SIRIM STANDARD

SIRIM xx:202x

ICS: 27.190, 75.160.30

Specification of biomethane for injection into natural gas pipeline

SIRIM Berhad

SIRIM STANDARD

SIRIM Berhad is a premier total solutions provider in quality and technology innovations that helps industries and businesses to compete better through every step of the business value chain.

SIRIM Berhad is the centre of excellence in standardisation, facilitating industries and businesses in enhancing their production and competitiveness, protecting consumers' health and safety, and giving them the choice for quality products and services.

As a standards development organisation, SIRIM Berhad has extensive expertise in standards research and consultancy which helps industries and businesses to meet local and international requirements and practices, through the development of SIRIM Standards.

SIRIM Standards are developed according to SIRIM standardisation procedures, which are in line with international practices that ensure appropriate notification of work programmes and participation of interested parties. SIRIM Standards are developed through consensus by committees, which consist of experts in the subject matter. The use of SIRIM Standards is voluntary, and it is open for adoption by regulators, government agencies, associations, industries, professional bodies, etc.

For further information on SIRIM Standards, please contact:

Standards Department
SIRIM Academy Sdn Bhd
(Company No. 448249 - A)
1, Persiaran Dato' Menteri
Section 2, P.O. Box 7035
40700 Shah Alam
Selangor Darul Ehsan
MALAYSIA

Tel: 60 3 5544 6089/6088

Email: standards@sirim.my
http://www.sirimacademy.my

Contents

Foreword

This SIRIM Standard was developed by the Project Committee on Biomethane established by SIRIM Berhad.

This standard was developed with the objective of ensuring the quality, safety, and compatibility of biomethane with the existing natural gas infrastructure. By setting clear quality parameters, this standard will facilitate the seamless integration of biomethane into the energy mix, promoting its use as a clean and sustainable fuel source. Additionally, this standard will set the development of a robust and transparent biomethane market.

This standard will be reviewed periodically, and revised if necessary, to ensure that it reflects current needs and conditions. Users and other interested parties may submit comments on the contents of this standard for consideration in future versions.

Compliance with this standard does not by itself grant immunity from legal obligations.

Specification of biomethane for injection into natural gas pipeline

1. Scope

This standard specifies the minimum requirements for the quality and composition of biomethane intended for injection into natural gas pipelines at the injection point. Biomethane transported via virtual pipeline is not covered in this standard.

This standard may also be applied to synthetic methane or e-methane.

2. Normative references

The following normative references are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the normative reference (including any amendments) applies.

Gas Supply Act 1993 and Gas Supply Regulations 1997

ISO 13443, Natural gas - Standard reference conditions

ISO 6976, Natural gas - Calculation of calorific values, density, relative density and Wobbe index from composition

ISO 15971, Measurement of calorific value and Wobbe index of natural gas - Energy determination

ISO 6974 series - Natural gas - Determination of composition with defined uncertainty by gas chromatography

ISO 6974-3 - Part 3, Determination of hydrogen, helium, oxygen, nitrogen, carbon dioxide and C1 to C8 hydrocarbons using two packed columns

ISO 6974-5 – Part 5, Determination of nitrogen, carbon dioxide and C1 to C5 and C6+ hydrocarbons for a laboratory and on-line measuring system using three capillary columns

ISO 6974-6 – Part 6, Determination of hydrogen, helium, oxygen, nitrogen, carbon dioxide and C1 to C8 hydrocarbons using three capillary columns

ISO 6327, Gas analysis - Determination of the water dewpoint of natural gas - Cooled surface condensation hygrometers

ISO 18453, Natural gas - Correlation between water content and water dewpoint

ISO 6326-1, Gas analysis - Determination of sulfur compounds in natural gas - Part 1: General introduction

ISO 6326-3, Gas analysis - Determination of sulfur compounds in natural gas - Part 3: Determination of hydrogen sulfide, mercaptan sulfur and carbonyl sulfide by potentiometry

ISO 6326-5, Gas analysis - Determination of sulfur compounds in natural gas - Part 5: Lingener combustion method

ISO 19739, Natural gas - Determination of sulfur compounds - Gas chromatographic method

ISO 16017-1, Indoor, ambient and workplace air - Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography- Part 1: Pumped sampling

