

CERTIFICATE OF ANALYSIS

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Issued by **EffecTech**
Date of issue **31 March 2025**

Certificate number **25/0027/05**

Approved signatory
Name: **Simon Yau**
Signature




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Customer : Gas Networks Ireland
Gasworks Road, Cork, County Cork, T12 RX96, Ireland.

Analysis method : Sample analysed by ISO 6974-1:2012 - *Natural Gas - Determination of composition and associated uncertainty by gas chromatography - Part 1 : General guidelines and calculation of composition*

Sample identification : Sample point: SC-2002 Bellanaboy, 2025-03-11, 09:00 hrs, line pressure 75.7 bar, line temperature 16 °C, sample vessel TR3026.
Other details: Dewpoint: -17 °C.

Date of analysis : 27 March 2025

This laboratory was not responsible for the sampling stage as the sample and sample identification information was provided by the customer. The results presented in this certificate apply to the sample analysed on an as received basis.

Composition

component	amount fraction (%mol/mol)	component	amount fraction (%mol/mol)
helium	0.02091 ± 0.00065	benzene	0.00078 ± 0.00006
hydrogen	<0.0005	cyclohexane	0.00006 ± 0.00002
argon	0.01407 ± 0.00028	heptanes†	0.00287 ± 0.00013
oxygen	<0.0015	n-heptane	0.00010 ± 0.00002
nitrogen	2.7051 ± 0.0073	toluene	0.00069 ± 0.00006
carbon dioxide	0.3401 ± 0.0013	methylcyclohexane	0.00049 ± 0.00005
methane	93.745 ± 0.019	octanes†	0.00063 ± 0.00006
ethane	2.9285 ± 0.0071	n-octane	0.00004 ± 0.00001
propane	0.14271 ± 0.00088	nonanes†	0.00072 ± 0.00006
iso-butane	0.05022 ± 0.00054	n-nonane	<0.00001
n-butane	0.01666 ± 0.00042	decanes†	0.00020 ± 0.00003
neo-pentane	0.01196 ± 0.00031	n-decane	<0.00001
iso-pentane	0.00700 ± 0.00021	undecanes†*	0.00006 ± 0.00002
n-pentane	0.00155 ± 0.00009	n-undecane*	<0.00001
2-methylpentane	0.00155 ± 0.00009	dodecanes†*	‡<0.00001
3-methylpentane	0.00067 ± 0.00006	n-dodecane*	<0.00001
2,2-dimethylbutane	0.00653 ± 0.00022		
hexanes†	0.00071 ± 0.00006	C ₆₊ (hexanes+)§	0.01641 ± 0.00031
n-hexane	0.00031 ± 0.00004		

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, which for a normal distribution provides a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with JCGM 100:2008 - *Evaluation of measurement data - Guide to the expression of uncertainty in measurement (GUM)*.

* these components/quantities are not UKAS accredited as they lie outside the scope of accreditation for our laboratory.

† the amount fraction of a grouped component is the sum of all isomers in that group **except** for those identified separately.

‡ no **individual** isomers could be measured above this limit of detection.

§ the C₆₊ (hexanes+) component is the sum of amount fractions of all hydrocarbons containing 6 carbon atoms or greater.

EffecTech is accredited by UKAS to undertake the analysis presented in this certificate according to ISO/IEC 17025:2017.	This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The laboratory activities reported were performed at the location of the issuing body The reference values reported relate only to the specific sample identified in this certificate
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UKAS accredited testing laboratory no.1927

Certificate number

25/0027/05

Physical Properties

Reference conditions	primary		secondary	
	combustion	metering	combustion	metering
	15°C	15°C	0°C	0°C
mean molar mass	16.966 ± 0.017	kg·kmol ⁻¹	16.966 ± 0.017	kg·kmol ⁻¹
compression factor	0.9979 ± 0.0010		0.9975 ± 0.0010	

Real gas properties

superior calorific value	37.64 ± 0.04	MJ·m ⁻³	39.78 ± 0.04	MJ·m ⁻³
	888.08 ± 0.89	kJ·mol ⁻¹	889.47 ± 0.89	kJ·mol ⁻¹
	52.35 ± 0.05	MJ·kg ⁻¹	52.43 ± 0.05	MJ·kg ⁻¹
inferior calorific value	33.92 ± 0.03	MJ·m ⁻³	35.80 ± 0.04	MJ·m ⁻³
	800.35 ± 0.80	kJ·mol ⁻¹	800.49 ± 0.80	kJ·mol ⁻¹
	47.17 ± 0.05	MJ·kg ⁻¹	47.18 ± 0.05	MJ·kg ⁻¹
relative density	0.5868 ± 0.0006		0.5869 ± 0.0006	
density	0.7190 ± 0.0007	kg·m ⁻³	0.7588 ± 0.0008	kg·m ⁻³
superior Wobbe index	49.13 ± 0.05	MJ·m ⁻³	51.93 ± 0.05	MJ·m ⁻³

Ideal gas properties

superior calorific value	37.56 ± 0.04	MJ·m ⁻³	39.68 ± 0.04	MJ·m ⁻³
	888.08 ± 0.89	kJ·mol ⁻¹	889.47 ± 0.89	kJ·mol ⁻¹
	52.35 ± 0.05	MJ·kg ⁻¹	52.43 ± 0.05	MJ·kg ⁻¹
inferior calorific value	33.85 ± 0.03	MJ·m ⁻³	35.71 ± 0.04	MJ·m ⁻³
	800.35 ± 0.80	kJ·mol ⁻¹	800.49 ± 0.80	kJ·mol ⁻¹
	47.17 ± 0.05	MJ·kg ⁻¹	47.18 ± 0.05	MJ·kg ⁻¹
relative density	0.5858 ± 0.0006		0.5858 ± 0.0006	
density	0.7175 ± 0.0007	kg·m ⁻³	0.7569 ± 0.0008	kg·m ⁻³
superior Wobbe index	49.07 ± 0.05	MJ·m ⁻³	51.85 ± 0.05	MJ·m ⁻³

The physical properties above are calculated from composition at a reference pressure of 1.01325 bar and at the combustion and metering temperatures stated in accordance with the international standard ISO 6976:1995 - *Natural Gas - Calculation of calorific value, density, relative density and Wobbe index from composition* (including amendment No.1 - May 1998).

