

| | | |
|------------|---|--|
| TNI | Plynárenská infraštruktúra Dôsledky vodíka v plynárenskej infraštruktúre a identifikácia súvisiacej potreby normalizácie v rozsahu pôsobnosti CEN/TC 234 | TNI CEN/TR 17797 38 6450 |
|------------|---|--|

Gas infrastructure - Consequences of hydrogen in the gas infrastructure and identification of related standardisation need in the scope of CEN/TC 234

Táto technická normalizačná informácia obsahuje anglickú verziu CEN/TR 17797:2022.
This Technical standard information includes the English version of CEN/TR 17797:2022.

Táto technická normalizačná informácia bola oznámená vo Vestníku ÚNMS SR č. 05/22

TECHNICAL REPORT**CEN/TR 17797****RAPPORT TECHNIQUE****TECHNISCHER BERICHT**

March 2022

ICS 01.120; 75.180.01

English Version

Gas infrastructure - Consequences of hydrogen in the gas infrastructure and identification of related standardisation need in the scope of CEN/TC 234

Infrastructure gazière - Consequences d'hydrogen dans l'infrastructure gazière et l'identification des besoins relatifs à la normalisation dans le domaine d'application de CEN/TC 234

Gasinfrastruktur - Auswirkungen von Wasserstoff in der Gasinfrastruktur und Identifikation des zugehörigen Normungsbedarfs im Zuständigkeitsbereich des CEN/TC 234

This Technical Report was approved by CEN on 24 January 2022. It has been drawn up by the Technical Committee CEN/TC 234.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

CEN/TR 17797:2022 (E)

| Contents | Page |
|---|-------------|
| European foreword | 5 |
| Introduction | 6 |
| 1 Scope | 7 |
| 2 Normative references | 7 |
| 3 Terms, definitions and abbreviations | 7 |
| 3.1 Terms and definitions | 7 |
| 3.2 Symbols and abbreviations | 10 |
| 4 Executive summary | 10 |
| 5 General considerations for the entire gas infrastructure | 12 |
| 5.1 Explosion protection and prevention | 12 |
| 5.1.1 General principles | 12 |
| 5.1.2 Safety characteristics of natural gas-hydrogen mixtures and their impact on explosion prevention | 13 |
| 5.1.3 Consequences of H₂ and H₂NG in NG infrastructure for explosion protection related to identified H₂ concentrations | 14 |
| 5.2 N₂NG mixtures in contact with materials — Pressure integrity, gas tightness and functionality | 15 |
| 5.2.1 General | 15 |
| 5.2.2 Steel | 18 |
| 5.2.3 PE and PA-U | 26 |
| 5.2.4 Alloys | 26 |
| 5.2.5 Information on deterioration and chemical aggression of elastomers | 26 |
| 5.2.6 Others | 26 |
| 5.3 Volume in relation to energy content — consequences for the capacity and function of the gas transportation, underground gas storage and distribution system | 26 |
| 6 Technical considerations per topic applicable for the different parts of the gas infrastructure (along chain) | 27 |
| 6.1 General | 27 |
| 6.2 Gas quality | 27 |
| 6.2.1 Scope of considerations — Gas quality — EN 16726 | 27 |
| 6.2.2 Technical considerations — Identified H₂NG | 28 |
| 6.3 Gas compression | 33 |
| 6.3.1 Scope of consideration — Gas compression | 33 |
| 6.3.2 Technical considerations — Identified H₂NG aspects — Gas compression | 34 |
| 6.4 Gas pipelines with MOP over 16 bar — Gas transmission | 34 |
| 6.4.1 Scope of consideration — Gas transmission — EN 1594 | 34 |
| 6.4.2 Hydrogen piping and pipelines — ASME B31.12 | 34 |
| 6.4.3 Technical considerations — Identified H₂NG aspect — Gas transmission | 35 |
| 6.5 Gas pressure control | 38 |
| 6.5.1 Scope of consideration — Gas pressure control — EN 12186 and EN 12279 | 38 |
| 6.6 Gas metering | 39 |
| 6.6.1 Scope of consideration — Gas metering — EN 1776 | 39 |
| 6.6.2 Technical considerations — Identified H₂NG aspects — Gas metering | 39 |
| 6.7 Gas supply systems up to and including 16 bar and pressure testing | 40 |

