DZ 5442:2025

PC-draft standard

DRAFT

New Zealand Standard

Committee: P4206

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Standards New Zealand

PO Box 1473, Wellington 6140

Committee representation

This standard was prepared by the P4206 Committee. The membership of the committee was approved by the New Zealand Standards Approval Board and appointed by the New Zealand Standards Executive under the Standards and Accreditation Act 2015.

The committee consisted of representatives of the following nominating organisations:

Energy Resources Aotearoa

GasNZ

Gas Industry Company

GNS Science

Hiringa Energy Limited

Master Electricians

Master Plumbers

Methanex New Zealand Limited

New Zealand institution of gas engineers

WorkSafe New Zealand: Energy Safety

Worley

Acknowledgement

Standards New Zealand gratefully acknowledges the contribution of time and expertise from all those involved in developing this standard.

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New Zealand Standard

Specification for reticulated gas

Superseding NZS 5442 (Int):2024

ISBN (Print) 978-1-77972-xxx-x
ISBN (PDF) 978-1-77972-xxx-x

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Reference is made in this document to the following:

New Zealand standards

NZS 5266:2014	Safety of gas appliances
NZS 5425:- - - -	Code of practice for CNG compressor and refuelling stations
Part 1:1994	On site storage and location of equipment
Part 2:1996	Compressor equipment
Part 3.1P:1985	Metering devices – Division 3.1: Metering method using tables and calculator programme
Part 3.2:1984	Metering devices – Division 3.2: Installation and operation of on-line metering devices
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Part 4:1994	CNG trickle fill stations on commercial and industrial premises
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Joint Australian/New Zealand standards

AS/NZS 2739:2009	Natural gas (CNG) fuel systems for vehicle engines
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AS/NZS 4645:- - - -	Gas distribution networks
Part 1:2018	Network management
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Part 3:2018	Plastics pipe systems

International standards

ISO 2611:- - - -	Analysis of natural gas – Halogen content of biomethane
Part 1:2024	HCl and HF content by ion chromatography
ISO 2613:- - - -	Analysis of natural gas – Silicon content of biomethane
Part 2:2023	Determination of siloxane content by gas chromatography with ion mobility spectrometry

ISO 2614:2023	Analysis of natural gas – Biomethane – Determination of terpenes' content by micro gas chromatography
ISO 2620:2024	Analysis of natural gas – Biomethane – Determination of VOCs by thermal desorption gas chromatography with flame ionization and/or mass spectrometry detectors
ISO 4259:2006	Petroleum products – Determination and application of precision data in relation to methods of test
ISO 5725:- - - -	Accuracy (trueness and precision) of measurement methods and results
Part 1:1994	General principles and definitions
ISO 6974:- - - -	Natural gas – Determination of composition with defined uncertainty by gas chromatography
Part 1:2000	Guidelines for tailored analysis
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Part 3:2000	Determination of hydrogen, helium, oxygen, nitrogen, carbon dioxide and hydrocarbons up to C8 using two packed columns
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Part 5:2000	Determination of nitrogen, carbon dioxide and C1 to C5 and C6+ hydrocarbons for a laboratory and on-line process application using three columns
Part 6:2002	Determination of hydrogen, helium, oxygen, nitrogen, carbon dioxide and C1 to C8 hydrocarbons using three capillary columns
ISO 6975:1997	Natural gas – Extended analysis – Gas chromatographic method
ISO 6976:2016	Natural gas – Calculation of calorific values, density, relative density and Wobbe indices from composition
ISO 6978.2:2003	Natural gas – Determination of mercury – Part 2: Sampling of mercury by amalgamation on gold/platinum alloy
ISO 10101:- - - -	Natural gas – Determination of water by the Karl Fischer method
Part 1:2022	General requirements
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ISO 11541:1997	Natural gas – Determination of water content at high pressure
ISO 11626:2024	Natural gas – Determination of sulfur compounds – Determination of hydrogen sulfide content by UV absorption method
ISO 19739:2004	Natural gas – Determination of sulphur compounds using gas chromatography
ISO/DID 2612:2023	Analysis of natural gas – Biomethane – Determination of ammonia content by tuneable diode laser absorption spectroscopy
ISO/DIS 5409:2023-10	Draft Stationary source emissions – Sampling and determination of mercury in flue gas using chemical absorption method

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American standards

ASME B31.12-2023	Hydrogen piping and pipelines. ASME code for pressure piping, B31
ASTM D1072:2023	Standard test method for total sulfur in fuel gases by combustion and barium chloride titration
ASTM D1142-95(2021)	Standard test method for water vapor content of gaseous fuels by measurement of dew-point temperature
ASTM D1945-14(2019)	Standard test method for analysis of natural gas by gas chromatography
ASTM D4888-06(2006)	Standard test method for water vapor in natural gas using length-of-stain detector tubes
ASTM D5504:2023	Standard test method for sulfur compounds in natural gas and gaseous fuels by gas chromatography and chemiluminescence
ASTM D5954:2022	Standard test method for mercury sampling and measurement in gaseous fuels by atomic absorption spectroscopy
ASTM D6228-19(2021)	Standard test method for determination of sulfur compounds in natural gas and gaseous fuels by gas chromatography and flame photometric
ASTM D7800/D7800M:2023	Standard test method for determination of elemental sulfur in natural gas

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AS 4564:2025	General-purpose natural gas

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Gas (Safety and Measurement) Regulations 2010

Other legislation

Queensland Petroleum and Gas (Safety) Regulation 2018

United Kingdom Gas Safety (Management) Regulations 1996

Websites

www.legislation.govt.nz

LATEST REVISIONS

The users of this standard should ensure that their copies of the above-mentioned New Zealand standards are the latest revisions. Amendments to referenced New Zealand and joint Australian/New Zealand standards can be found on www.standards.govt.nz.

REVIEW OF STANDARDS

Suggestions for improvement of this standard will be welcomed. They should be sent to the National Manager, Standards New Zealand, PO Box 1473, Wellington 6140.

FOREWORD

The revision of this standard by Standards New Zealand Committee P4206 serves as a specification for reticulated methane-based gas. It acknowledges and accommodates blending renewable gases (such as biomethane and hydrogen) supplied to consumers, to help ensure that the gas is suitable for transportation, and safe to use in gas-burning appliances and equipment. The committee has, therefore, decided to drop the word 'natural' from the title of this standard, to reflect that blending other gases with methane-based gas in the network is an acceptable practice.

