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OFFLINE ANALYSER VERIFICATION AND TERMINAL CORRELATION RESULTS – GC8

25/3/2025

CERTIFICATE OF CALIBRATION

Approved signatory
Name: **Simon Yau**
Signature

Issued by **EffecTech**
Date of Issue **03 June 2020**

Certificate Number **20/0378/03**

EffecTech
Global Leaders In Gas Measurement

Dove House
Dove Fields
Uttoxeter
Staffordshire ST14 8HU
United Kingdom

www.effectech.co.uk

ilac-MRA UKAS CALIBRATION 0590

Customer	: CAC Gas & Instrumentation Pty. Ltd. Unit 3 / 36 Holbeche Rd., Arndell Park, NSW 2148, Australia.
Customer reference	: PO No.PO4283 (Part Code: 50ST-INPX-LNGCALCH4)
Product Description	: Certified Reference Material (CRM) for use as a calibration gas mixture in natural gas analysis Multi-component natural gas mixture
Preparation method	: Mixture prepared by ISO 6142-1:2015 - *Gas Analysis - Preparation of calibration gas mixtures - Part 1 : Gravimetric method for Class I mixtures*
Calibration method	: Mixture calibrated by ISO 6143:2001 - *Gas Analysis - Comparison methods for determining and checking the composition of calibration gas mixtures* using high precision gas chromatography
Traceability	: Mixture classified as a Calibrated Gas Mixture (CGM) at Level-3 in the metrological hierarchy of traceability by direct analytical comparison with a Secondary Reference Gas Mixture (SRGM)
Cylinder number	: 20/4435
Date of calibration	: 28 May 2020
Contents pressure	: 100 bar
Cylinder size	: 50 litres
Cylinder material	: steel
Valve outlet connection	: BS341 - No.4

Minimum usage pressure	: 3 bar
Usage temperature range	: 15 to 50 °C
Storage (transport) temperature range	: -33 to 50 °C

Composition

component	amount fraction (%mol/mol)
oxygen	0.00977 ± 0.00017
nitrogen	0.5992 ± 0.0020
carbon dioxide*	0.01000 ± 0.00020
methane	83.902 ± 0.028
ethane	13.965 ± 0.035
propane	1.3021 ± 0.0042
iso-butane	0.05991 ± 0.00045
n-butane	0.04060 ± 0.00045
iso-pentane	0.06046 ± 0.00040
n-pentane	0.04026 ± 0.00030
n-hexane	0.01004 ± 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 UKAS requirements.The reference values presented in this certificate apply to the calibration of the individual and unique gas mixture identified above

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

The following information provided on stability and the expiry date is outside the scope of UKAS accreditation but is required to fulfil the mandatory requirements of ISO 6141:2015 - *Gas Analysis - Contents of certificates for calibration gas mixtures*

Stability	: EffecTech stability studies of similar gas mixtures in this type of cylinder/valve combination have demonstrated a shelf-life of 5 years, providing the contents pressure and usage/storage temperature remain within the limits stated in the table above.
Expiry date	: 28 May 2025

To re-order this gas mixture contact CAC Gas & Instrumentation quoting certificate number 20/0378/03.
tel: 1300 CAC GAS (+61 2 8676 6500) email: cac@cacgas.com.au

CERTIFICATE OF CALIBRATION

UKAS Accredited Calibration Laboratory No. 0590

Certificate number

20/0378/03

Physical Properties

Physical properties are calculated from composition in accordance with the international standard ISO 6976:1995 (E) including amendment No.1 - May 1998.

Properties are calculated at a reference pressure of 1.01325 bar and at reference temperatures stated.

Note :- In accordance with the recommendations of the international standard, the gas mixture is assumed dry (free from moisture) for the purpose of these calculations.

Reference conditions	**primary** combustion 15°C metering 15°C	**secondary** combustion 0°C metering 0°C
mean molecular mass	18.549 ± 0.019 kg·kmol^{-1}	18.549 ± 0.019 kg·kmol^{-1}
compression factor	0.9972 ± 0.0010	0.9967 ± 0.0010
Real gas properties		
superior calorific value	42.494 ± 0.042 MJ·m^{-3}	44.921 ± 0.045 MJ·m^{-3}
	1002.0 ± 1.0 kJ·mol^{-1}	1003.5 ± 1.0 kJ·mol^{-1}
	54.018 ± 0.054 MJ·kg^{-1}	54.101 ± 0.054 MJ·kg^{-1}
inferior calorific value	38.422 ± 0.038 MJ·m^{-3}	40.561 ± 0.041 MJ·m^{-3}
	905.97 ± 0.91 kJ·mol^{-1}	906.13 ± 0.91 kJ·mol^{-1}
	48.842 ± 0.049 MJ·kg^{-1}	48.850 ± 0.049 MJ·kg^{-1}
relative density	0.64197 ± 0.00064	0.64221 ± 0.00064
density	0.78667 ± 0.00079 kg·m^{-3}	0.83032 ± 0.00083 kg·m^{-3}
Wobbe index	53.037 ± 0.053 MJ·m^{-3}	56.055 ± 0.056 MJ·m^{-3}
Ideal gas properties		
superior calorific value	42.376 ± 0.042 MJ·m^{-3}	44.772 ± 0.045 MJ·m^{-3}
	1002.0 ± 1.0 kJ·mol^{-1}	1003.5 ± 1.0 kJ·mol^{-1}
	54.018 ± 0.054 MJ·kg^{-1}	54.101 ± 0.054 MJ·kg^{-1}
inferior calorific value	38.316 ± 0.038 MJ·m^{-3}	40.427 ± 0.040 MJ·m^{-3}
	905.97 ± 0.91 kJ·mol^{-1}	906.13 ± 0.91 kJ·mol^{-1}
	48.842 ± 0.049 MJ·kg^{-1}	48.850 ± 0.049 MJ·kg^{-1}
relative density	0.64045 ± 0.00064	0.64045 ± 0.00064
density	0.78449 ± 0.00078 kg·m^{-3}	0.82757 ± 0.00083 kg·m^{-3}
Wobbe index	52.952 ± 0.053 MJ·m^{-3}	55.945 ± 0.056 MJ·m^{-3}

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 UKAS requirements.

ADVICE on the storage and use of your calibration gas mixture

The calibration gas mixture supplied to you contains components which are condensable under certain conditions of temperature. It is important that these conditions are avoided where possible during storage and usage of the mixture.

Please read this advice in conjunction with recommended storage/usage conditions given son the certificate of calibration.

Storage

*Has the ambient temperature during **storage** dropped below the hydrocarbon dew temperature at contents pressure?*

If so then there will be stratification of your mixture into two phases (vapour and liquid)

The withdrawal of any gas phase content from this two phase mixture will invalidate the certified reference values we have provided with your calibration gas.

Advice before use

There will be no record of the minimum temperature to which your gas mixture has been exposed in transport to you. Hence, there is no guarantee that the gas mixture has not been exposed to temperatures below the hydrocarbon dew temperature of your mixture at contents pressure. If you suspect the gas has been exposed to temperatures below this the contents must be allowed to equilibrate at a greater temperature for a minimum period of about 24 hours. Following this equilibration time your mixture should be entirely homogeneous and gaseous. Often, it is good practice to roll the cylinder, where possible, to encourage mixing during equilibration.