ISO 6975, Natural gas - Extended analysis - Gas-chromatographic method

ISO 17179, Stationary source emissions - Determination of the mass concentration of individual gaseous organic compounds- Ion chromatography method

ISO 21877, Natural gas and biomethane - Determination of siloxanes and volatile methylsiloxanes - Gas chromatography-mass spectrometry method

ASTM D1945, Standard Test Method for Analysis of Natural Gas by Gas Chromatography

ASTM D1142, Standard Test Method for Water Vapor Content of Gaseous Fuels by Measurement of Dew-Point Temperature

ASTM D5454, Standard Test Method for Water Vapor Content of Gaseous Fuels Using Electronic Hygrometers

ASTM D5504, Standard Test Method for Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence

ASTM D6667, Standard Test Method for Determination of Total Volatile Sulfur in Gaseous Fuels by Ultraviolet Fluorescence

ASTM D8455, Standard Test Method for Determination of Individual Volatile Siloxanes in Biogas and Biomethane by Sorbent Tube Thermal Desorption Gas Chromatography-Mass Spectrometry

ASTM D6919, Standard Test Method for Determination of Dissolved Alkali and Alkaline Earth Cations and Ammonium Ion in Water and Wastewater by Ion Chromatography

MS 2392-2, Natural gas - Determination of composition with defined uncertainty by gas chromatography - Part 2: Uncertainty calculations

MS 2066, Natural gas - Determination of hydrogen sulfide, mercaptan sulfur and carbonyl sulfide by potentiometry

MS 1867, Natural gas - Determination of sulfur compounds -Lingener combustion method

VDI2467 Blatt 2, Measurement of the concentration of Primary and Secondary Aliphatic Amines by High-Performance Liquid Chromatography (HPLC)

3. Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

3.1 Biogas

Gas, consisting mainly of methane and carbon dioxide, obtained from the anaerobic digestion of biomass.

[ISO 14532:2014, 3.18]

3.2 Biomass

Material of biological origin, excluding material embedded in geological formations and transformed to fossil.

[ISO 14532:2014, 3.19]

3.3 Biomethane

Gas comprising principally methane, obtained from either upgrading of biogas or methanation of bio-syngas.

[EN 16723-1:2016, 3.3]

3.4 Bio-syngas

Gas comprising principally carbon monoxide and hydrogen, obtained from the gasification of biomass.

[EN 16723-1:2016, 3.4]

3.5 Natural gas

A mixture of hydrocarbons and small quantities of non-hydrocarbons, existing in the gaseous phase at a given temperature and pressure, in which methane is the main constituent.

[ISO 14532:2014, 3.1]

3.6 Odourisation

Addition of odourants to a gas to aid detection of leaks.

[ISO 14532:2014, 3.51]

3.7 Upgrading of biogas

Process of removing carbon dioxide and contaminants from biogas to produce biomethane.

[EN 16723-1:2016, Note]

3.8 Virtual pipeline

Method of transporting gas without using physical pipeline infrastructure. The gas is either compressed or liquefied and then transported via trucks, ships, or rail to its destination.

3.9 Water dew point temperature

Temperature at which water vapour is saturated at a given pressure.

[ISO 14532:2014, 3.40]

4. General requirements

4.1 Biomethane and blends of biomethane and natural gas to be injected into the natural gas pipeline shall be free from any constituents or impurities other than those described in this standard, and shall comply with the requirements of the *Gas Supply Act 1993 (Act 501)*, *Gas Supply Regulations 1997* and any other applicable local laws or regulations.

4.2 The technical specifications of biomethane and blends of biomethane and natural gas at the injection point into the pipeline and the related test methods are specified in Table 1. Biomethane injected into the pipeline shall be fully interchangeable with natural gas in the network and comply with the operational requirements of the receiving pipeline. The injected biomethane shall not constitute impurities exceeding the limits as specified in Table 1.

4.3 The producer of biomethane (or the injection facility operator) shall be responsible for upgrading and conditioning biomethane to meet the quality specifications in Table 1 of this standard prior to injection.

NOTE. A formal agreement (e.g., Grid Injection Agreement or Supplemental Gas Supply Agreement) may be in place between the biomethane producer and the pipeline operator. This agreement may be used to define the technical and commercial terms of injection, including gas quality specifications, maximum injection volume/flow rates, pressure requirements, odourization, shutdown procedures, gas sampling protocols, data sharing, and liability for off-spec gas.

