

H₂/CO₂ Quality Specifications Proposals

Fluxys

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Introduction

The development of the hydrogen and carbon transmission infrastructure requires the right coordination between all relevant stakeholders in the value chain. One of the most important building blocks to make the cooperation successful consists in characterizing what H₂ and CO₂ products shall be to be transported through the pipelines.

The general principles that should govern the gas quality specifications in the networks are:

- Ensure infrastructures are fit for purpose → transporting gases
- Protect the infrastructures (e.g. from corrosion) → limiting free water and acid components
- Safeguard safety of operations and end-use → limiting toxic components
- Ensure interoperability with adjacent systems → aligning specifications

In order to catalyse the industry efforts and establish adequate specifications, Fluxys Belgium has prepared H₂ and CO₂ gas quality specifications proposals. Industry is invited to formulate feedback on those specifications, which are now submitted to you for consultation. End goal is to establish the optimum gas quality specifications for H₂ and CO₂ based on market feedback and technical feasibility.

Call for feedback

All feedback will be welcome. Any interested party is invited to complete the questionnaire "RFI H₂/CO₂ Development" available on Fluxys website. Discussion can also be organized on demand via mail at info.hydrogen-carbon-transport@fluxys.com

Disclaimer

The attached gas quality specifications proposals which are now submitted to consultation have been drafted with the sole purpose to collect feedback from the industry and of any interested party. Hence, those gas quality specifications proposals are per definition (i) non-binding upon Fluxys and any entity providing feedback on those specifications and (ii) subject to evolution.

Hydrogen Gas Quality Specification Proposals

Two hydrogen gas quality specifications are proposed. Both specifications require a H₂ purity of at least 98% but differ in the composition of the remaining 2%.

The specification 1 might contain up to 1,5% of hydrocarbons but only 0,5% of inerts. The specification 2 contains a maximum of 0.1% of hydrocarbons but up to 2% of inerts. The presence of inerts will have a bigger impact on fluctuations of the Wobbe Index as compared to the presence of hydrocarbons.

It is recognized that both specifications 1 and 2 for the transport of H₂ per pipeline require an additional treatment of the hydrogen before it can be used in fuel cells (according to ISO14687 - fuel cell applications for road vehicles) or specific processes.

Constituents	Units	Spec 1	Spec 2	Note
H ₂	% mol	> 98		1
Total hydrocarbons	% mol	< 1,5	< 0,1	2
Sum of inerts (N ₂ +He+Ar)	% mol	< 0,5	< 2	3
<i>Wobbe Index (informative)</i>	<i>MJ/m³(n)</i>	<i>45,3-48</i>	<i>42,2-48</i>	4
HC Dewpoint	°C from 0 to 69 barg	< -2		5
H ₂ O Dewpoint	°C at 69 barg	< -8		6
O ₂	% mol	< 0,2		7
CO ₂	ppm v	< 20	< 1	8
CO	ppm v	< 20	< 1	8
S _{TOT} (without odorant)	mg/m ³ (n)	< 10		9
H ₂ S + COS (without odorant)	mg/m ³ (n)	< 5		10
NH ₃	ppm v	< 10	< 1	11
Formaldehyde	ppm v	< 10	< 1	12
Formic acid	ppm v	< 10	< 1	12
Halogenated compounds	ppm v	< 0,05		13
Impurities	The H ₂ delivered shall not contain any other elements or impurities (solid, liquid or gaseous) that might interfere with the integrity or operation of the pipelines or the gas appliances.			