| | | |
|--------|--|----|
| 6.7.1 | Statement for gas pipelines with MOP up to and including 16 bar for all concentrations..... | 40 |
| 6.7.2 | Requalifying existing pipelines for hydrogen service..... | 41 |
| 6.7.3 | Technical consideration — Scoping considerations — EN 2007-1 to -4, CEN/TS 12007-6, EN 12327 and EN 12732..... | 41 |
| 6.8 | Service lines..... | 45 |
| 6.8.1 | Scoping considerations — Service lines — EN 12007-5..... | 45 |
| 6.8.2 | Technical considerations — Identified H ₂ NG aspects integrity and safety, reliability and operation..... | 46 |
| 6.9 | Industrial piping..... | 47 |
| 6.9.1 | Scope of consideration - Industrial piping - EN 15001-1 and EN 15001-2..... | 47 |
| 6.9.2 | Technical considerations — Industrial piping..... | 48 |
| 6.10 | Gas pipework for buildings..... | 49 |
| 6.10.1 | Scope of consideration — Gas pipework for buildings - EN 1775..... | 49 |
| 6.10.2 | Technical considerations — Gas pipework for buildings..... | 49 |
| 6.11 | Underground gas storage..... | 49 |
| 6.11.1 | Scope of consideration for underground gas storage — Generals EN 1918-1 to -5.... | 49 |
| 6.11.2 | Technical considerations — Underground gas storage..... | 50 |
| 6.11.3 | Identified H ₂ NG impacts — Underground gas storage..... | 51 |
| 6.12 | Safety management and integrity management..... | 52 |
| 6.12.1 | Scope of considerations..... | 52 |
| 6.12.2 | Safety management system — Management of change..... | 52 |
| 6.12.3 | Pipeline integrity management system..... | 53 |
| 7 | Conclusions — H ₂ suitability of components, materials and procedures used in the gas infrastructure related to identified H ₂ concentrations..... | 54 |
| 7.1 | General..... | 54 |
| 7.2 | H ₂ suitability — Gas quality..... | 55 |
| 7.2.1 | H-gas quality - Admixture of H ₂ | 55 |
| 7.2.2 | Hydrogen quality in converted natural gas grids..... | 56 |
| 7.3 | H ₂ suitability — Gas compressor stations..... | 57 |
| 7.3.1 | General..... | 57 |
| 7.3.2 | Less than 1 % hydrogen in natural gas..... | 58 |
| 7.3.3 | Over 1 Vol.-% up to 5 Vol.-% H ₂ in natural gas..... | 58 |
| 7.4 | H ₂ suitability — Gas transmission pipelines with MOP over 16 bar..... | 61 |
| 7.5 | H ₂ suitability — Gas pressure control..... | 62 |
| 7.5.1 | Introduction..... | 62 |
| 7.5.2 | General..... | 63 |
| 7.5.3 | Up to 10 Vol.-% H ₂ in natural gas..... | 63 |
| 7.5.4 | Over 10 Vol.-% up to 100 % H ₂ in natural gas..... | 64 |
| 7.6 | H ₂ suitability — Gas metering..... | 65 |
| 7.7 | H ₂ suitability — Gas pipelines with MOP up to and including 16 bar..... | 65 |
| 7.7.1 | A Summary of findings for gas pipeline systems up to and including 16 bar and pressure testing (CEN/TC 234 WG 2)..... | 65 |
| 7.8 | H ₂ suitability — Service lines..... | 66 |
| 7.9 | H ₂ suitability — Industrial piping..... | 66 |
| 7.10 | H ₂ suitability — Gas pipework for buildings..... | 67 |
| 7.11 | H ₂ suitability — Underground gas storage..... | 67 |
| 7.11.1 | Between 0 % and 1 % hydrogen in natural gas..... | 67 |
| 7.11.2 | Between 1 % and 20 % hydrogen in natural gas..... | 68 |
| 7.11.3 | Above 20 % hydrogen up to full replacement of natural gas by hydrogen (100 % hydrogen)..... | 68 |

CEN/TR 17797:2022 (E)

| | | |
|------------------------------|--|------------|
| 8 | Revision needs of existing CEN/TC 234 standards and additional deliverables for the H₂-readiness of the gas infrastructure | 68 |
| 8.1 | Action need..... | 68 |
| 8.2 | Gas quality — Expected revision of EN 16726:2015+A1:2018..... | 69 |
| 8.3 | Gas compression — Expected revision of EN 12583:2014..... | 69 |
| 8.4 | Pipelines for maximum operating pressure over 16 bar — Expected revisions of EN 1594:2013 | 70 |
| 8.5 | Gas pressure control — Expected revisions of EN 12186:2014 and EN 12279:2000 | 71 |
| 8.6 | Gas measuring systems — Expected revision of EN 1776:2015 | 73 |
| 8.7 | Pipelines for maximum operating pressure up to and including 16 bar — Expected revision of EN 12007 Parts 1 to 4 and EN 12327:2012 | 74 |
| 8.8 | Pressure testing, commissioning and decommissioning procedures — Expected revision of EN 12327:2012 | 77 |
| 8.9 | Welding of steel — Expected revision of EN 12732:2013 | 78 |
| 8.10 | Service lines — Expected revision of EN 12007-5:2014 | 78 |
| 8.11 | Gas installation pipework- Expected revision of FprEN 15001-1:2019 and EN 15001-2:2019 | 81 |
| 8.12 | Gas pipework for buildings — Expected revision of EN 1775 | 85 |
| 8.13 | Underground gas storage- Expected revision of EN 1918-1:2016 to -5:2016..... | 86 |
| 8.14 | Safety and Integrity Management System — Expected revision of EN 16348 and EN 15399 by prEN 17649 (merged standard) | 91 |
| Annex A (informative) | Any issue coming up during the discussion and outside of the TC 234 scope..... | 92 |
| Annex B (informative) | Safety characteristics of natural gas-hydrogen mixtures..... | 93 |
| Annex C (informative) | Operating principles for gas warning devices [2]..... | 94 |
| Annex D (informative) | Hydrogen pressure versus hydrogen percentage | 96 |
| Annex E (informative) | Hydrogen pressure versus hydrogen fugacity | 97 |
| Annex F (informative) | An example of the use of an existing gas pipeline for hydrogen gas | 99 |
| Annex G (informative) | Use of polyamide (PA-U) in gas piping systems in relation to hydrogen, methane or their mixtures..... | 101 |
| Annex H (informative) | Netbeheer Nederland Study for biomethane and 100 % hydrogen | 112 |
| Annex I (informative) | Responsibility of CEN/TC 234 'Gas infrastructure' Working groups for the parts of the gas infrastructure along the chain | 114 |
| Annex J (informative) | Symbols and abbreviations..... | 115 |
| Bibliography | | 118 |