In this latest revision of the standard, Table 2 has been amended to reflect the new limit for hydrogen blending, and an informative Appendix G has been added, which gives details of what to consider when injecting hydrogen into the local distribution system (LDS) of the reticulated gas network.

While there are no specific limits on the level of biomethane that can be blended, the committee determined that blending hydrogen is restricted to injection within the LDS (< 20 barg) and limited to 10% maximum. The rationale for this requirement comes from a body of international research. The limits set by the committee are designed to remain within the range set by the Wobbe index parameters, while being consistent and aligned with hydrogen blending limitations in the latest revision of AS 4564, *General-purpose natural gas*.

This standard specifies limits for gas characteristics and components that are consistent with safely operating the existing population of appliances. It provides certainty for those who manufacture appliances for the New Zealand market, and for installers who set up these appliances. By specifying limits for contaminants, it seeks to ensure the integrity of transportation systems and prevent operating problems for most gas consumers.

Certain limits specified in this standard can be exceeded under certain circumstances without compromising safety, but this must be a matter for competent technical review, and specific to the conditions at the time. Exceeding the specification shall be accepted by the pipeline operator. Also, if a specified limit is exceeded, the pipeline operator's required access conditions and interconnection agreements shall be adhered to.

In the previous interim edition of this standard (NZS 5442 (Int):2024), biomethane test methods and frequencies were suggested. Because biomethane was introduced, the limit for oxygen was relaxed and, relatedly, the limit for water was also reduced (see Table 2).

Some gas consumers will require tighter limits on some listed or unlisted constituents, to support specific end uses (for example, to avoid poisoning catalysts). Gas consumers should meet these requirements by additional processing or through the contract with their gas supplier. Any such limits shall be technically justifiable and supported by appropriate methods to demonstrate compliance with this standard. If the limits are sufficiently general, they will be incorporated into this standard through the normal process for amending standards.

New Zealand Standard

Specification for reticulated gas

1. SPECIFICATION FOR RETICULATED GAS

1.1 Scope

This standard sets out the safety and suitability requirements for transporting methane-based gas (this includes biomethane and hydrogen); and supplying it for appliances and equipment that burn natural gas, and vehicles that are powered by natural gas.

This standard covers most uses, but additional – or more stringent – limits could be necessary to cover every requirement for specific applications.

1.2 Application

This New Zealand standard applies to all methane-based gases from these sources: natural petroleum, landfill drainage, biogas production, and coal-seam drainage. It applies when they provide gas commercially for a direct or blended supply through an open-access supply system; and when they are used in these appliances and equipment:

(a) Gas-burning appliances that comply with New Zealand's safety requirements for gas appliances and their installation;

(b) Compressed natural gas (CNG) compressors and refuelling facilities that comply with NZS 5425 Parts 1 to 4; or

(c) Vehicles powered by natural gas that comply with AS/NZS 2739.

This standard does not apply to methane-based gas supplied as a feedstock; however, it could provide a basis for such a specification.

1.3 Interpretation

For the purposes of this standard, the word 'shall' refers to requirements that are essential for compliance with the standard, while the word 'should' refers to practices that are advised or recommended.

The terms 'normative' and 'informative' are used in this standard to define how to apply the appendix they refer to. A 'normative' appendix is an integral part of a standard, while an 'informative' appendix is for information and guidance only.

This standard is supported by informative appendices that provide further information and guidance on how the requirements are derived; sources of biomethane and potential contaminants; issues to consider in contracts; and testing methods to verify compliance and alignment with gas-distribution regulations on hydrogen injection.

Where an informative appendix specifies a prescribed test procedure, the word 'shall' means that, if users elect to conduct this test it shall be undertaken exactly as set out in the appendix.

Notes to tables form part of this standard's requirements, while notes elsewhere are for information and guidance only.

Pressures are expressed as gauge pressures (barg), unless stated otherwise.

In general, ‘methane-based gas’ means any gas in the second family in the international grouping, based on the Wobbe index (see Table 1). Methane is the predominant component of these gases.

Table 1 – International families of gases

Family	Wobbe index MJ/m^3
1^{st}	22.5 – 30.0
2^{nd}	39.1 – 55.0
3^{rd}	73.5 – 87.5
NOTE – Because of special requirements that suit the existing population of appliances in New Zealand, the Wobbe index limits in this standard do not include the entire second family.	

1.4 Definitions

For the purposes of this standard, the following definitions shall apply:

Barg	The unit for measuring gauge pressure. Gauge pressure is measured against ambient pressure. Therefore, it is equal to absolute pressure minus atmospheric pressure
Biogas	A gas that is principally methane and carbon dioxide, such as gas obtained from the anaerobic digestion of organic material
Biomethane	A gas that is principally methane, which is obtained from upgrading and processing biogas to meet this standard
Calorific value	The gross (or superior) calorific value is the amount of heat, expressed in megajoules, that is generated by the complete combustion in air of 1 m^3 of gas free from water vapour. The gas, air, and products of combustion are all measured at standard conditions, and all the water formed by combustion is condensed
Gas distribution network	A network of gas pipes that is supplied with gas by the gas transmission system, from one or more gas entry points. It operates at pressures ≤20 barg . Its operator can also be called a distribution network operator (DNO) or a gas transporter. (DNO is also used for electricity distribution network operators)
Gas installation	An installation that is, or is intended to be, connected with any source (this includes any container) from which gas is supplied. It includes any associated fittings but excludes any part of a distribution system. It includes gas appliances, but excludes portable appliances that are designed to have

	their own internal, or attached, gas supply
Gas transmission system	Pipelines that transport gas from upstream gas fields (15 in the Taranaki region) to major population centres, power stations, and large industrial and commercial plants. In New Zealand, the gas transmission system operates at pressures >20 barg
Gas transportation system	New Zealand's entire gas infrastructure, used to transport gas from upstream producers to industrial, commercial, and residential consumers. It includes the gas transmission system (pipelines), compressor stations, storage facilities, and gas distribution networks
Injection point	The point at which a gas is transferred from a producer to a reticulated gas transmission system or gas distribution network
Limit	The value beyond which a component's specified characteristic or concentration shall not vary
distribution system (LDS)	Gas mains and services that supply methane-based gas directly to consumers
Off-specification gas	Gas that does not comply with the gas-quality specifications for the system injection point
Relative density	The density of dry gas relative to dry air (dry air has a density of 1.225 kg/m^3), when both are measured at standard conditions
Reticulated gas network	A grid-like or web-like ('reticulated') system of interconnected pipelines and infrastructure that distribute natural gas, or other types of gas, to homes, businesses, and industries for heating, cooking, and industrial energy. The network typically includes main supply lines and smaller local pipelines that branch out to individual properties. The 'reticulated' design ensures widespread access to gas
Off-specification gas	Gas that does not comply with the gas-quality
Selected ion flow tube mass spectrometry (SIFT MS)	A quantitative mass spectrometry technique for analysing trace gas. The technique involves chemical ionization of trace volatile compounds by selected positive precursor ions, during a well-defined time period and along a flow tube
Standard conditions	A temperature of 15°C and an absolute pressure of 101.325 kPa

Wobbe index	Expressed in MJ/m^3, the number produced when the calorific value of a gas is divided by the square root of the relative density of the same gas

1.5 Abbreviations

The following abbreviations are used in this standard.

