

# CERTIFICATE OF ANALYSIS

Issued by **EffecTech**  
Date of issue **02 April 2025**

Certificate number **25/0055/03**

Approved signatory  
Name: **Ryan Richards**  
Signature




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Customer : Southern Gas Networks plc  
Fullarton House, 1 Fullarton Drive, Cambuslang, G32 8FD.

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: Beattock Compressor Station, 2025-03-20, 14:30 hrs, line pressure 60.57 bar, line temperature 6.3 °C, sampled by RB/SJ, sample vessel #TR3044.

Date of analysis : 01 April 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	0.00705 ± 0.00035	benzene	0.00215 ± 0.00010
hydrogen	0.00215 ± 0.00010	cyclohexane	0.00277 ± 0.00012
argon	0.00415 ± 0.00017	heptanes†	0.00491 ± 0.00017
oxygen	<0.0015	n-heptane	0.00090 ± 0.00006
nitrogen	0.7297 ± 0.0041	toluene	0.00052 ± 0.00005
carbon dioxide	2.4269 ± 0.0070	methylcyclohexane	0.00113 ± 0.00007
methane	87.334 ± 0.033	octanes†	0.00037 ± 0.00005
ethane	7.081 ± 0.021	n-octane	0.00009 ± 0.00002
propane	1.8444 ± 0.0060	nonanes†	0.00010 ± 0.00002
iso-butane	0.1587 ± 0.0016	n-nonane	<0.00001
n-butane	0.2819 ± 0.0015	decanes†	‡<0.00001
neo-pentane	0.00091 ± 0.00006	n-decane	<0.00001
iso-pentane	0.04768 ± 0.00075	undecanes†*	‡<0.00001
n-pentane	0.04748 ± 0.00066	n-undecane*	<0.00001
2-methylpentane	0.00643 ± 0.00019	dodecane†*	‡<0.00001
3-methylpentane	0.00332 ± 0.00013	n-dodecane*	<0.00001
2,2-dimethylbutane	0.00063 ± 0.00005		
hexanes†	0.00308 ± 0.00012	C <sub>6+</sub> (hexanes+)§	0.03399 ± 0.00042
n-hexane	0.00762 ± 0.00020		

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 C<sub>6+</sub> (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

**25/0055/03**

## Physical Properties

Reference conditions	primary		secondary	
	combustion	metering	combustion	metering
	15°C	15°C	0°C	0°C
mean molar mass	18.584 ± 0.019	kg·kmol <sup>-1</sup>	18.584 ± 0.019	kg·kmol <sup>-1</sup>
compression factor	0.9974 ± 0.0010		0.9969 ± 0.0010	

## Real gas properties

superior calorific value	40.19 ± 0.04	MJ·m <sup>-3</sup>	42.48 ± 0.04	MJ·m <sup>-3</sup>
	947.74 ± 0.95	kJ·mol <sup>-1</sup>	949.21 ± 0.95	kJ·mol <sup>-1</sup>
	51.00 ± 0.05	MJ·kg <sup>-1</sup>	51.08 ± 0.05	MJ·kg <sup>-1</sup>
inferior calorific value	36.30 ± 0.04	MJ·m <sup>-3</sup>	38.32 ± 0.04	MJ·m <sup>-3</sup>
	856.07 ± 0.86	kJ·mol <sup>-1</sup>	856.22 ± 0.86	kJ·mol <sup>-1</sup>
	46.07 ± 0.05	MJ·kg <sup>-1</sup>	46.07 ± 0.05	MJ·kg <sup>-1</sup>
relative density	0.6431 ± 0.0006		0.6433 ± 0.0006	
density	0.7880 ± 0.0008	kg·m <sup>-3</sup>	0.8317 ± 0.0008	kg·m <sup>-3</sup>
superior Wobbe index	50.11 ± 0.05	MJ·m <sup>-3</sup>	52.97 ± 0.05	MJ·m <sup>-3</sup>

## Ideal gas properties

superior calorific value	40.08 ± 0.04	MJ·m <sup>-3</sup>	42.35 ± 0.04	MJ·m <sup>-3</sup>
	947.74 ± 0.95	kJ·mol <sup>-1</sup>	949.21 ± 0.95	kJ·mol <sup>-1</sup>
	51.00 ± 0.05	MJ·kg <sup>-1</sup>	51.08 ± 0.05	MJ·kg <sup>-1</sup>
inferior calorific value	36.21 ± 0.04	MJ·m <sup>-3</sup>	38.20 ± 0.04	MJ·m <sup>-3</sup>
	856.07 ± 0.86	kJ·mol <sup>-1</sup>	856.22 ± 0.86	kJ·mol <sup>-1</sup>
	46.07 ± 0.05	MJ·kg <sup>-1</sup>	46.07 ± 0.05	MJ·kg <sup>-1</sup>
relative density	0.6416 ± 0.0006		0.6416 ± 0.0006	
density	0.7859 ± 0.0008	kg·m <sup>-3</sup>	0.8291 ± 0.0008	kg·m <sup>-3</sup>
superior Wobbe index	50.04 ± 0.05	MJ·m <sup>-3</sup>	52.87 ± 0.05	MJ·m <sup>-3</sup>

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).