4.4 Tolerances to the specified limit values may be established by mutual agreement between the supplier, pipeline operator, and other relevant parties. Such tolerances shall not compromise pipeline integrity, safety, or compliance with applicable legal and regulatory requirements.

4.5 All biomethane production, upgrading, and injection facilities shall comply with the relevant laws and regulations.

4.6 While the primary focus of this standard is on gas quality, producers are strongly encouraged to obtain sustainability certification for their biomethane production site to demonstrate greenhouse gas (GHG) emissions savings and sustainable feedstock sourcing.

NOTE. Sustainability certification bodies include International Sustainability and Carbon Certification (ISCC) or equivalent.

5 Quality Requirements

5.1 Biomethane injected into the pipeline shall meet the quality requirements in Table 1 and the additional notes thereafter.

5.2 Unless otherwise stated, all volumes are for the real dry gas at 15 °C and 101.325 kPa in accordance with ISO 13443 Standard Reference Conditions.

5.3 Unless otherwise stated all calorific values are for the real dry gas at 15 °C (combustion) and 15 °C and 101.325 kPa (metering) in accordance with ISO 13443 Standard Reference Conditions.

Table 1. Requirements and limit values for biomethane for injection into pipeline

No.	Parameter	Unit	Limit values		Reference test methods
			Min	Max	
1	Gross heating value (GHV)	MJ/Sm³	35.1	48.1	ISO 6976 (from GC composition); ISO 15971 (direct CV); Bomb calorimeter
2	Specific gravity (relative density)			0.75	ISO 6976 (from composition); ISO 6974 series
3	Methane content	% mol	93		ISO 6974-3 ISO 6974-6; ISO 6974-5; ASTM D 1945

No.	Parameter	Unit	Limit values		Reference test methods
			Min	Max	
4	Hydrocarbon dew point			10 °C at 56 bar g	ISO 6327 (condensation hygrometer); ISO 18453 (correlation method)
5	Water dew point			10 °C at 56 bar g	ISO 6327; ISO 18453; ASTM D1142; ASTM D5454
6	Hydrogen sulphide (H_2S)	mg/m^3		5.7	ISO 6326-3; ISO 6326-1; ISO 19739 (GC); MS 2392-2; ASTM D5504; ASTM D6667
7	Total sulphur	mg/m^3		30 [a]	ISO 6326-5; ISO 19739; MS 2066; MS 1867; ASTM D 5504; ASTM D 6667
8	Inert gas (N_2)	mol %		5	ISO 6974-3 ISO 6974-6 ASTM D 1945
9	Total silicon including siloxanes	mg Si/Sm^3		< 0.3 – 1 [b]	ISO 16017-1 (VOC GC-MS); ASTM D 8455;

No.	Parameter	Unit	Limit values		Reference test methods
			Min	Max	
10	Oxygen (O_2)	mol %		1	ISO 6974-3; ISO 6974-6; ISO 6975; ASTM D 1945
11	Carbon dioxide (CO_2)	mol %		5	ISO 6974-3 ISO 6974-6 EN ISO 6974-5; ASTM D1945
12	Ammonia (NH_3)	mg/m^3		10 [c]	ISO 17179 (ion chromatography); ASTM D 6919; ISO 21877
13	Amines	mg/m^3		10 [d]	VDI2467 Blatt 2*; (HPLC)*

[a] At any other part of distribution network the limit can be ≥ 34 mg/m^3

[b] A range of limit values for siloxanes is proposed for this standard. Studies have demonstrated that continuous exposure to 100 % biomethane for 15 years should require a specification as low as 0.1 mg Si/m^3. However, a limit set at this level would present difficulty in terms of analytical measurement (current quantification limits are at best 0.10 mg Si/m^3, which would imply setting a limit of 0.30 mg Si/m·). Moreover, this would not recognise the mitigating effects of dilution of injected biomethane by natural gas. It is therefore suggested that the limit value to be applied in a Grid Injection Agreement should be agreed between biomethane producer and gas transporter or grid operator taking into account both performance of current analytical methods and dilution opportunities through, e.g. capacity studies. For biomethane sourced from agricultural waste that can be demonstrated not to have materials containing organic silicon, it is not necessary to monitor this parameter.