Use

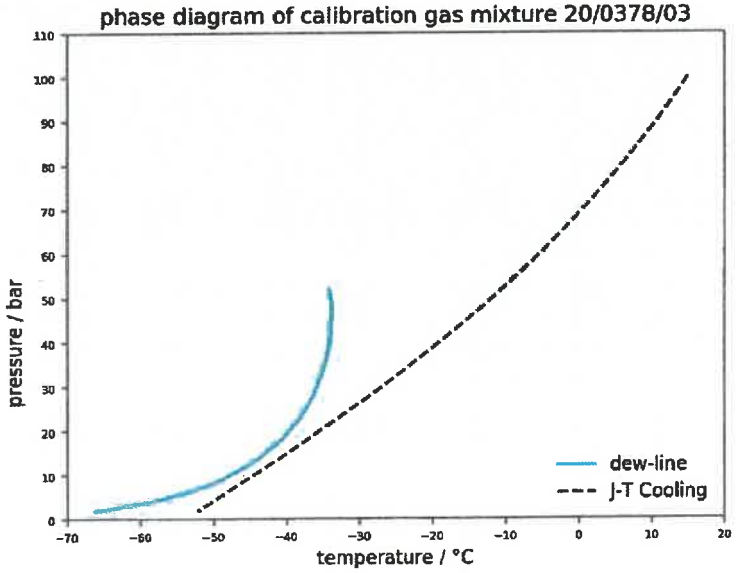
*When in **use** does condensation occur in your gas mixture following depressurisation as a result of cooling?*

Your gas mixture cools when it is depressurised through your pressure regulator. This is called Joule-Thomson (or Joule-Kelvin) cooling. If the gas cools to below the hydrocarbon dew temperature at its pressure then your mixture will stratify into two phases (vapour and liquid).

If this occurs the gas phase composition delivered to your application will not be representative of the certified reference values we have provided with your calibration gas.

Advice during use

The diagram below shows the pressure-temperature phase characteristics of your particular calibration mixture. Conditions shown to the left of the hydrocarbon dewline are in the two phase (liquid and vapour) region, whilst to the right your mixture remains as a single phase vapour. The cooling curve shown does not enter the two-phase region.



This demonstrates that during use your mixture remains entirely in the vapour phase should it be depressurised in a single stage from contents pressure and at a starting temperature of 15°C.

Technical information : The dewline and the cooling curve were calculated using GasVLE™ and constructed using the LRS equation of state (EOS) and the cooling curve generated from a simulated isenthalpic flash calculation assuming adiabatic conditions starting at contents pressure and the stated temperature.

LNG Calibration Standard Instrument: GC8		Data File: L2405878001.6.dx	Data File: L2405878001.7.dx	Data File: L2405878001.8.dx	Cal Date: 04/12/2024	Cylinder No: 20/4435 Expiry 28/05/2025			
Compound	Certified Value	Area	Area	Area	Av. Peak area across 3 Cal runs-2 d.p				
Detector (TCD/FID)	mol %	25uV*s (TCD)/ pA*s (FID)	25uV*s (TCD)/ pA*s (FID)	25uV*s (TCD)/ pA*s (FID)	Average Peak Area (Run1+Run2+Run3)/3	Response Factor (Certified Value/Average Peak Area)	0.5% of average peak area (GPA2261:2000 - Clause 6.3)	Acceptance Criteria - Peak Area Min	Acceptance Criteria - Peak Area Max
Methane	83.902	72413.15068	72401.33702	72345.55104	72386.68	1.15908E-03	361.93	72024.75	72748.61
Ethane	13.965	18345.84502	18350.59981	18326.45630	18340.97	7.61410E-04	91.70	18249.26	18432.67
Propane	1.3021	163591.68999	163644.84397	163473.39252	163569.98	7.96051E-06	817.85	162752.13	164387.83
Isobutane	0.05991	10027.34803	10027.76021	10020.25076	10025.12	5.97599E-06	50.13	9974.99	10075.25
n-Butane	0.04060	6893.80374	6897.09582	6888.18356	6893.03	5.89001E-06	34.47	6858.56	6927.49
Isopentane	0.06046	12708.81029	12712.27139	12693.66845	12704.92	4.75879E-06	63.52	12641.39	12768.44
n-Pentane	0.04026	8335.92438	8342.78265	8320.29516	8333.00	4.83139E-06	41.67	8291.34	8374.67
n-Hexane	0.01004	2497.14295	2502.21678	2515.83300	2505.06	4.00788E-06	12.53	2492.54	2517.59
Carbon dioxide	0.01000	10.91868	10.83901	11.02476	10.93	9.15124E-04	0.05	10.87	10.98
Oxygen	0.00977	0.79296	0.90257	0.73220	0.81	1.20730E-02	0.00	0.81	0.81
Nitrogen	0.5992	36.48746	36.40831	36.30544	36.40	1.64614E-02	0.18	36.22	36.58
Total	99.999								

Analyst : HK *Date :* 4/12/2024

Checked by : KZ *Date :* 4/12/2024

Legend

Within Specification

Outside Specification

Cylinder certified value and calculated precision data

Calculated value

Data entry

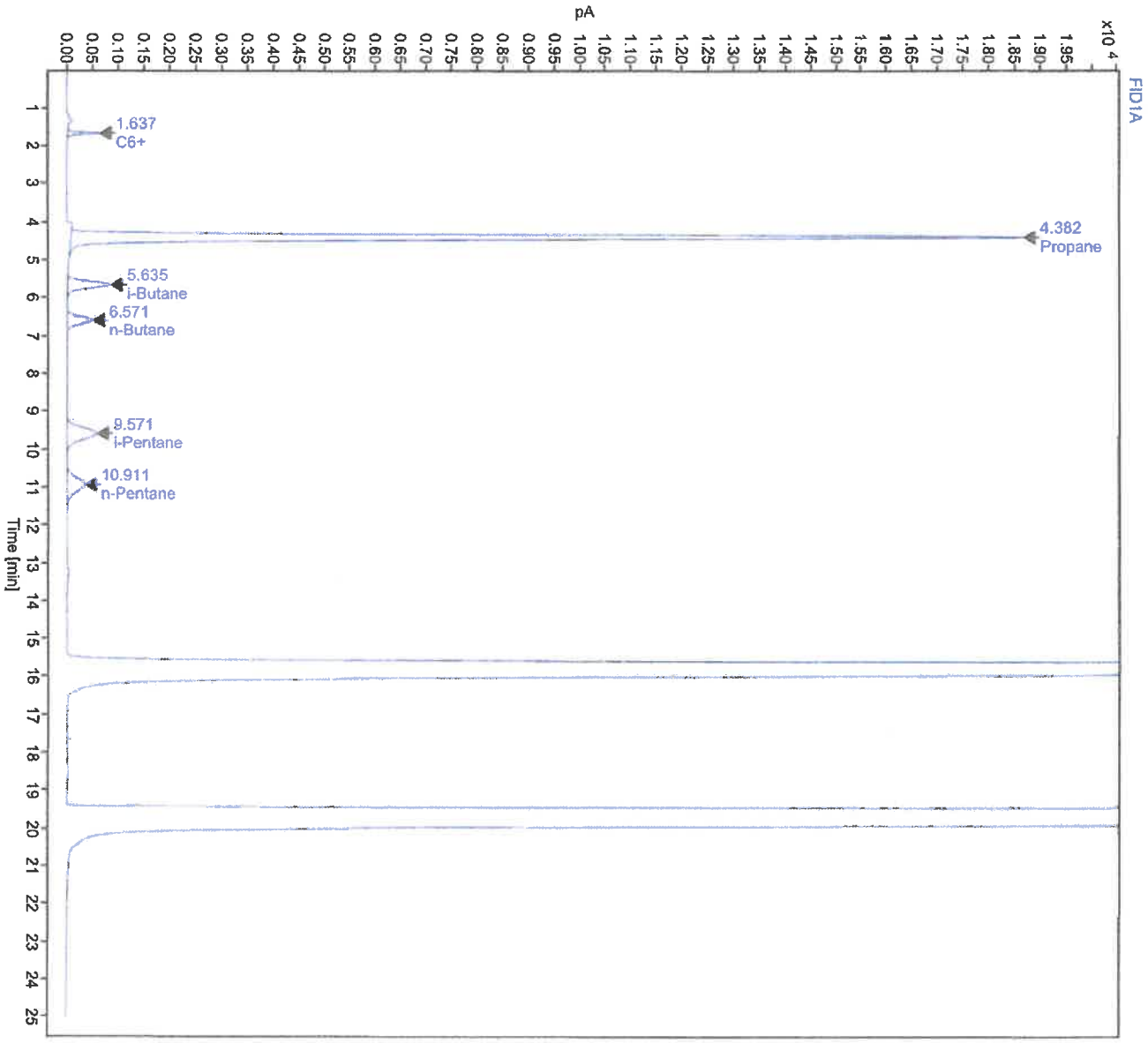
Single Injection Report

Agilent

Sample name:	20241204 LNG Cal run 6		
Data file:	L2405878001.6.dx	**Operator:**	SYSTEM (SYSTEM)
Instrument:	GC-08	**Injection date:**	2024-12-04 09:25:45+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC08_ACQUISITION_NAT_GAS_20240819.amx		
Injection Acq Method Modified Date	2024-08-19 07:03:00+09:30		
Processing method:	NATURAL_GAS_PROCESSING_20240819.pmx		
Injection DA Method Latest File Change	2024-08-19 15:50:19+09:30		