AD	Anaerobic digestion
CNG	Compressed natural gas
EOS	Equation of state
GHV	Gross heating value
HE	Hydrogen embrittlement
SIFT MS	Selected ion flow tube mass spectrometry
SVOC	Semi-volatile organic compound
VOC	Volatile organic compound
YSI	Yield Sooting Index

2. REQUIREMENTS

2.1 Safety and suitability for transportation and use

For New Zealand reticulated gas, at the injection point the characteristics and components of a gas shall always be within the limits set out in Table 2. Table B1 sets out additional limits for biomethane.

Off-specification gas shall not be injected.

NOTE –

(1) At the point of transfer from a producer to a transmission or distribution system, details of gas characteristics and components should be measurable and available; elsewhere in the system, details should be available by transferring information between relevant parties.

(2) Blending outside the limits shall comply with the main requirement at the injection point.

Table 2 – Specification limits for New Zealand reticulated gas

Characteristic or component	Limit	
Wobbe index	Minimum Maximum	46.0 MJ/m^3 52.0 MJ/m^3
Relative density	Maximum	0.80
Oxygen – For network pressures ≤ 38 barg For network pressures > 38 barg	Maximum Maximum	1.0 mol % 0.1 mol %
Hydrogen[a] For network pressures ≤ 20 barg For network pressures > 20 barg	Maximum Maximum	10.0 mol % 0.1 mol %
Hydrogen sulphide	Maximum	5 mg/m^3
Total sulphur (as S)	Maximum	50 mg/m^3
Water	Maximum	65 mg/m^3
Hydrocarbon dew-point temperature	Maximum	2°C at 5 MPa
Temperature	Minimum Maximum	2°C 40°C

NOTE –

(1) Standard conditions apply for measuring all gas properties listed in this table, except hydrocarbon dew-point temperature.

(2) The limit for total sulphur applies after odorant addition.

(3) The Wobbe index and relative-density limits in this specification imply a calorific value range of 35.2 to 46.5 MJ/m^3.

(4) Appendix C gives suitable test methods.

(5) Oxygen concentrations may be acceptable at up to 1% for pressures above 38 barg following an appropriate risk review by the network owner, considering the extent of the network affected and the application of ongoing monitoring systems to measure free water in the network affected.

(a) Clause C2.3 gives more information on the rationale for hydrogen blending levels and what to consider when injecting hydrogen into the network.

2.2 Contaminants

The gas shall not contain materials, dust, or other solid or liquid matter; waxes, gums, or gum-forming constituents; or aromatics, to an extent that could damage or interfere with the proper operation of lines, meters, regulators, control systems, equipment, or appliances through which the gas flows.

NOTE –

(1) Compressor stations that supply gas into a gas transportation system or are used as part of a gas transportation system, should include coalescers or filters that are designed, installed, and maintained to ensure the content of compressor oil in gas that is downstream of the compressor station is no more than 20 ml/TJ. (This has been derived from Queensland Petroleum and Gas (Safety) Regulation 2018). Other than normal combustion products, the gas shall not contain substances (such as heavy metals) that cause the combustion products to be toxic or hazardous to health.

(2) Appendix A provides guidance on known contaminants form different sources, while Appendix B defines biomethane contaminants and permitted limits. These are additional to the requirements of 2.2.

3. COMPLIANCE

3.1 General

Appendix D provides guidelines on monitoring and controlling gas quality; Appendix E provides guidelines on what to consider in contracts; Appendix F provides a checklist to assess compliance with this standard; and Appendix G provides guidelines on matters related to hydrogen gas blending.

3.2 Demonstration of compliance

Compliance with the specification limits for characteristics and components listed in Table 2 and Table B1 shall be demonstrated by showing that the values do not exceed the set limits.

The reproducibility of test methods shall be considered, so there is a 95% level of confidence that the result lies within the set limits (see Appendix B).

Monitoring shall be representative of the gas quality injected and ensure it meets the requirements of this standard.

Monitoring components or contaminants (this includes components in blends) other than those listed in Table 2 and Table A1 shall be undertaken on the basis of an assessment of these risks:

(a) The likelihood that the components or contaminants are present in the gas injected; and

(b) The consequences of the components or contaminants being present in the gas injected.

This risk assessment shall be reviewed periodically, and if the source or feedstock of gas injected changes. If the risk assessment results in any changes to the schedule of verification and testing, these shall be implemented and reported to all parties without delay.

The risk assessment, and any reviews, shall be documented and made available to all interested parties.

NOTE –

(1) This standard does not prescribe methods for any specific test. However, test methods that have documented reproducibility should be used, to achieve a 95% level of confidence.

(2) Appendix A gives the risk assessment associated with biomethane.

3.3 Frequency of testing

The frequency and location of testing the value of characteristics, components, and contaminants listed in Table 2 and Table B1 shall ensure that they remain representative, and that any potential deviation from the limits will be detected if it occurs.

When setting the testing frequency, consider how accurate the testing is; the likelihood that testing will disturb processes and feedstock, and what the impact of those disturbances will be.

If a component is demonstrated to be absent or present at a very low level compared with the limits in Table 2 or Table B1, and the component is not foreseen to be produced, the testing frequency for the component can be reduced. Testing shall be undertaken following a significant change to production (for example, production from a new gas source or changes to an existing gas source), or a major change to a biogas digestate source, to confirm whether these conditions are still valid.

3.4 Quality assurance

Quality assurance procedures that ensure compliance with this standard shall be documented.

APPENDIX A – BIOMETHANE

(INFORMATIVE)

A1 General

This appendix outlines the logic for the limits in this standard. The information is for guidance only; it does not form part of the requirements of this standard.