European foreword

This document (CEN/TR 17797:2022) has been prepared by Technical Committee CEN/TC 234 “Gas infrastructure”, the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

CEN/TR 17797:2022 (E)

Introduction

The injection of hydrogen in natural gas infrastructures demands considerations with regard to the integrity, safety and performance of the systems facing increasing hydrogen levels, its fluctuation and variation.

There is extensive research on the use of hydrogen as an admixture with natural gas in various percentages or as pure hydrogen. Impact studies already completed or in progress are focusing on the use of existing gas networks but also of dedicated gas networks for hydrogen. They also include the impact of the introduction of hydrogen in various percentages into the gas infrastructure on all the existing technologies within the gas supply chain.

Accepting hydrogen into the natural gas network requires input from many gas TCs at CEN, i.e. CEN/TC 234 and particularly from the manufacturers of essential components, e.g. valves, gas pressure regulators, gas meters, safety control devices, leak detection devices, and many more (see Annex A). Many of these manufacturers are assessing the potential impact of hydrogen on existing components in natural gas service.

Co-operation with these other CEN and ISO/TCs for various essential components and applications will be necessary to ensure that projects to introduce hydrogen have all the essential elements of the gas chain fully co-ordinated into the plan. The positive co-operation of the component manufacturers will be particularly important.

In the transition scheme to hydrogen, there is a large body of knowledge and experience available from the hydrogen industry for gas production and use. The long-established safety requirements in this sector will aid the amendment of natural gas standards and codes of practice and the development of any new standards

This report is written for

- CEN/TC 234 as basis for definition of a TC roadmap for standardisation
- CEN/TC 234 WGs as a guideline for the standardisation work
- interested parties to get an insight in the decision process of CEN/TC 234's hydrogen standardisation.

NOTE This document has been elaborated in co-operation between the Working Group convenors, secretaries and experts, TC chair and secretariat of CEN/TC 234. Respecting different working group contributions, the way in which the content is presented and the level of details differs for the different topics. This is acceptable as the real technical work will take place in the dedicated working groups with co-ordination of the TC 234 Convenors/Secretaries group to ensure the final coherence of the resulting standardisation deliverables.

1 Scope

This document is written in preparation of future standardization and provides guidance on how injection of H₂ into the gas infrastructure can impact processes from the input of gas into the on-shore transmission network up to the inlet connection of gas appliances.

NOTE 1 Gas infrastructure includes gas installation pipework between the delivery point of the gas and the inlet connection to the gas appliance in buildings and on industrial sites.

The assessments refer to the concentrations of 2, 5, 10, 20 and up to 100 Vol.- % hydrogen in natural gas.

Furthermore, it identifies the expected revision need of the existing CEN/TC 234 standards as well as the need of further new standardisation deliverables.

It examines the effects on each part of the gas infrastructure in the scope of the CEN/TC 234 Working Groups 1 to 12 inclusive, based on available studies, reports and research. Due to several limitations at different hydrogen concentrations, the impacts are specified.

For some specific impacts, pre-standardization research is needed.

By convention, for this technical report, the injection of pure hydrogen, i. e. without trace and/or minor components is considered. Awareness is given that there is the need to consider trace and/or minor components and limits set on the gas quality on European and national level, too.

The information from this report is intended to define the CEN/TC 234 work program for the coverage of H₂NG in relation to the scope of the CEN/TC 234 and its WGs.

NOTE 2 Progress on hydrogen will develop over time. In principle this will be reflected in the standardisation process in CEN/TC 234.

2 Normative references

There are no normative references in this document.

koniec náhľadu – text ďalej pokračuje v platenej verzii STN