4/12/24

04 DEC 2024



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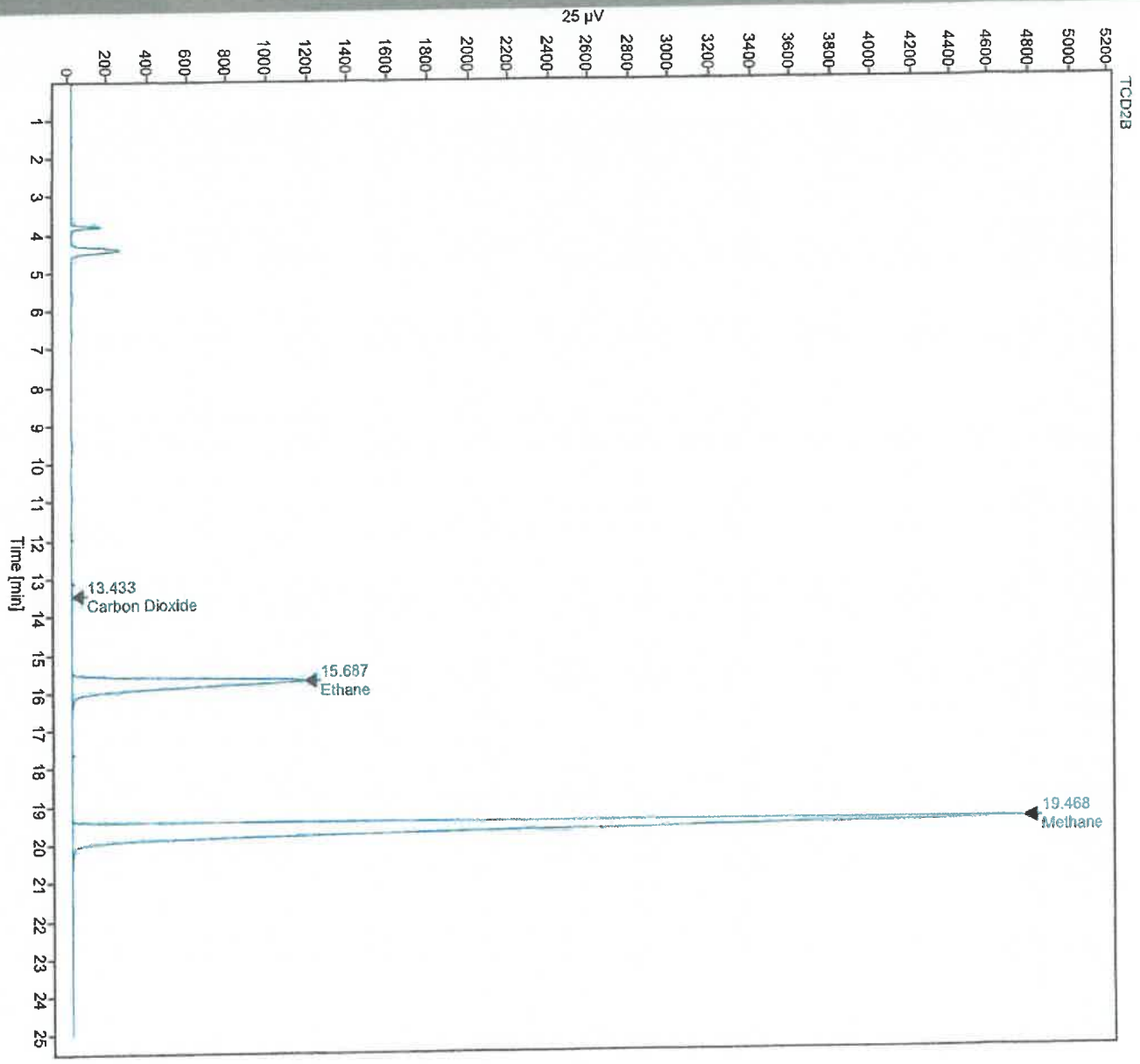
04 DEC 2024



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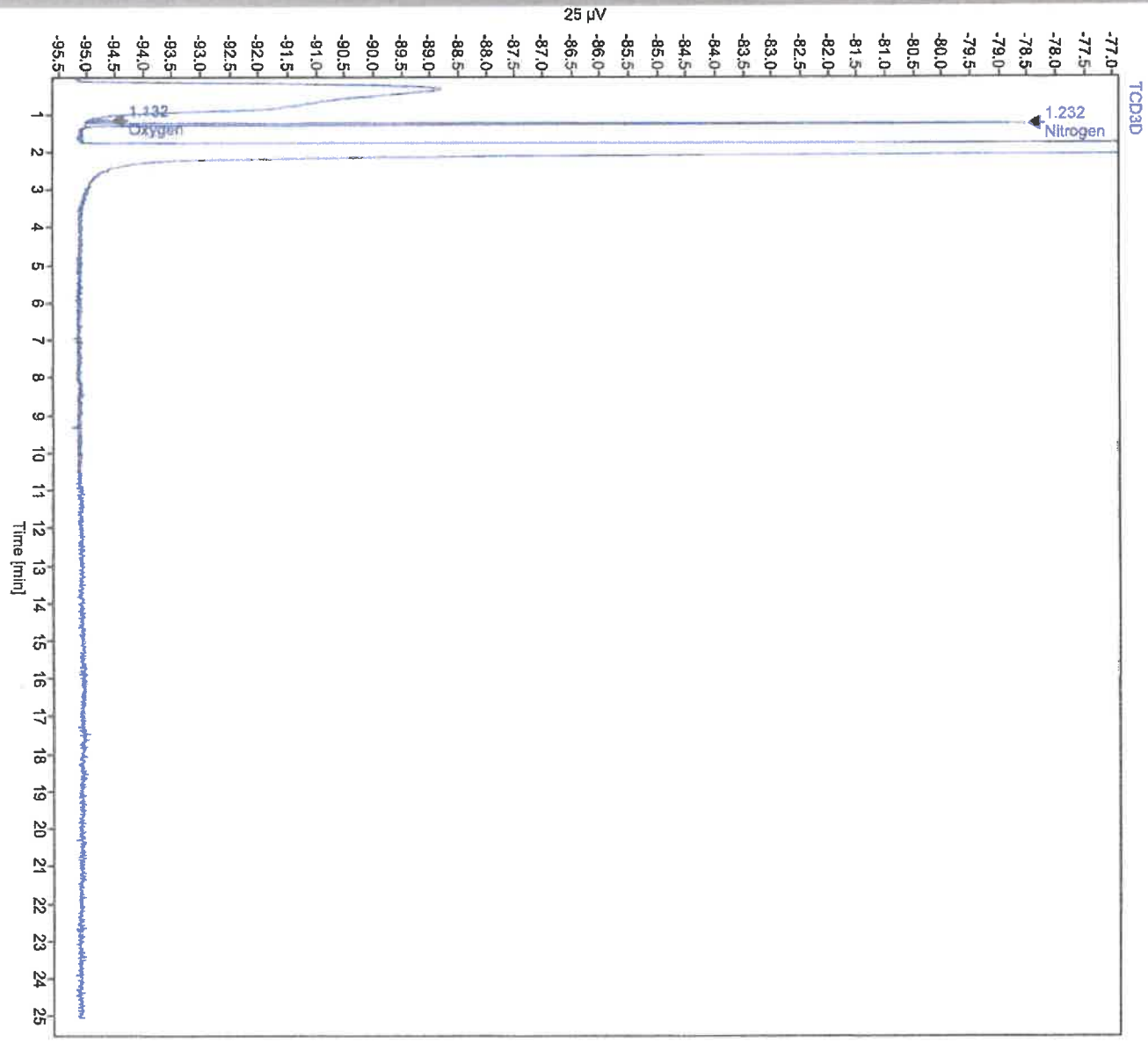