A2 Introduction

A variety of source materials can be used to generate raw biogas. These include landfill, agricultural waste, sewage, wastewater, and biowaste. Typically, anaerobic digestion (AD) plants are designed to process one of these main groups (and, occasionally, a mixture). AD plants generate waste-specific contaminants, which should be considered, and controlled or eliminated according to this standard. In general, an AD plant will be capable of controlling or eliminating many of the contaminants, and the biogas-to-biomethane processing facility will be used to achieve the gas specification defined here, as well as ensure the integrity of the downstream reticulated gas network and, ultimately, the safe use of gas for consumers.

A3 Landfill gas

Biogas can be derived from the microbial breakdown of all domestic and industrial waste in landfill. Landfill sites contain a wide variety of waste types, including food and biodegradable waste; and recyclable and non-degradable materials (such as, paint, oils, appliances, and old furniture). Raw gas from landfill can include arsenic and carbonyls, such as aldehydes and ketones (solvents and pharmaceuticals). It can also include odiferous odorant-masking compounds, such as terpenes (including pinene and limonene). Of all waste types, biogas from landfill has the potential to contain the broadest range of contaminants, due to the diversity of its source material.

A4 Agricultural waste or energy crops

Biogas derived from the microbial breakdown of waste from farming operations is the most widely used biogas feedstock. This waste includes post-harvest crop residues (for example, stalks, straw, and plant trimmings) and, in some cases, can include an entire agricultural crop that is grown specifically for energy generation (these are known as energy crops).

This type of biogas can also include dairy, pig, and poultry manure. These types of waste source will influence the ammonia content of the biogas.

A5 Wastewater or sewage

Biogas derived from the microbial breakdown of waste from municipal wastewater-treatment plants is known as sewage waste or sludge.

Biogas from this waste material has the highest potential to contain siloxanes, which are present in hand and body washes, shampoos, conditioners, and many household cleaning products.

This type of biogas includes industrial wastewater from meat-processing plants, dairy-processing factories, pulp and paper sites, distilleries, and breweries.

A6 Food waste

Biogas can be sourced from the microbial breakdown of waste that was intended for human consumption, but, for various reasons, was not eaten. This can happen during food production, processing, distribution, or retail; during the sale of food services; or when household food is not used. This type of waste can be sourced from domestic, industrial, and commercial properties.

Biogas produced from food waste is typically most free of potential contaminants, if the food waste material is separated from other waste.

Table A1 shows the components that are most likely to be found in 'raw' biogas, relative to the source of that biogas. This table lists areas that can be affected by the components (such as, human health; the environment; and existing gas infrastructure, including gas appliances).

Table A1 – Likely components in biogas, and their potential concentration[a], by source

Likely components	Source				Potential impact
	Landfill	Agriculture	Wastewater	Food	
Hydrogen sulphide	🟥	🟥	🟥	🟧	Human health, environment, pipeline system performance
Carbon dioxide	🟥	🟥	🟥	🟥	Environment
Total sulphur	🟥				Pipeline system performance
Water	🟧			🟧	Pipeline corrosion
Oxygen	🟥	🟧	🟥	🟧	Pipeline corrosion
Hydrogen	🟧				Pipeline integrity
Ammonia	🟧	🟧	🟧		Environment
Mercury	🟧		🟧		Human health
Arsenic	🟧				Human health
Volatile organic compounds (VOC)	🟥		🟥		Human health, environment
Semi-volatile organic compounds (SVOC)	🟥	🟧		🟧	Human health, environment, odorant masking
Aromatics	🟥				Human health
Halocarbons	🟥		🟥		Environment
Siloxanes	🟥		🟥	🟧	Appliance performance, environment

Red – Potentially high concentration in biogas

Orange – Potentially moderate concentration in biogas

White – Potentially negligible concentration in biogas

NOTE –

(1) Volatile organic compounds (VOCs) include alcohols and aromatics such as benzene, toluene and xylene.

(2) Semi-volatile organic compounds (SVOCs) include food preservatives, pesticides, limonene, and pinene.

(3) Halocarbons include solvents, pesticides, refrigerants, adhesives, plastics, and halogens fluorine and chlorine gas.

APPENDIX B – BIOMETHANE (CONTAMINANTS)

(NORMATIVE)

B1 General

In addition to the requirements of Table 2. Table B1 shows the contaminant limits (maximum values) that apply to biomethane at the injection point.

Table B1 – Additional specification limits for biomethane

Contaminant	Gas-quality limit	Initial sample – test frequency and method	Target sample – test frequency and method
Ammonia	10 mg/m^3	Batch testing[a]	Batch testing[b]
Heavy metals		Batch testing[a]	Batch testing[b]
Mercury	0.001 mg/m^3		
Arsenic	0.050 mg/m^3		
VOCs		Batch testing[a]	Batch testing[b]
Toluene	188 mg/m^3		
Xylene	217 mg/m^3		
SVOCs		Batch testing[a]	Batch testing[b]
Limonene	100 mg/m^3		
Halogens		Batch testing[a]	Batch testing[b]
Fluorine	5.0 mg/m^3		
Chlorine	1.5 mg/m^3		
Siloxanes	0.23 mg of Si/m^3	Batch testing[a]	Batch testing[b]

NOTE –

[a] Monthly, until two successive analyses suggest the risk is low enough to change to quarterly.

[b] Quarterly, until two successive analyses suggest the risk is low enough to change to six-monthly.

B2 Risk assessment

When considering the quality of gas that a new biogas facility will generate, use Table B1 to identify the risks of introducing contamination from the intended sources of waste material. This will allow each risk to be considered, so that necessary mitigations can be introduced to achieve the defined gas-quality limits for the gas transportation system and safe consumer use.

During pre-injection testing, when specific contaminants are demonstrated to be absent their contaminant tests can be removed from the ongoing test plan. However, as biogas source materials are subject to regular change, the presence of these excluded contaminants should be checked annually. If they are found to be present at an above-negligible level, they should be included in the future test plan at the frequency stated in Table B1 (see 3.2).

Initial sample tests are required from the point when a gas is first injected into a network. The frequency of initial-sample testing can be reduced to target-sample test frequency when contamination levels are consistent and within the limits in Table 2 and Table B1.

Target-sample testing is a reduced testing regime that can be introduced if initial-sample tests demonstrate that contamination levels from the biomethane source remain within the limits for at least two successive analyses.