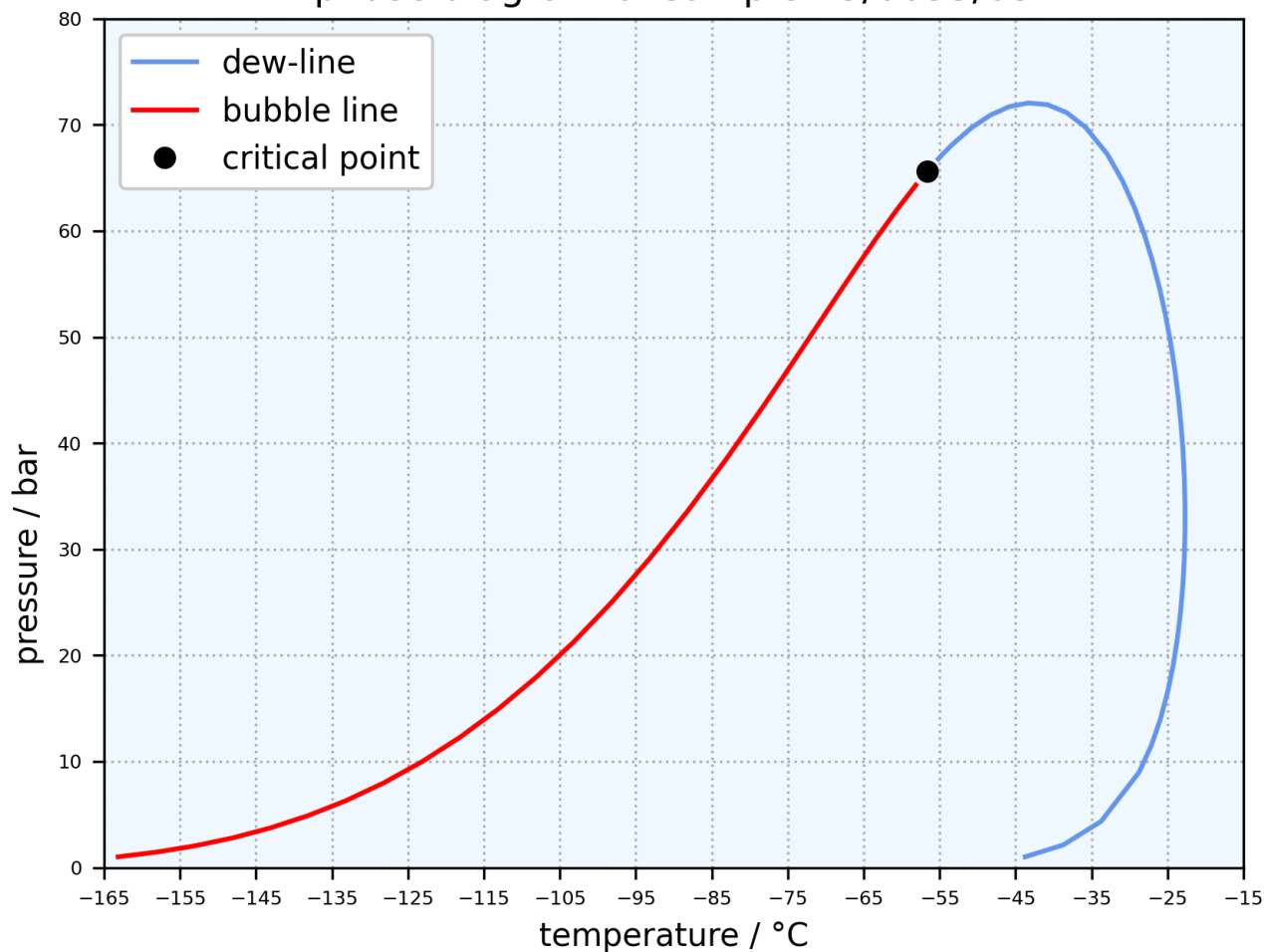
## Auxiliary properties

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	0.5384
incomplete combustion factor	-0.1965

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 25/0055/03



Cricondentherm: -22.7°C @ 32.9bar