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Single Injection Report

Agilent

Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]
Oxygen	TCD3	1.132	0.011576515	0.79296	0.009180	0.009254
Nitrogen	TCD3	1.232	0.016482332	36.48746	0.601398	0.606235
C6+	FID1	1.637	0.000004011	2497.14295	0.010016	0.010097
Propane	FID1	4.382	0.000007954	163591.68999	1.301208	1.311673
i-Butane	FID1	5.635	0.000005964	10027.34803	0.059803	0.060284
n-Butane	FID1	6.571	0.000005877	6893.80374	0.040515	0.040841
i-Pentane	FID1	9.571	0.000004742	12708.81029	0.060265	0.060750
n-Pentane	FID1	10.911	0.000004817	8335.92438	0.040154	0.040477
Carbon Dioxide	TCD2	13.433	0.000916516	10.91868	0.010007	0.010088
Ethane	TCD2	15.687	0.000754509	18345.84502	13.842105	13.953426
Methane	TCD2	19.468	0.001149343	72413.15068	83.227548	83.896877
				Total mol%	99.202200	100.000000

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4/12/24

KZ
04 DEC 2024

Single Injection Report

Agilent

Sample name:	20241204 LNG Cal run 7		
Data file:	L2405878001.7.dx	**Operator:**	SYSTEM (SYSTEM)
Instrument:	GC-08	**Injection date:**	2024-12-04 09:51:12+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC08_ACQUISITION_NAT_GAS_20240819.amx		
Injection Acq Method Modified Date	2024-08-19 07:03:00+09:30		
Processing method:	NATURAL_GAS_PROCESSING_20240819.pmx		
Injection DA Method Latest File Change	2024-08-19 15:50:19+09:30		

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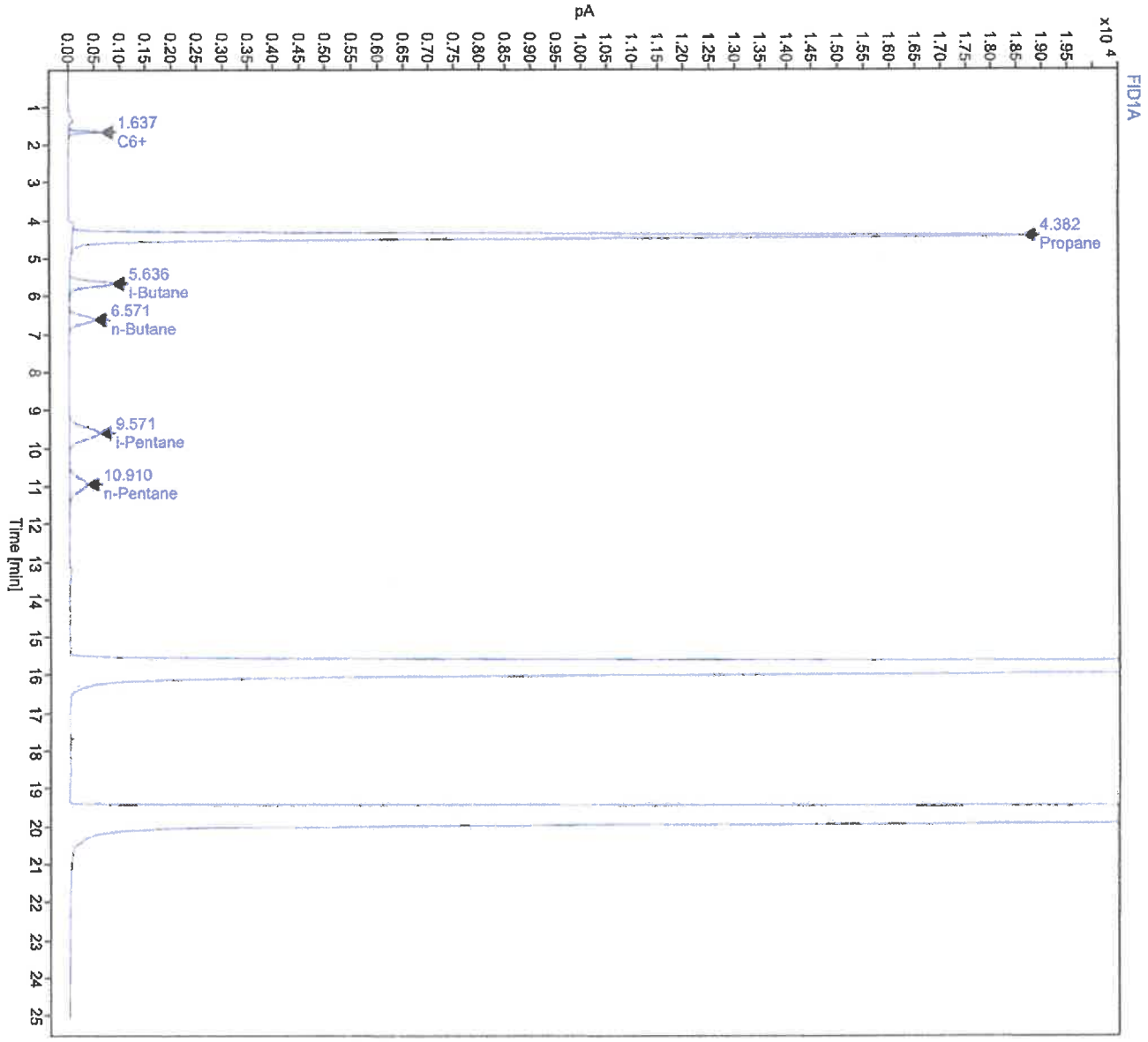
04 DEC 2024



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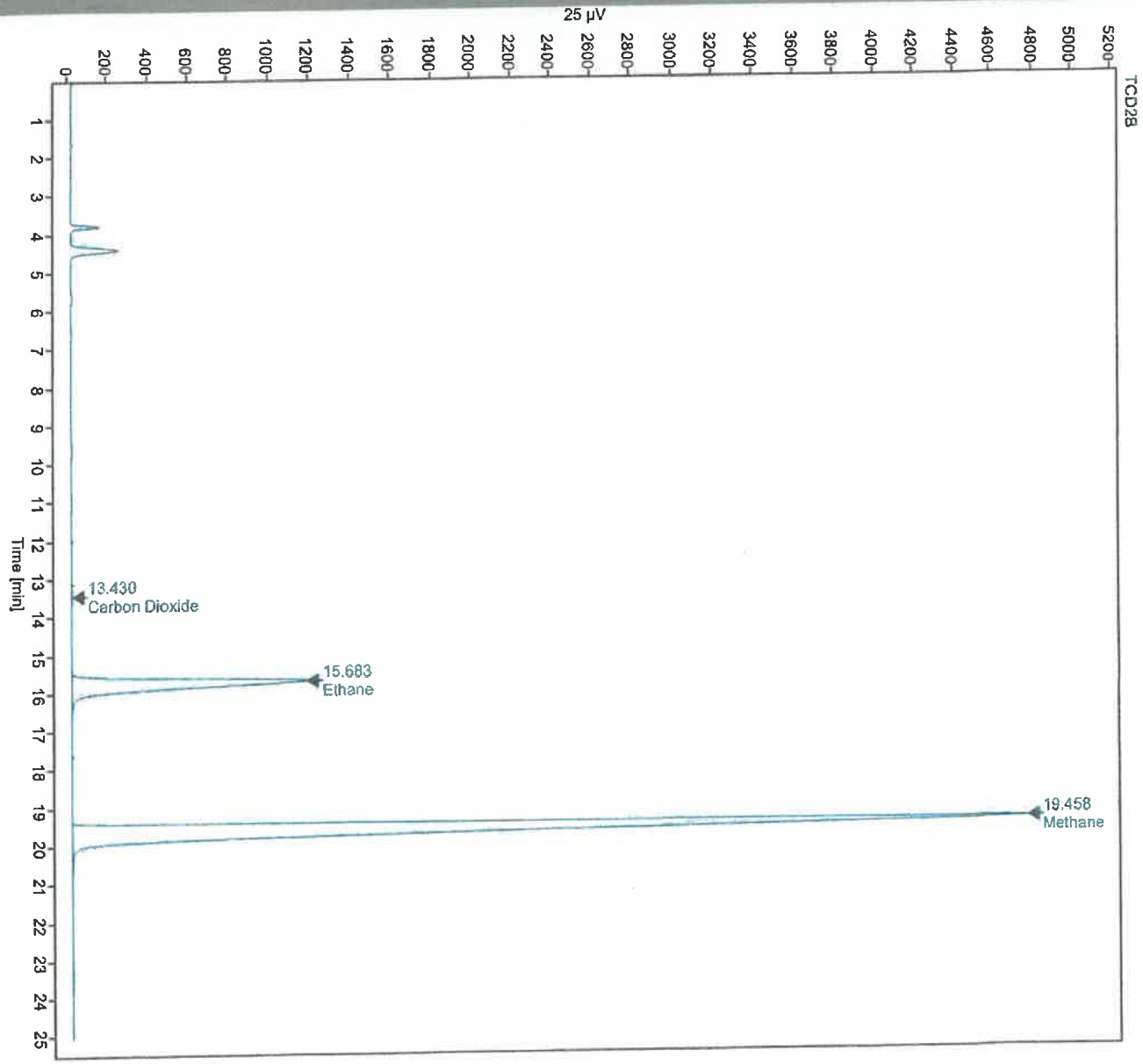