If target-sample tests – at any time – show that the biomethane contaminants exceed the set limits for two successive analyses, the test frequency shall revert to the initial-sample frequency (monthly). This test frequency shall continue until the biomethane contaminants comply with the set limits for at least two successive monthly analyses.

A change, of any magnitude, to the biogas source materials can change the biomethane contamination levels. This could be a reason to revert to initial-sample test frequencies until a consistent gas quality is achieved.

APPENDIX C – DERIVATION OF SPECIFICATIONS USED IN THIS STANDARD

(INFORMATIVE)

C1 Background

This appendix outlines the rationale for the limits for the existing reticulated gas network, which are set out in this standard. This information is for guidance only.

The requirements in this standard are similar to New Zealand contract specifications for natural gas, in that the primary criterion is the Wobbe index and its stated limits. Historically, this standard's requirements have been based on the quality specifications in the original supply contract for Maui gas, which was the main source of reticulated gas in New Zealand. However, as Maui gas is less dominant today, this standard has been extended to cover methane-based gases, reflecting the increasing use of gas from other oil and gas fields (this includes gas extracted from landfill and other biogas sites).

From what is known about the composition of wellheads, all New Zealand's petroleum-based gas fields appear to contain ordinary natural gases. To retain a flexible gas supply, there has been no attempt to detail the composition of gas beyond compounds that are normally regarded as gas contaminants and have a detrimental effect on gas properties.

This standard is intended to cover only gases in which methane is a predominant component. More detailed limits on gas composition would be needed, if other gases (such as, liquefied petroleum gas or air, or synthetic natural gas) were to be included in the reticulated gas network.

In general, the limits in this standard are consistent with overseas practice, although they are not based on overseas specifications except when noted in this appendix. Most countries that New Zealand obtains gas appliances from design their appliances for gases that are within the range stated in this standard.

C2 Limits

C2.1 General

In any natural gas specification, a balance is needed between optimum gas performance, which requires the narrowest possible combustion limits, and cost of supply. If possible, the cost of supply is not limited, so that any available gas can be used. To achieve the best balance, this standard sets the limits as wide as possible. The point is to maintain safe combustion in gas-burning appliances that are designed to use methane-rich gases. If a gas falls outside safety and performance limits, both may be compromised.

C2.2 Oxygen

This standard allows a maximum oxygen concentration of 0.1 mol % (as O_2) in the transmission system (operating at > 38 barg). However, this is relaxed to 1.0 mol % if the gas is transported only through networks that operate at pressures up to 38 barg. These limits minimise the corrosion of steel in high- and intermediate-pressure pipelines, but allow gases (such as, landfill gas) to be transported through distribution networks that are predominantly plastic. This change is justified by international evidence that oxygen concentration increases by up to 1% in steel pipelines operating at pressures up to 38 barg. However, increasing the allowable oxygen concentration could accelerate steel corrosion, if water is present in the gas. To counter this risk, the allowable water limit has been reduced from 100 mg/m^3 to 65 mg/m^3.

C2.3 Hydrogen

Hydrogen atoms can enter and permeate the walls of steel pipelines. Adsorbed hydrogen can have numerous degradative effects. In steel, the most common degradative effect is hydrogen embrittlement (HE). HE can lead to subcritical cracking, reduced ductility, reduced strength, and unexpected fracture.

While hydrogen will embrittle all steel pipelines, pipelines that operate at high pressures face the highest risk of premature failure, due to the internal pipeline hoop stresses acting on the steel. For this reason, this standard sets the limit for hydrogen blending to 10% for pipe systems that operate at up to 20 barg, while the limit of 0.1% remains for pipe systems that operate above 20 barg.

Ongoing research seeks to establish whether higher pressure systems could allow higher hydrogen concentrations, but this work has not yet been published.

Adding hydrogen will, correspondingly, reduce the Wobbe number of the blended gas, which must also meet the requirements of this standard.

Substantial research into the performance of older and new gas appliances in Australia has confirmed that the hydrogen limits in this standard are appropriate for existing gas appliances to continue operating safely.

The limit in this standard is based on the level imposed in Australia and associated Australian research.

NOTE – For more information on HE, refer to NZS TS 19883:2025, 5.3.2.2.

C2.4 Hydrogen sulphide

The limit on hydrogen sulphide in gas is necessary because it has a corrosive effect on copper. Also, in the presence of water and at high pressures, hydrogen sulphide can cause corrosion in different types and levels of high-tensile steel.

C2.5 Total sulphur

The maximum permitted sulphur concentration in gas is 50 mg/m^3, which includes sulphur from odorisation of gas. At desired odorisation levels, odorisation contributes approximately 6 mg/m^3 of sulphur with common odorants. In New Zealand, with widespread use of flueless heating and increasing awareness of air quality, it is desirable to keep the sulphur content of methane-based gases low.

Some petrochemical processes require significantly lower limits on sulphur in gas. In these cases, gas would be unodorised and specific limits would need to be set in relevant supply and transport contracts.

C2.6 Water vapour

The main concern about water content in gas is the risk of hydrate formation in CNG equipment, particularly during refuelling. When combined with hydrogen sulphide and carbon dioxide, water can also lead to stress corrosion cracking and HE. To avoid saturating CNG, and the consequent risk of hydrate forming at temperatures above 0°C, the water content should not exceed the stated limit. Most countries control water content by dew point at a specific pressure.

C2.7 Total halogens

Many trace gas compounds in gas do not affect the operation of gas equipment or the combustion process. Apart from compounds that contain sulphur, one exception is compounds that contain halogens (such as, chlorine, fluorine, or bromine). These compounds harm equipment and, in the case of unflued gas appliances, can harm health. The halogen limits for fluorine and chlorine in Table B1 are introduced, principally, for gas produced from landfill and biogas. Halogens are not normally found in significant quantities in gas of petroleum origin, so they are not in the limits for petroleum-based gases (see Table 2).

C2.8 Hydrocarbon dew point

The hydrocarbon dew point is controlled by limiting the quantity of heavy hydrocarbons in the gas (C3 upwards). Heavy hydrocarbons are a concern because, at the high pressure used in gas transmission and CNG storage, heavy hydrocarbons can condense at low temperatures. During normal operations, vehicle CNG cylinders can go below 0°C and cascade cylinders can be subjected to freezing conditions.

C2.9 Temperature

The temperature of gas entering a system can adversely affect the life of plastic pipelines or the coating on steel pipelines. If the gas temperature exceeds a reasonable limit at the custody transfer point, it can be inconvenient and expensive for gas transporters.