Note 1: In accordance with the recommendations of the international standard, the gas mixture is assumed dry (free from moisture).

Note 2: For the purpose of these calculations grouped components are given the property of the corresponding normal alkane.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, which for a normal distribution provides a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with JCGM 100:2008 - *Evaluation of measurement data - Guide to the expression of uncertainty in measurement* (GUM).

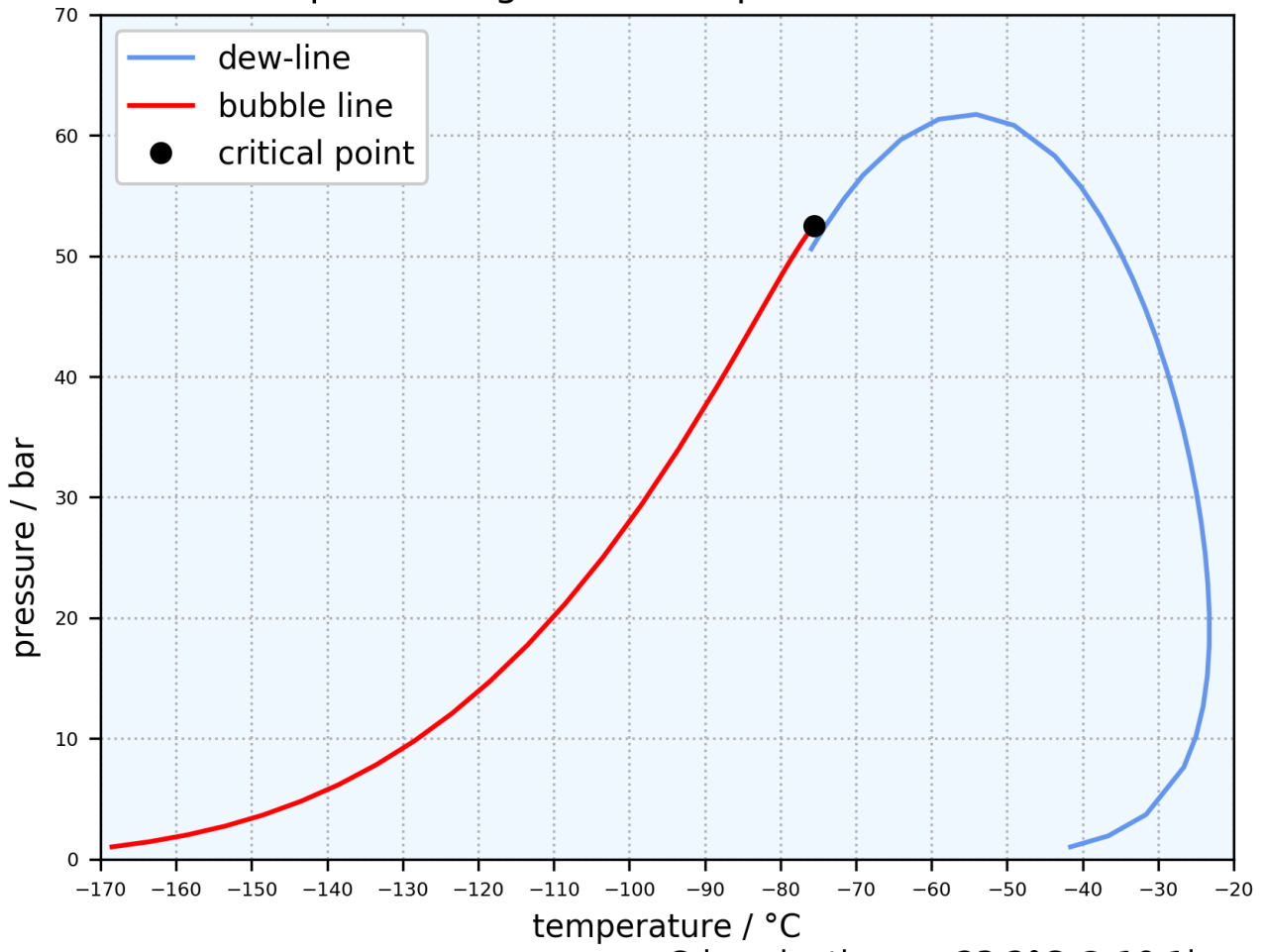
Auxiliary properties

The following additional properties are calculated from equivalent composition in accordance with the UK Statutory Instrument 1996 No.551 *Gas Safety (Management) Regulations 1996 - Regulation 8 (Schedule 3) - Content and other Characteristics of Gas - Part III - Interpretation*

sooting index	0.4769
incomplete combustion factor	-0.9225

The auxiliary properties given above are not UKAS accredited, as the calculations fall outside the scope of accreditation for our laboratory.

phase diagram of sample 25/0027/05



Cricondentherm: -23.2°C @ 19.1bar