1. Minimum hydrogen content (purity)
2. Might be present after gas reforming. Limited to reduce emissions and H₂ dilution.
3. Limited to reduce H₂ dilution and impact on GCV and Wobbe Index. Depends on the room given for total hydrocarbons
4. Ranges derived from possible compositions
5. To avoid formation of liquids in operating conditions. Same as for natural gas (EN16726)
6. To avoid formation of free water in operating conditions and limit corrosion. Same as for natural gas (EN16726)
7. Small amount of oxygen (minimum 1000 ppm) added to the hydrogen stream to mitigate hydrogen enhanced fatigue phenomenon on steel pipelines and thereby decrease potential restrictions on pressure variations and/or number of cycles.
8. Limited to reduce emissions
9. Takes into account both the sulfur components originating from natural gas and potential contamination from the pipelines previously used to transport natural gas (remaining after cleaning). Specification applies for non-odorized H₂ networks. Where odourisation is performed, 10 mg/m³ are added to the specification (same as for natural gas – EN 16726)
10. Same as for natural gas (EN16726)
11. Might be present in very small quantities after natural gas reforming or after cracking when it is used as an energy carrier.
12. Might be present in very small quantities after natural gas reforming.
13. Adopted from ISO14687 (fuel cell applications for road vehicles)

Hydrogen Operating Conditions Proposal

Parameters	Units	Operating conditions	Note
Pressure	barg	Up to 60	1
Temperature	°C	2 – 38	2

1. As for natural gas, H₂ network will be operated with several operating pressures depending on pipelines, location and capacities (still to be defined)
2. In line with pipelines/stations design. Aligned with natural gas.

Carbon Dioxide Gas Quality Specifications Proposals

Two CO₂ gas quality specifications are proposed to better appreciate the market position to that regard. Both specifications meet the requirements for the transport infrastructure.

Constituents	Units	Specification 95	Specification 99	Note
CO ₂	% mol	> 95	> 99	1
Water	ppm v	< 40		2
H ₂ S	ppm v	< 5		3
O ₂	ppm v	< 40		4
NO _x	ppm v	< 5		3
NO	ppm v	< 2,5		3
NO ₂	ppm v	< 2,5		3
SO _x	ppm v	< 10		3
H ₂	% mol	< 0,75	< 0,2	5, 9
N ₂	% mol	< 2	< 0,5	6, 9
Argon	% mol	< 1	< 0,2	7, 9
CH ₄	% mol	< 1	< 0,1	7, 9
CO	ppm v	< 100		8, 9
N ₂ +Ar+H ₂ +CH ₄ +CO+O ₂	% mol	< 4	< 0,8	9
Amine	ppm v	< 10		10
C ₂₋₆	ppm v	< 1200		11
VOC	ppm v	< 350		10
Aromatics (incl.BTEX)	ppm v	< 0,1		10
Ethylene	ppm v	< 1		10
HCyanide	ppm v	< 15		12
COS	ppm v	< 0,1		10
DimethylSulfide	ppm v	< 1,1		10
NH ₃	ppm v	< 10		10

Impurities	The CO ₂ delivered shall not contain any other elements or impurities (solid, liquid or gaseous) that might interfere with the integrity or operation of the pipelines or downstream systems.	13
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1. Minimum CO₂ content (purity); 95%mol figure as per ISO 27913
2. To avoid the presence of free water and limit corrosion.
3. Health and safety. To limit corrosion.
4. To limit corrosion.
5. Amount of "non-condensables" to be limited. 0,75%mol value as per ISO 27913
6. Amount of "non-condensables" to be limited. 2%mol value as per ISO 27913
7. Amount of "non-condensables" to be limited.
8. Health and safety.
9. Amount of "non-condensables" to be limited. 4%mol value as per ISO 27913
10. Compatibility with potential receiving parties.
11. No heaviers than C7 to avoid liquids. Compatibility with potential receiving parties.
12. Health and safety. Compatibility with potential receiving parties.
13. Non exhaustive list of impurities: Mercury, Glycol, Methanol, Ethanol, C7+, Acetaldehyde, Formaldehyde, Cadmium, Thallium

Carbon dioxide gas operating conditions proposal

Parameters	Units	Operating conditions	Note
Pressure	barg	Up to 35	1
Temperature	°C	5 – 40	1, 2

1. Conditions selected for operating in vapor form.
2. In line with pipelines/stations design.