The temperature of gas entering a pipeline should not exceed the limits in this standard, unless specific measures have been taken that allow for this.

C3 Combustion characteristics

The purpose of a gas specification is to ensure that the gas it describes is suitable for appliances that the gas supplies. If the gas is unsuitable, combustion will be unsatisfactory. This will be evident by flame abnormalities (these include flame lift, light back, yellow tipping, sooting, and incomplete combustion). Flame abnormalities depend strongly on the Wobbe index, and less on the composition of the gas.

Research on natural gas interchangeability focuses on how higher hydrocarbons (such as, ethane, propane and butane) improve combustion stability. These hydrocarbons enhance flame stability, increase blow-off velocity, and widen the flame-stability range, particularly in lean-fuel regions. For most burners using recirculation, these benefits outweigh the less favourable transport properties. However, for laminar jet-nozzle burners, heat-transfer properties are more significant.

Nitrogen and carbon dioxide both reduce the stabilisation quality of the flame, although the effect of carbon dioxide is stronger. If a burner has inferior flame stabilisation, its thermal capacity will be directly affected by any deterioration in the quality of natural-gas stabilisation that comes with increased nitrogen content. On the other hand, if a burner has good flame stabilisation, its thermal capacity will be reduced only by the same proportion as the lower calorific value of the fuel−air mixture (this is a much smaller reduction than for a burner with inferior flame stabilisation).

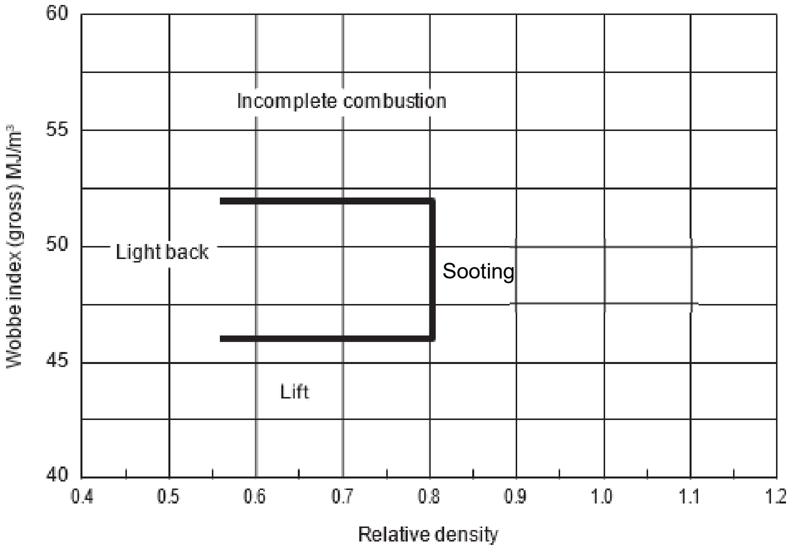
The composition of natural gas affects all its properties, some of which can be used as indicators of composition. Most overseas specifications include limits on calorific value. While calorific value can be an indicator of composition, it is not ideal because inert gases decrease the calorific value while higher hydrocarbons increase it. As a result, the two can cancel each other out.

The most direct assessment of flame abnormality is the various combustion indices and prediction diagrams that have been developed from natural gas interchangeability studies in several countries over the past 70 years. In general, overseas gas transportation systems that have been studied are too complex for a gas specification, which needs simple requirements and ways to test compliance. There is also a risk that including such methods in a specification could lead to them becoming contractual obligations, which could lock assessment into methods that become outdated when improved ways to predict interchangeability become available.

When the original standard was developed in 1990, a study of available interchangeability information was carried out. This revealed that relative density is more relevant to predicting flame abnormality than previously realised. When relative density is combined with the Wobbe index, it will sufficiently delineate the suitability of natural gas, to ensure freedom from flame abnormality in appliances that are set up to appropriate standards, usually test gases.

Of the other potential parameters that could be included in this standard, the Yield Sooting Index (YSI), proposed by Dutton (1984), was closely examined. This index was shown to be unnecessary, as all practical gases in the Wobbe index and relative-density limits have lower YSI values than most relevant test gases. However, the European Union uses the sooting test gas G21, which has a marginally lower YSI value than gases allowed by this standard.

With the Wobbe index limits adopted in this standard, the maximum advisable relative density is 0.80. Figure C1 shows the relationship between this limit, the Wobbe index limits, and gas properties. This diagram is sufficient to assess the suitability of all ordinary natural gases, but it should be used cautiously for gases that have a high hydrogen or carbon monoxide content. This is because hydrogen and carbon monoxide, not being members of the second family of gases (see Table 1), show the greatest deviation from the proportionality of the stoichiometric combustion air requirements with the heating value.



NOTE –

(1) Refer to Table 2 of this standard for Wobbe index and relative density limits.

(2) Refer to NZS 5266 (Appendix C – Table C2) for the specification of test gases relevant to this figure. Table C3 gives indicative test gas compositions and properties for appliance testing

Figure C1 – Gas limits and flame characteristics

APPENDIX D – QUALITY MONITORING AND DEMONSTRATION OF COMPLIANCE WITH THIS STANDARD

(INFORMATIVE)

D1 Purpose

This appendix provides guidance on how to demonstrate compliance with the specifications in this standard. It includes test methods, means of testing, and test frequencies. Other test methods can be used, but the listed recognised standards are the default.

D2 Test methods

Table D1 sets out the methods that should be used to identify characteristics and components of methane-based gases and confirm they comply with this standard's requirements (see Table 2). The names and parts of the suggested standards in Table D1 are listed in Referenced documents.

Table D1 – Methods to test the specification limits for New Zealand reticulated gas

Characteristic or component	Condition	Range of application for test method		Suggested test method or standard
		Low	High	
Wobbe index				ISO 6974 & ISO 6976
Calorific value				ISO 6975 & ISO 6976
Relative density				ISO 6976
Oxygen		0.001%	0.5%	ISO 6974 & ISO 6975
		0.007%	5.0%	ISO 6974.6
		0.01%	20.0%	ASTM D1945-14
Hydrogen		0.001%	10.0%	ISO 6974, ISO 6975 & ASTM D1945-14
		0.001%	10.0%	
Hydrogen sulphide		0.1 mg/m^3	100.0 mg/m^3	ISO 11626
Total sulphur (as S)		0.5 mg/m^3	1000.0 mg/m^3	ASTM D1072, ASTM D6228:19 & ASTM D7800/D7800M
Water	If the concentration of sulphur compounds in the gas is less than 20% of the water content	5.0 mg/m^3	5000 mg/m^3	ISO 10101 & ASTM D5504
	If pressure is more than 1 MPa		10 mg/m^3 or more	ISO 11541
	If the calculation is for water vapour content based on dew-point measurement			ASTM D1142-95
	If water vapour content is up to 40 mg/L			ASTM D4888-06
Hydrocarbon dew point				ISO 6975 with an appropriate equation of state

NOTE –

(1) In addition to the standards listed, guidance is provided in ISO 5725.1. As standards are subject to revision, the most recent edition should always be used.