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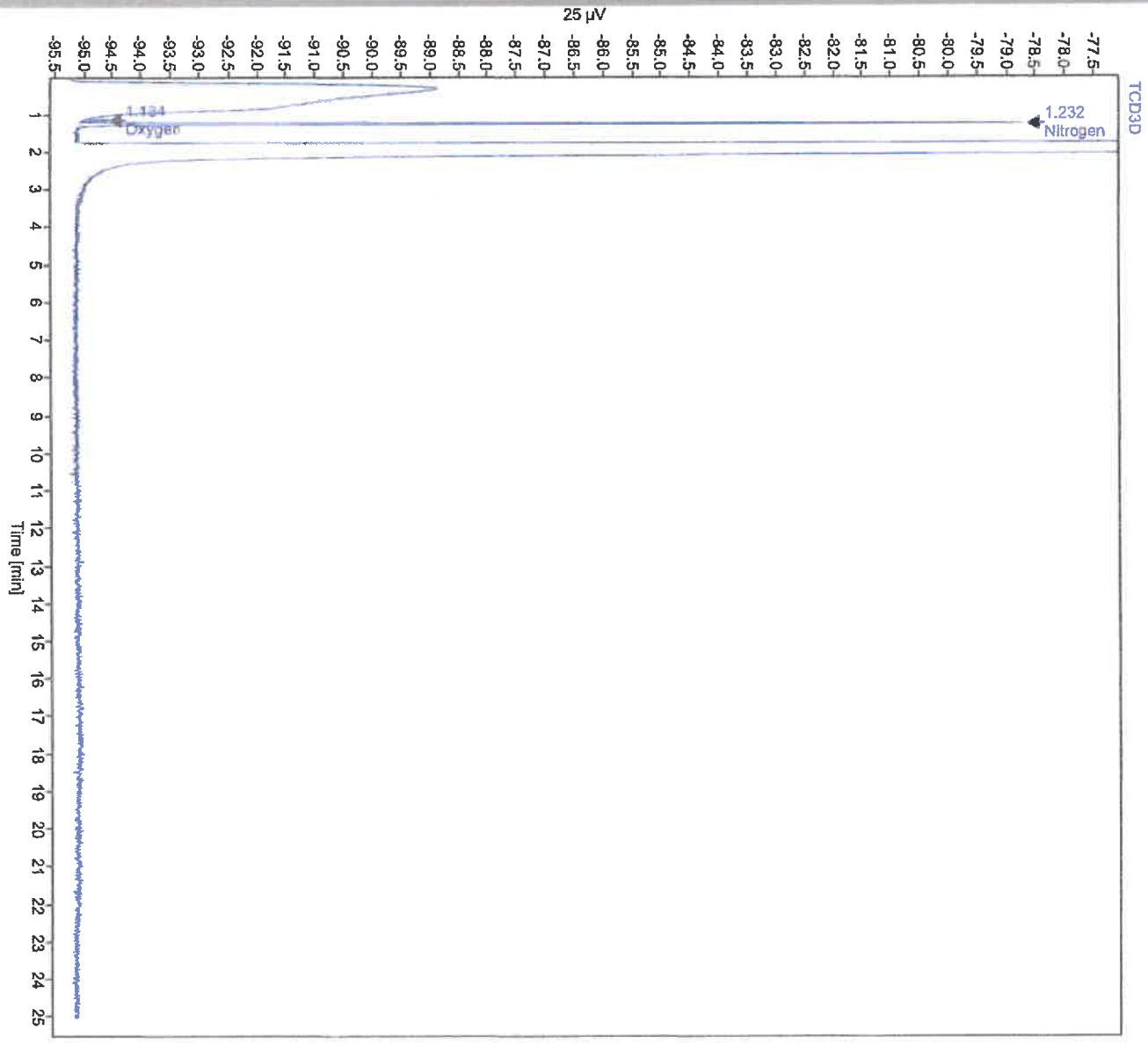

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Single Injection Report

Agilent

Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]
Oxygen	TCD3	1.134	0.011576515	0.90257	0.010449	0.010534
Nitrogen	TCD3	1.232	0.016482332	36.40831	0.600094	0.604978
C6+	FID1	1.637	0.000004011	2502.21678	0.010036	0.010118
Propane	FID1	4.382	0.000007954	163644.84397	1.301631	1.312226
i-Butane	FID1	5.636	0.000005964	10027.76021	0.059806	0.060292
n-Butane	FID1	6.571	0.000005877	6897.09582	0.040534	0.040864
i-Pentane	FID1	9.571	0.000004742	12712.27139	0.060282	0.060772
n-Pentane	FID1	10.910	0.000004817	8342.78265	0.040187	0.040514
Carbon Dioxide	TCD2	13.430	0.000916516	10.83901	0.009934	0.010015
Ethane	TCD2	15.683	0.000754509	18350.59981	13.845693	13.958391
Methane	TCD2	19.458	0.001149343	72401.33702	83.213970	83.891295
				Total mol%	99.192615	100.000000

4/12/24

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Single Injection Report

Agilent

Sample name:	20241204 LNG Cal run 8		
Data file:	L2405878001.8.dx	**Operator:**	SYSTEM (SYSTEM)
Instrument:	GC-08	**Injection date:**	2024-12-04 11:12:14+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC08_ACQUISITION_NAT_GAS_20240819.amx		
Injection Acq Method Modified Date	2024-08-19 07:03:00+09:30		
Processing method:	NATURAL_GAS_PROCESSING_20240819.pmx		
Injection DA Method Latest File Change	2024-08-19 15:50:19+09:30		

