution based on internal and external research, requirements or decisions by regional government or regulatory bodies, and European CO₂ quality standards initiatives. The information contained in this document reflects common work of Fluxys group as infrastructure operator, together with partners on the capture-to sequestration logistic chains solutions.

The CO₂ specification is publicly disclosed for information purposes only and on a strict non-reliance basis. Fluxys c-grid undertake any commitment or liability whatsoever with respect to the publication of this specification.

3. CO₂ operating conditions

CO₂ operating conditions refer to the conditions at which the Network User delivers its CO₂ for transport. CO₂ will be injected into the CO₂ Network at the Connection Point at the CO₂ Injection Station.

The pressure operating conditions are outlined in Fluxys c-grid Connection Agreement Schedule 3 - Technical Requirements for CO₂ Injection Stations. The document provides guidance for connecting CO₂ Injection Stations to the CO₂ Network, including the minimum requirements for the Network User's metering and safeguarding systems.

The operating conditions for temperature at the Connection Point:

Temperature setpoints	
Maximum Acceptable Operating Temperature	40 °C
Minimum Acceptable Operating Temperature	10 °C

4. CO₂ quality specification

Following the initial release of the Carbon Specification Proposal, Fluxys c-grid has continued to advance in the development of CO₂ quality standards in consultation with all relevant stakeholders.

Throughout this process, Fluxys c-grid has engaged extensively with prospective Network Users of the CO₂ Network, both in one-to-one discussions as in group sessions. Fluxys c-grid had particular attention on ensuring interoperability with Adjacent CO₂ Networks, recognising its importance for a robust and accessible infrastructure. In addition, Fluxys c-grid and its partners have carried out a comprehensive laboratory test programme to further create a reliable system.

Each Network User is individually responsible for supplying CO₂ that meets at all times the required specifications across all parameters. This responsibility is essential to maintain open access and reliable operation for all Network Users.

The Network User shall inform Fluxys c-grid of any impurities which are expressly listed in the specification and expected to be present in its CO₂ stream up to the allowed thresholds. Furthermore, the Network User is required to specify any components believed to be present in the CO₂ stream that are not expressly included in the specification. Once these components are identified, they will be subject to a risk assessment and evaluated in collaboration with all stakeholders in the value chain.

The CO₂ quality specification for transmission is set out in the following table and applies at every point where CO₂ enters and leaves the network. The specification is designed for CO₂ transport in vapor phase and will continue to evolve as new research and testing results become available.

The CO₂ specification for dense phase will be added in a future update.

The CO₂ specification listed is based on laboratory testing with limited residence time.

The Fluxys c-grid CO₂ vapor specification

Category	Component	Unit	Requirement	
Purity	CO₂	% mol	≥ 98 ⁽¹⁾	
Non-condensables	H₂	% mol	≤ 0.75	Sum ≤ 2
	N₂	% mol	≤ 2	
	Ar	% mol	≤ 0.4	
	CH₄	% mol	≤ 0.15	
	CO	ppm mol	≤ 100	
Reactive and polar components	O₂	ppm mol	≤ 10	S _{tot} ⁽²⁾ ≤ 4,5
	H₂S	ppm mol	≤ 0.5	
	SO₃	ppm mol	≤ 0.1	
	SO_x	ppm mol	≤ 4	
	NO_x ⁽³⁾	ppm mol	≤ 1.35	
	H₂O	ppm mol	≤ 30	
	Ethanol	ppm mol	≤ 0,94	
	Methanol ⁽⁴⁾	ppm mol	≤ 70	
	HCN	ppm mol	≤ 20	
	NH ₃	ppm mol	≤ 3	
	Total amine compounds	ppm mol	≤ 1	
	Glycol	ppm mol	≤ 0.15 (MEG) ≤ 0.15 (TEG)	
	Acetic Acid	ppm mol	≤ 1	
	Ethylene (C2)	ppm mol	≤ 45	
	Ethane (C2) ⁽⁵⁾	ppm mol	≤ 330	
Organic compounds	C3+ (hydrocarbons) with below sublimits	ppm mol	≤ 1010	Sum ≤ 9,6 (VOC)
	Propane (C3)	ppm mol	≤ 1010	
	Butanes-Pentanes (C4-C5)	ppm mol	≤ 750	
	Hexanes-Heptanes (C6-C7)	ppm mol	≤ 69	
	Octanes-Nonanes(C8-C9)	ppm mol	≤ 7,4	
	Methyl acetate	ppm mol		
	Acetone	ppm mol		
	Hexanal	ppm mol		
	Diethyl ether	ppm mol		
	Acetonitrile	ppm mol		
	1,2,4-Trimethylbenzene	ppm mol	≤ 4,5	
	1-Propanol	ppm mol	≤ 0,9	
	2-Butanol	ppm mol	≤ 0,9	
	BTEX ⁽⁶⁾	ppm mol	≤ 0,1	
	Formaldehyde + Acetaldehyde	ppm mol	≤ 10	
Solids	Mercury (Hg)	ppb mol	≤ 0.06 equivalent to 0.5 µg/Nm ³	
	Full removal cut-off diameter ⁽⁷⁾	µm	≤ 3.8 mg/Nm ³ max. diameter 10µm	
	Dew point		≤ -10 °C at 20 barg (Gas phase)	

Legend:

ppm: parts per million
ppb: parts per billion
µm: micrometer

⁽¹⁾ Subject to further alignment along the value chain

⁽²⁾ S_{tot} : Total sulphur means all components containing sulphur.
Subject to further alignment along the value chain

⁽³⁾ NO_x: The sum of 50% NO and NO₂

⁽⁴⁾ Values up to 125ppm temporary after startup and shutdown are accepted

⁽⁵⁾ Values up to 1050ppm temporary during operational upsets and with limited outages, are accepted on a case-by-case evaluation

⁽⁶⁾ BTEX: Benzene, Toluene, Ethylbenzene, Xylene

⁽⁷⁾ Full removal cut-off diameter shall not exceed 1µm for 50wt%, 5µm for 95wt% and 10µm for 99 wt%
Subject to further alignment along the value chain

Other impurities that are not present in the table should be risk evaluated on a case-by-case basis

Impurities highlighted in bold will be measured online by Fluxys c-grid.
The Network User will perform online measurement on the impurities in bold as a minimum requirement, pending his choice he can measure online on more components.