[c] Ammonia is only measured for biomethane from sources other than palm oil mill wastes.

[d] Amines is only measured if amine method is used.

5.4 Test methods other than those listed in Table 1 may be used provided their fitness for purpose can be demonstrated and validated. Additional information on some of the parameters listed in Table 1 can be found in Annex A.

5.5 Biomethane and blends of biomethane and natural gas shall be technically free from particulate matter and compressor oil.

NOTE. Technically free means the gas may contain traces of particulate matter and compressor oil which is acceptable to the downstream equipment specification.

5.6 Biomethane shall be technically free from chlorinated and fluorinated compounds.

NOTE. Technically free means the gas may contain traces of chlorinated and fluorinated compounds which is acceptable to the downstream equipment specification.

5.7 When odourization is necessary, the relevant applicable laws and regulations shall be complied with.

6 Sampling

6.1 Sampling for online or offline analysis should, where appropriate, be in accordance with ISO 10715.

6.2 Samples for offline analysis should be collected either in bags of non-permeable and non-absorbent material (e.g. PVF, aluminised polyester or borosilicate glass), or by concentrating the sample on adsorption material. The time interval between the collection of the sample and the actual testing of the sample should be such that any influence on the composition of the sample is eliminated.

Annex A
(informative)

Parameters

A.1 Methane content and calorific value

High methane content is essential to ensure biomethane provides energy equivalence with pipeline natural gas and avoids operational issues in downstream applications such as turbines, burners, and household appliances. A reduction in methane purity is usually accompanied by an increase in inert gases such as carbon dioxide (CO_2) or nitrogen (N_2), which lowers the heating value and combustion efficiency.

Malaysian studies show that raw biogas produced from palm oil mill effluent (POME) typically contains 50 % to 65 % methane, with gross calorific values reported between 17.9 MJ/Sm^3 and 29.9 MJ/Sm^3 Upgrading technologies available demonstrate reliability in producing biomethane that complies with the gross heating value threshold mandated by the Energy Commission.

A.2 Oxygen (O_2)

Oxygen accelerates internal corrosion and can impact odourant stability especially where water is present. Upgrading plants that use air for desulphurisation or water scrubbing are frequently the source of oxygen infiltration. Adopting a low O_2 limit supports pipeline integrity.

A.3 Carbon dioxide (CO_2) and inert gases (N_2)

Excess CO_2 lowers the calorific value, while high N_2 increases volumetric flow without contributing to energy content. Both reduce pipeline capacity and can affect billing accuracy. EN 16726 specifies limits for CO_2 and inert gases to maintain network interchangeability.

A.4 Sulphur compounds (H_2S, total sulphur)

Sulphur is highly corrosive and toxic, even at trace levels. Hydrogen sulphide is toxic and corrosive, requiring strict control in biomethane. Internationally, the maximum H_2S limit is 9armonized at 5 mg/m^3, as specified in DVGW G262, EN 16726, and the Dutch Gas Act. SoCalGas Rule 30 similarly limits H_2S to 4 ppm (≈5.7 mg/m^3), while Australian AS 4564 specifies a similar value, with actual palm oil mill waste biomethane consistently achieving near-zero levels.

Carbonyl sulphide is treated together with H_2S in several standards, with the sum of H_2S and COS not to exceed 5 mg/m^3 in the Netherlands. Palm oil mill waste biogas initially contains elevated H_2S, often in the hundreds of ppm, but standard scrubbing processes reliably reduce levels below 5 mg/m^3. COS is negligible in anaerobic digestion biogas such as palm oil mill waste , and EN 16723-1 as well as SIRIM 31 for vehicle fuel note that COS monitoring is only necessary for thermochemical biogas sources. Therefore, COS testing can be excluded for palm oil mill waste biomethane.

Total sulphur represents the sum of all sulphur species, including H_2S, COS, mercaptans, and odourant compounds. The aim to protect combustion systems and minimise sulphur emissions. EN 16726 and DVGW G262 specify maximum total sulphur values of 10 mg/m³ to 20 mg/m³, including odourants. The Netherlands sets a total sulphur limit of 20 mg/m³ at H-gas entry points, with sub-limits for mercaptan sulphur (≤ 6 mg/m³). SoCalGas and the CPUC under AB1900 impose similar restrictions, with combined sulphur levels not to exceed health-protective limits. Australia specifies total sulfur limits around 10 mg/m³, excluding odorant added downstream. In palm oil mill waste biomethane, once H_2S is removed, residual sulphur is negligible. Total sulphur levels are typically below detection, and compliance can be easily demonstrated.