(2) More appropriate test methods should be used when they become available, provided that the test results are known to be accurate and reproducible.

Table D2 highlights known contaminants that can appear in biomethane relative to the source of biogas. It identifies recognised test methods and techniques, and associated standards.

Table D2 – Biomethane contaminants

Characteristic or component	Suggested test method or standard
Ammonia	Selected ion flow tube mass spectrometry (SIFT MS)
Arsenic	SIFT MS
Chlorine	ISO 2611.1
Fluorine	ISO 2611.1
Limonene	ISO 2614 or SIFT MS
Mercury	ISO 6978.2 or ASTM D5954
Siloxane	ISO 2613, ISO 2620, or SIFT MS
Toluene	ISO 2620 or SIFT MS
Xylene	ISO 2620 or SIFT MS
NOTE – (1) For more information on biomethane, see Appendix A. (2) For more information on gas-quality contaminant limits, see Table A1.	

D3 Confidence levels

To show compliance with this standard, it is not necessary to determine a property's absolute value; it is necessary to demonstrate that the limit is not breached at a 95% confidence level. This confidence level is applied to individual measurements, and recommended test frequencies (see D4) are then used to demonstrate overall compliance. It is not necessary to include the test frequency in the statistical demonstration of compliance.

For any established analytical or test method, the reproducibility should be known. This is normally expressed as error bounds on the determined value. These bounds mean there is a 95% probability that the real value will lie within the range given by the measured value, plus or minus the error. When comparing a test result with a specification limit, this statistical feature should be appropriately recognised.

In the absence of any other source of information on the true value of a characteristic, a single result from a method with a reproducibility, R, shall be considered to meet the specification limit with 95% confidence, but only if the result, X, meets these conditions:

(c) In the case of a single limit (upper limit A_1 or lower limit A_2), $X \leq A_1 - 0.95\ R$ or $X \geq A_2 + 0.95\ R$, or

(d) In the case of a double limit (upper limit A_1 and lower limit A_2), $A_1 - 0.71\ R \geq X \geq A_2 + 0.71\ R$.

The measured value determined by a low-accuracy method shall be lower than one determined by a high-accuracy method, to satisfy a limit in the standard with 95% confidence.

No specific test methods are stipulated to demonstrate compliance with this standard.

However, only methods of known reproducibility are acceptable. The reproducibility could be that stated in the standard, or that determined by statistical analysis of laboratory results.

ISO 4259 discusses reproducibility and other statistical attributes of test results.

D4 Quality monitoring and test frequencies

D4.1 General

D1 to D3 provide guidance on which test methods to use and how to ensure that individual measurements demonstrate compliance with the limits in this standard. The test frequency should be sufficient to be reasonably certain that a test will detect off-specification gas in a timely manner.

When continuous test frequency is recommended (see Table D3), this should be interpreted to mean an 'online' instrument that continuously samples and measures the gas stream. These instruments, particularly gas chromatographs, take time to complete the analysis (typically 5 to 10 minutes). Therefore, 'continuous' means that the instrument is continuously online, not that it is reporting measurements at a high frequency.

Table D3 shows recommended test frequencies. Operators should set test frequencies based on steady-state operations and increase the frequency during any abnormal or new situations (for example, when commencing production from new gas reservoirs (petroleum-based sources) or changing feedstocks (biomethane sources)). Normally, new gas reservoirs are interpreted to be any new source within a new reservoir, rather than additional perforations or infill drilling into existing reservoirs. If there is any doubt about whether the source is 'new', undertake additional testing.

Table D3 – Recommended test frequencies

Characteristic or component	Recommended test frequency for petroleum-based gas	Recommended test frequency for biomethane
Wobbe index	Continuous	Continuous
Relative density	Continuous	Continuous
Oxygen	See D4.1	Continuous
Hydrogen	See D4.2	See D4.2
Hydrogen sulphide	Low H_2S sources – annual (see D4.3)	Low H_2S sources – annual (see D4.3)
	High H_2S sources – continuous	High H_2S sources – continuous
Total sulphur (as S)	See D4.4	See D4.4
Water	Continuous	Continuous
Hydrocarbon dew point	Continuous – see D4.5	Annual – see D4.5
Temperature	Continuous	Continuous

Fiscal metering of the gas requires the composition to be continuously measured, to calculate the gross heating value (GHV) and relative density. As the Wobbe index is derived from GHV and relative density, using them as the instruments for fiscal metering normally achieves continuous measurement of all characteristics and components in Table D3.

D4.2 Oxygen

Oxygen is not normally present in petroleum-based gases. When it is, the most likely source is from facilities while they are restarted after maintenance activities. Operators should have robust procedures to purge equipment of oxygen before it is restarted. An auditable record of purging before facilities are restarted is a suitable alternative to installing continuous monitoring.

D4.3 Hydrogen

Hydrogen is not normally present in biogas or petroleum-based gas in New Zealand. An initial test to confirm the absence of hydrogen should be performed. If the test shows it is absent, further testing is only required after changing to a new gas source.

D4.4 Hydrogen sulphide

The concentration of hydrogen sulphide in petroleum reservoirs is normally stable, but it can increase with reservoir souring (for example, if water is injected for pressure support, or from a water flood. On the other hand, the concentration of hydrogen sulphide in biogas can vary, depending on how it is produced.

To set the test frequency, measure the hydrogen sulphide concentration. If the concentration among all producing sources is significantly below 75% of the limit, continuous monitoring is not required. Instead, a test frequency (typically annual) can be set. Review this frequency and complete additional tests, if new production sources are introduced.

If the hydrogen sulphide concentration is significant (≥ 75% of the limit), continuous monitoring is recommended.

If the gas processing includes technology to remove hydrogen sulphide, continuous testing is required.