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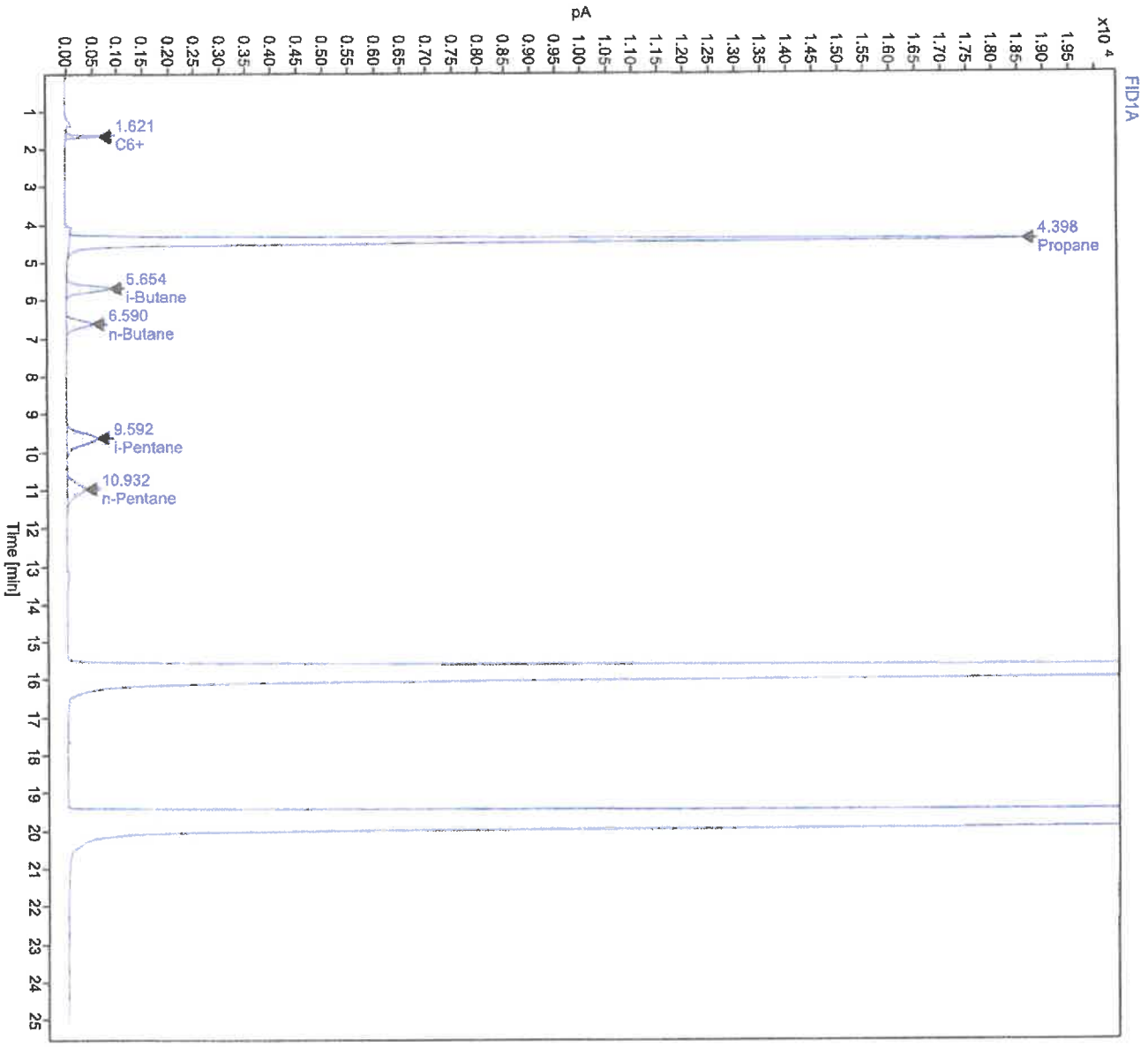

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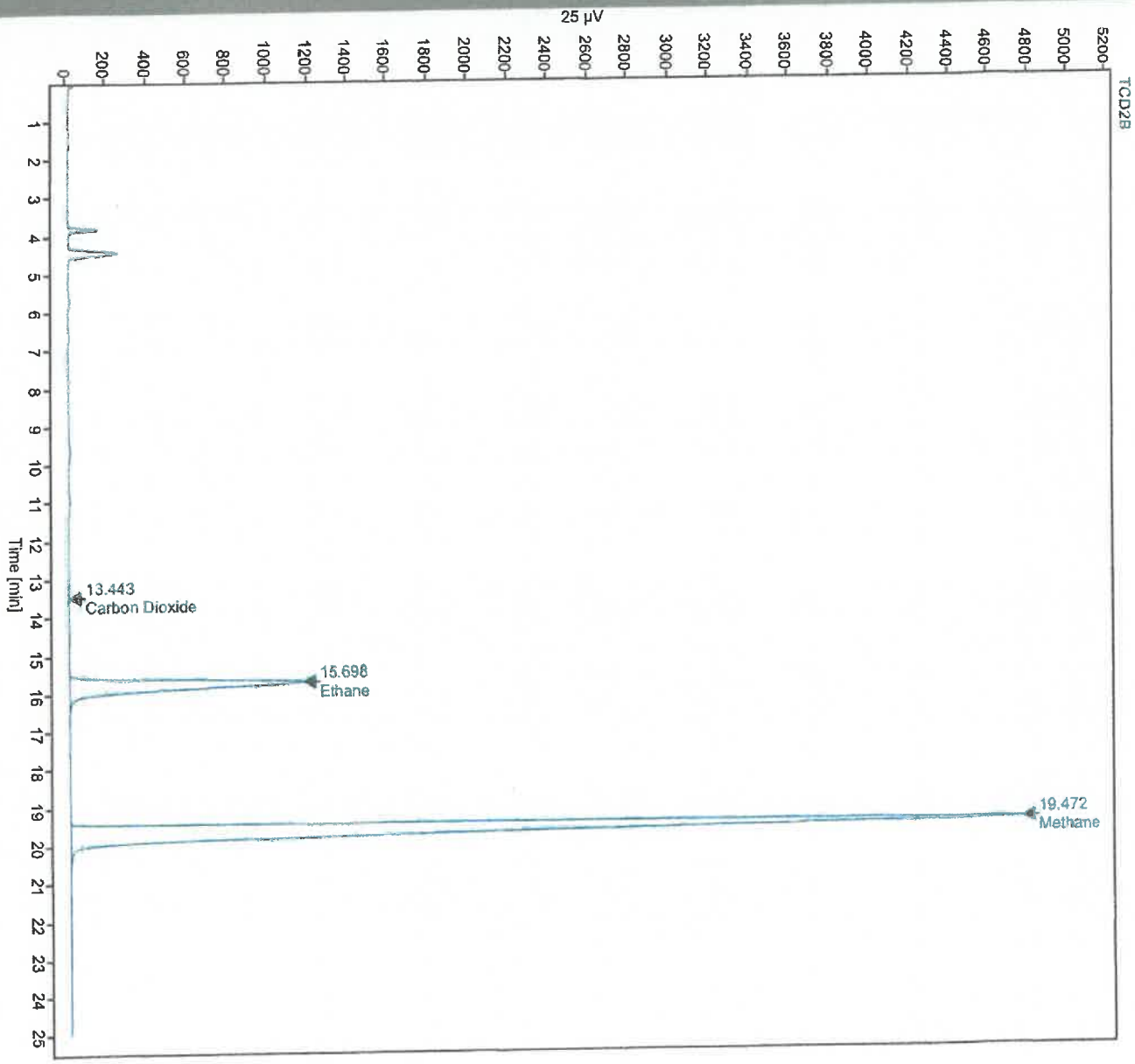