A.5 Total silicon including siloxanes

Siloxanes originate from industrial and domestic waste streams such as landfills and wastewater treatment plants, where silicone-based products are present. When combusted, siloxanes form abrasive silica deposits harmful to engines and turbines. Standards such as California's AB1900 establish strict trigger and action levels, typically around 0.1 mg Si/m³ to 0.4 mg Si/m³. DVGW guidelines recommend a maximum of 5 mg Si/m³, though values as low as 0.1 mg/m³ are advised for sensitive end uses. However, siloxane occurrence is feedstock dependent. Palm oil mill waste, being an agricultural effluent with no exposure to silicone products, produces biogas free of siloxanes. SIRIM 31 for vehicle fuel states that monitoring is unnecessary when the feedstock contains no silicon-based materials. Therefore, siloxane testing can be excluded for palm oil mill waste biomethane.

A.6 Ammonia (NH_3) and amines

NH_3 and amines can originate from certain feedstocks such as manure, food waste, or from upgrading processes using amine solvents. Ammonia is undesirable due to corrosion and NOx emissions, while amine residues can damage pipelines and appliances. DVGW G262 requires biomethane to be technically free of ammonia. California's AB1900 identifies ammonia as a constituent of concern with a very low health-protective level. SIRIM 31 sets an amine limit of 10 mg/m³, with testing required only if amine scrubbers are used. In the case of palm oil mill waste, digestion produces only small amounts of ammonia, which are efficiently removed during upgrading. Moreover, water scrubbing and membrane separation which are the most common upgrading technologies in Malaysia do not use amines, eliminating the risk of amine carryover. Therefore, the standard permits that ammonia testing is only required when the feedstock is not exclusively palm oil mill wastes, or when there is co-digestion with nitrogen-rich wastes.

Bibliography

[1] ISO 18453, *Natural gas - Correlation between water content and water dew point*

[2] ISO 14532:2014, *Natural gas - Vocabulary*

[3] ISO 18453:2005, *Natural gas - Correlation between water content and water dew point*

[4] ISO 19739:2005, *Natural gas - Determination of sulfur compounds using gas chromatography (ISO 19739:2004)*

[5] BS EN 16723-1:2016, *Natural gas and biomethane for use in transport and biomethane for injection in the natural gas network Part 1: Specifications for biomethane for injection in the natural gas network*

[6] EN 16726:2015 +A1, Gas infrastructure – Gas quality – Group H

[7] DVGW G 260:2021-09, Gas Quality

[8] AS 4564:2020, General purpose natural gas

[9] Southern California Gas Company, Rule No 30

[10] AB 1900 Biogas Recommendations

[11] ISIBIO 2019, The Main Parameter Analysis in Developing Low Pressure Biogas Standards

[12] Marcogaz, Quality of biomethane required in European countries for injecting into natural gas grid.

Acknowledgements

SIRIM Berhad would like to thank the members of the Project Committee on Biomethane who have contributed their ideas, time and expertise in the development of this standard.

Ms Hasinah M Hanafi Omar (Chairperson)	PETRONAS
Ms Siti Hadijah Hassan/ Ms Zulaikah Zulkefly (Technical Secretary)	SIRIM Academy Sdn Bhd
Mr Norzaifizy Khalid Nordin	BAC Renewable Energy
Mr Mohd Asraf Hamdan Mustafa Mr Hew Yoong Shern Mr Mohd Nazul Abdul Kadir	Biogas Developer Association
Mr Syed Mohd Ash-Syadiq Syid Putra	Gas Malaysia Berhad
Dr Zahari Mohamad	MTC Orec
Ms Nurul Huda Mohd Nazly Tan Mr Mohd Shapiza Ishak Ms Jennyfer Joseph Kuanji Mr Mohd Hisham Ibrahim Mr Raymond Lam Choong Meng Mr Mohd Hafizi Alias	PETRONAS
Ts Azhar Abdul Rauf	SIRIM Berhad
Prof. Madya Dr Peer Mohamed	Universiti Kebangsaan Malaysia