D4.5 Sulphur

The total sulphur measurement includes sulphur from odorisation. Operators that odorise gas should ensure that testing for total sulphur is suitable (typically it will be continuous). In unodorised gas, the presence of sulphur contaminants is normally set by the hydrogen sulphide concentration. In these cases, testing can be for hydrogen sulphide (see D4.3). However, the assumption that no other significant sulphur compounds are present should be demonstrated by an initial test, and additional tests performed if new production sources are introduced.

D4.6 Hydrocarbons

Hydrocarbon dew point shall be continuously monitored for petroleum-based gases. This can be done through a specific instrumented test (for example, chilled mirror), or by calculating an appropriate thermodynamic equation of state (EOS) based on the composition, which is measured by a gas chromatograph. If the EOS method is used, a full uncertainty analysis should be completed. This analysis should be based on the precision or uncertainty of the gas chromatograph and the calibration gas, in accordance with D3. A Monte Carlo analysis is recommended for this purpose.

The dew-point calculation is very sensitive to the EOS, so the EOS should be carefully chosen and calibrated against field measurements (chilled mirror). This calibration is important to demonstrate that the chosen EOS is valid. The Peng-Robinson EOS is a good choice for petroleum-based gases.

The dew point is very sensitive to heavy-end (C6+) components. Therefore, a gas chromatograph that measures up to C9+ or C12+ is preferable to a C6+ instrument.

If a C6+ instrument is chosen, use laboratory analysis to determine the split of the C6+ fraction into heavier hydrocarbons to calculate the dew point. The dew point needs to be regularly checked and updated. The uncertainty analysis and confidence-interval calculation should include the uncertainty introduced by characterising the C6+ fraction.

Monitoring the hydrocarbon dew point for biomethane can be undertaken annually, as biomethane is not expected to contain higher hydrocarbons (more than methane), in any significant quantity.

D5 Notifications

D5.1 Purpose

Relevant parties should be notified, as soon as practicable, about any significant risk related to a non-specification gas that is being delivered. Notification will allow relevant parties to take appropriate action, to avoid such deliveries or minimise the adverse consequences of them.

D5.2 Characteristics and components

When a party in the supply chain considers there is a significant risk that a characteristic or component is outside the limits in Table 2, that party should notify the pipeline operator as soon as practicable. The pipeline operator should assess the information and initiate any necessary further action as soon as practicable.

D5.3 Contaminants

If a party in the supply chain detects any contamination, they should notify the pipeline operator as soon as practicable. The pipeline operator should assess the information and initiate any necessary further action as soon as practicable.

D6 Off-specification-gas events

D6.1 Definition

If a characteristic or component cannot be maintained within the limits specified in Table 2 (see D5.2), or the pipeline operator determines that contamination could create a significant risk (see D5.3), the pipeline operator should give notice of an off- specification-gas event.

D6.2 Safe operation

If a pipeline operator gives notice of an off-specification-gas event, gas producers, pipeline operators, gas wholesalers, gas retailers, and gas consumers should take prompt action to maintain safe levels of operation when transporting gas and installing gas appliances. This could mean gas producers have to curtail the flow of gas into the transportation system, or gas suppliers have to curtail the supply of gas to consumers, if it is not suitable for use.

D6.3 Response

All parties should have a documented plan for responding to off-specification-gas events. These should include a mechanism to inform all affected parties (this includes consumers), implement corrective actions, take other precautions to reduce the possibility of incidents, and coordinate with emergency services.

APPENDIX E – MATTERS FOR CONSIDERATION IN CONTRACTS

(INFORMATIVE)

E1 General

This appendix mentions matters that are outside the scope of this gas specification but can be relevant to consider in gas-transportation and gas-supply contracts.

E2 Rate of change

When a gas will be used in equipment that is sensitive to changing characteristics (such as gas turbines, industrial boilers, and ovens), the rate that the gas's calorific value can change should be limited at the consumers' supply points.

E3 Verification of composition

Verifying the characteristics and components of a gas should consider these matters:

(a) The frequency that compliance needs to be verified;

(b) Agreements between parties on exchanging the results of tests;

(c) The period that test results need to be kept;

(d) Fundamental changes to the feedstock; and

(e) Any operational changes that have affected the gas output.

APPENDIX F – AUDIT CHECKLIST

(INFORMATIVE)

F1 General

Table F1 can be used as a checklist to demonstrate or assess compliance with this standard. All responses to questions in the checklist should be supported by appropriate documentation.

Table F1 – Checklist of NZS 5442:2025 requirements

Topic	Question or requirement	Response or comment	Has the objective been achieved?	How has the objective been achieved?	How has the achievement been assessed?
Demonstrating compliance	Has compliance with the requirements in 2.1 been demonstrated?				
	Has compliance with the requirements in 2.2 and section 3 been demonstrated?				
	How frequently has information been provided on compliance?				
Testing	Are appropriate test methods used to determine characteristics?				
	Is the testing frequency appropriate?				
Competency	Are those involved in testing gas quality competent?				
	Are those who interpret the test results competent to do so?				
Managing off-specification-gas events	Are procedures in place to notify the pipeline operator when gas characteristics are outside the limits in Table 2 or Table B1?				
	Are procedures in place to respond to situations when gas characteristics are outside the limits in Table 2 or Table B1?				
	Are procedures in place to notify the pipeline operator of a situation where a gas contains other contaminants?				
	Are procedures in place to respond to situations where a gas contains other contaminants?				
Documenting compliance	Is documentation available to confirm compliance with this standard?				
	Who receives the documentation to confirm compliance?				
	Is documentation of compliance kept for an appropriate period?				
Assuring the quality of compliance	Are processes in place to assure the quality of compliance?				

APPENDIX G – HYDROGEN

(INFORMATIVE)

G1 Alignment of gas-distribution standards

Regardless of the source of high-purity hydrogen, blending it within the existing reticulated gas network should align with existing joint standards. At pressures >10.5 barg, AS/NZS 2885 series for gas pipelines and liquid petroleum should be adhered with. At pressures ≤10.5 barg AS/NZS 4645 series for gas distribution networks shall be adhered with.

Pipeline operators should ensure that pipelines conform with generally accepted and appropriate industry practice. As no relevant New Zealand or Australian standard exists for hydrogen pipelines, operators could use ASME B31.12 as a benchmark for hydrogen, or a new, approved international standard that is published in future. The standard selected should be compared with the AS/NZS 2885 series, to identify and address any areas that the standard does not adequately cover.

The P4206 Committee understands that AS/NZS 2885 and AS/NZS 4645 are being or will be reviewed during the 2025/26 fiscal year.