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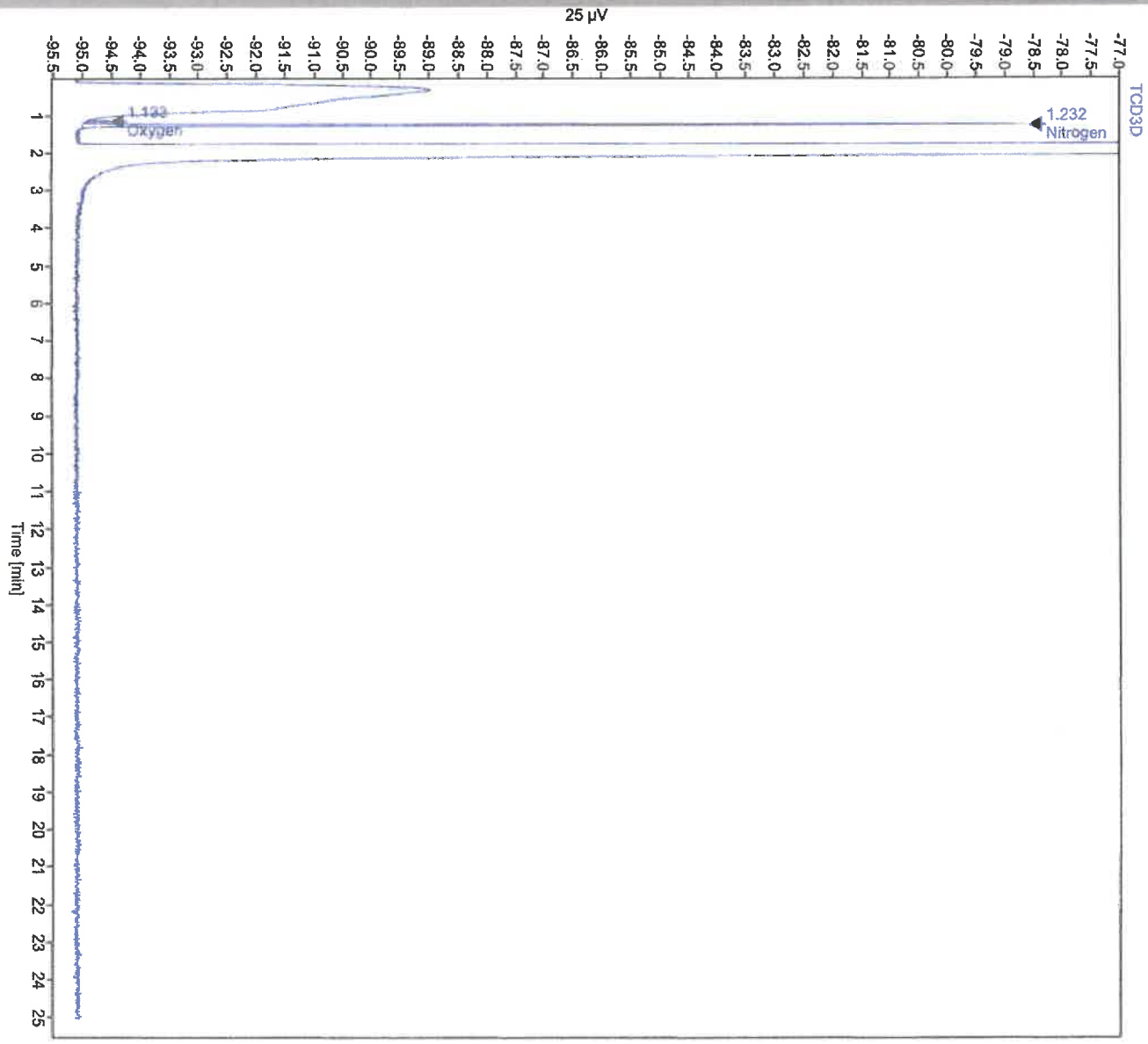

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Single Injection Report

Agilent

Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]
Oxygen	TCD3	1.133	0.011576515	0.73220	0.008476	0.008553
Nitrogen	TCD3	1.232	0.016482332	36.30544	0.598398	0.603801
C6+	FID1	1.621	0.000004011	2515.83300	0.010091	0.010182
Propane	FID1	4.398	0.000007954	163473.39252	1.300267	1.312007
i-Butane	FID1	5.654	0.000005964	10020.25076	0.059761	0.060300
n-Butane	FID1	6.590	0.000005877	6888.18356	0.040482	0.040847
i-Pentane	FID1	9.592	0.000004742	12693.66845	0.060193	0.060737
n-Pentane	FID1	10.932	0.000004817	8320.29516	0.040079	0.040441
Carbon Dioxide	TCD2	13.443	0.000916516	11.02476	0.010104	0.010196
Ethane	TCD2	15.698	0.000754509	18326.45630	13.827476	13.952324
Methane	TCD2	19.472	0.001149343	72345.55104	83.149853	83.900611
				Total mol%	99.105181	100.000000

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04 DEC 2024

Method Report

Agilent

Data Analysis Method: NATURAL_GAS_PROCESSING_20241204.pmx
Path: C:\CDSProjects\GC-08\Methods

1 Method Information

Last Saved As:	C:\CDSProjects\GC-08\Methods\NATURAL_GAS_PROCESSING_20241204.pmx	**Modified:**	2024-12-04 13:56:54+09:30	**Modifier:**	SYSTEM (SYSTEM)
Created:	2024-12-04 13:02:26+09:30	**Creator:**	SYSTEM (SYSTEM)	**Description:**	
Version:	2024-1204-0426-54678	**Method Status:**	Generic	**Type:**	GC/LC Norm Percent

2 Method Parameters

2.1 Signals

2.1.1 Blank Subtraction

Blank subtraction:	None	**Used blank:**	Defined in sequence	**Specific blank path:**	
Specific blank:		**Subtract blank if data rates are different:**	No	**Signal matching mode:**	Perform blank subtraction if signal names match

2.1.2 Scaling

From time:	min	**To time:**	min	**Use time axis:**	No
From response:		**To response:**		**Use response axis:**	No

2.1.3 Chromatogram Smoothing

Smoothing algorithm:	None

2.2 ChemStation integrator

2.2.1 ChemStation integrator parameters

Tangent skim mode:	Standard	**Baseline correction:**	Advanced	**Front peak skim height ratio:**	0.00
Tail peak skim height ratio:	0.00	**Skim valley ratio:**	20.00	**Peak to valley ratio:**	500.00

2.2.1.1 Initial timed events

Use	Time	Event	Value
Yes	0.000 min	Slope sensitivity	1
Yes	0.000 min	Peak width	0.02
Yes	0.000 min	Area reject	1
Yes	0.000 min	Height reject	1.7
Yes	0.000 min	Shoulders mode	Off
Yes	0.000 min	Area% reject	0

2.2.2 ChemStation integrator parameters FID1A

2.2.2.1 Initial timed events

Use	Time	Event	Value
Yes	0.000 min	Slope sensitivity	1
Yes	0.000 min	Peak width	0.1
Yes	0.000 min	Area reject	2
Yes	0.000 min	Height reject	2
Yes	0.000 min	Shoulders mode	Off
Yes	0.000 min	Area% reject	0

HK 4/12/24

2.2.2.2 Timed events

Use	Time	Event	Value
Yes	0.000 min	Integration	Off
Yes	1.400 min	Integration	On
Yes	9.000 min	Integration	Off

2.2.3 ChemStation integrator parameters TCD2B

2.2.3.1 Initial timed events

Use	Time	Event	Value
Yes	0.000 min	Slope sensitivity	1
Yes	0.000 min	Peak width	0.118
Yes	0.000 min	Area reject	0
Yes	0.000 min	Height reject	0
Yes	0.000 min	Shoulders mode	Off
Yes	0.000 min	Area% reject	0

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04 DEC 2024

2.2.3.2 Timed events

Use	Time	Event	Value
Yes	0.000 min	Integration	Off
Yes	11.000 min	Integration	On

2.2.4 ChemStation integrator parameters TCD3D

2.2.4.1 Initial timed events

Use	Time	Event	Value
Yes	0.000 min	Slope sensitivity	1
Yes	0.000 min	Peak width	0.01
Yes	0.000 min	Area reject	0
Yes	0.000 min	Height reject	0.1
Yes	0.000 min	Shoulders mode	Off
Yes	0.000 min	Area% reject	0

2.2.4.2 Timed events

Use	Time	Event	Value
Yes	0.000 min	Integration	Off
Yes	1.200 min	Integration	On
Yes	2.800 min	Integration	Off

2.3 Compound parameters

Include ISTD Amount:	No	**Is normalized:**	Yes	**Apply correction factors to normalized concentrations:**	Yes
Level count:	1	**ISTD method:**	No	**Use time reference compounds:**	No
Use RRT reference compounds:	No	**Norm amount:**	100.0	**Norm amount unit:**	%
Response factor calculation mode:	Amount per response	**Use individual points:**	No	**Concentration calculation:**	Amount * Multipliers / Dil. factor
Calculate mass %:	No	**Allow level specific ISTD amounts:**	No	**Qualifier count:**	2
Qualifier RT Window:	0.010 min	**Qualifier response window:**	20.0 percent	**Response Window Type:**	Relative

2.3.1 Expected compounds

Empty columns are hidden.

Row ID	Name	Signal	Exp. RT	Absolute RT window	Relative RT window	RT update	RT update factor	Factor	Peak match	Response Window Type	Role	Amount unit
1	Oxygen	TCD3D	1.132 min	0.050 min	1.000 percent	Never	50.000 percent	1.000	Closest	Relative	None	mol%
2	Nitrogen	TCD3D	1.232 min	0.150 min	1.000 percent	Never	50.000 percent	1.000	Closest	Relative	None	mol%
3	C6+	FID1A	1.638 min	0.100 min	1.000 percent	Never	50.000 percent	1.000	Closest	Relative	None	mol%
4	Propane	FID1A	4.390 min	0.150 min	1.000 percent	Never	50.000 percent	1.000	Closest	Relative	None	mol%
5	i-Butane	FID1A	5.648 min	0.100 min	1.000 percent	Never	50.000 percent	1.000	Closest	Relative	None	mol%
6	n-Butane	FID1A	6.587 min	0.100 min	1.000 percent	Never	50.000 percent	1.000	Closest	Relative	None	mol%
7	i-Pentane	FID1A	9.599 min	0.100 min	1.000 percent	Never	50.000 percent	1.000	Closest	Relative	None	mol%
8	n-Pentane	FID1A	10.944 min	0.100 min	1.000 percent	Never	50.000 percent	1.000	Closest	Relative	None	mol%
9	Carbon Dioxide	TCD2B	13.461 min	0.100 min	1.000 percent	Never	50.000 percent	1.000	Closest	Relative	None	mol%
10	Ethane	TCD2B	15.731 min	0.300 min	1.000 percent	Never	50.000 percent	1.000	Closest	Relative	None	mol%
11	Methane	TCD2B	19.505 min	0.600 min	1.000 percent	Never	50.000 percent	1.000	Closest	Relative	None	mol%

Row ID	Use in normalization	Multiplier	Response	Mode	Manual factor	Response scaling	Sensitivity	UV spectrum	MS reference spectrum
1	Yes	1.00000	Area	Manual factor	0.012073056	None	50	No	No
2	Yes	1.00000	Area	Manual factor	0.016461358	None	50	No	No
3	Yes	1.00000	Area	Manual factor	0.000004008	None	50	No	No
4	Yes	1.00000	Area	Manual factor	0.000007961	None	50	No	No
5	Yes	1.00000	Area	Manual factor	0.000005976	None	50	No	No
6	Yes	1.00000	Area	Manual factor	0.000005890	None	50	No	No
7	Yes	1.00000	Area	Manual factor	0.000004759	None	50	No	No
8	Yes	1.00000	Area	Manual factor	0.000004831	None	50	No	No
9	Yes	1.00000	Area	Manual factor	0.000915124	None	50	No	No
10	Yes	1.00000	Area	Manual factor	0.000761410	None	50	No	No
11	Yes	1.00000	Area	Manual factor	0.001159081	None	50	No	No

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04 DEC 2024

2.4 System Suitability

EP:	No	**Column performance:**	None	**JP:**	No
USP:	No	**Signal to noise:**	None	**Noise calculation:**	P2P
Use blank reference for noise:	on blank	**Use blank reference for relative noise:**	on blank	**Calculate noise before or after peak:**	before peak start
Range mode for Noise Selection:	Automatic	**Noise range end time:**	0.60	**Noise range start time:**	50
Noise range relative end time:	0.40	**Noise range relative start time:**	0.00	**Overwrite column parameters:**	No
Tangent calculation mode:	Standard				

2.5 Custom calculations

Last imported file:		**Embedded file:**		No	**Created by:**
Creation date:		**Last modified by:**			**Last modified date:**
File version:		**Custom calculations file:**			

2.6 Reporting parameters

Use time axis:		No	**Use response axis:**	No	**From time:**
To time:			**From response:**		**To response:**

2.6.1 General reporting parameters

Row ID	Report #	Report template	Report file name	Report for sample types	Do print	Printer name	Do create file	Copy report location
1	1	20221203 NAT GAS REPORT.rdl	<DX>_<R>	All sample types	No	Local Printer	Yes	Windows file system
2	2	NormAmount.rdl	<DX>_<R>	All sample types	No	Local Printer	No	

Row ID	Report copy folder	Report selected signals	Report file type
1	C:\CDSProjects\GC-08\Result Reports\2022\Dec\	All signals	pdf
2		All signals	pdf

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04 DEC 2024

Method Audit Trail

#	Username Reviewed	Date (yyyy-MM-dd) Version	Category Hostname	Description Reason
1	SYSTEM (SYSTEM)	2024-12-04 13:02:26+09:30 2024-1204-0332-26809	Method CSW10D2331LMD.inpex.com.au	Saved method 'C:\CDSProjects\GC-08\Methods\NATURAL_GAS_PROCESSING_20240819.pmx' version 2024-0819-0620-19238 as 'C:\CDSProjects\GC-08\Methods\NATURAL_GAS_PROCESSING_20241204.pmx'.
2	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Calibration CSW10D2331LMD.inpex.com.au	Changed 'Manual factor' from '0.000004011' to '0.000004008' for 'C6+ (FID1A)'.
3	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Calibration CSW10D2331LMD.inpex.com.au	Changed 'Manual factor' from '0.000007954' to '0.000007961' for 'Propane (FID1A)'.
4	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Calibration CSW10D2331LMD.inpex.com.au	Changed 'Manual factor' from '0.000005964' to '0.000005976' for 'i-Butane (FID1A)'.
5	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Calibration CSW10D2331LMD.inpex.com.au	Changed 'Manual factor' from '0.000005877' to '0.000005890' for 'n-Butane (FID1A)'.
6	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Calibration CSW10D2331LMD.inpex.com.au	Changed 'Manual factor' from '0.000004742' to '0.000004759' for 'i-Pentane (FID1A)'.
7	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Calibration CSW10D2331LMD.inpex.com.au	Changed 'Manual factor' from '0.000004817' to '0.000004831' for 'n-Pentane (FID1A)'.
8	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Calibration CSW10D2331LMD.inpex.com.au	Changed 'Manual factor' from '0.000916516' to '0.000915124' for 'Carbon Dioxide (TCD2B)'.
9	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Calibration CSW10D2331LMD.inpex.com.au	Changed 'Manual factor' from '0.000754509' to '0.000761410' for 'Ethane (TCD2B)'.
10	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Calibration CSW10D2331LMD.inpex.com.au	Changed 'Manual factor' from '0.001149343' to '0.001159081' for 'Methane (TCD2B)'.
11	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Compound identification CSW10D2331LMD.inpex.com.au	Changed 'Exp. RT' from '1.175000000' to '1.132000000' min for 'Oxygen (TCD3D)'.
12	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Calibration CSW10D2331LMD.inpex.com.au	Changed 'Manual factor' from '0.011576515' to '0.012073056' for 'Oxygen (TCD3D)'.
13	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Compound identification CSW10D2331LMD.inpex.com.au	Changed 'Exp. RT' from '1.332000000' to '1.232000000' min for 'Nitrogen (TCD3D)'.
14	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Calibration CSW10D2331LMD.inpex.com.au	Changed 'Manual factor' from '0.016482332' to '0.016461358' for 'Nitrogen (TCD3D)'.
15	SYSTEM (SYSTEM)	2024-12-04 13:56:54+09:30 2024-1204-0426-54678	Method CSW10D2331LMD.inpex.com.au	Saved method.

MK 4/12/24

CERTIFICATE OF CALIBRATION

Replacement of Certificate of Calibration Serial No 21/1161/10

Approved signatory
Name: **Alan Boulton**
Signature

Issued by **EffecTech**
Date of issue **27 July 2022**

Certificate number **21/1161/10A**

EffecTech
Global Leaders In Gas Measurement

Dove House
Dove Fields
Uttoxeter
Staffordshire ST14 8HU
United Kingdom

www.effectech.co.uk

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Customer	: CAC Gas & Instrumentation Pty. Ltd. Unit 3 / 36 Holbeche Rd., Arndell Park, NSW 2148, Australia.
Customer reference	: PO No.PO5181 (Part Code: 50ST-INPX-LNGQC1CH4)
Product description	: Calibrated Gas Mixture (CGM) for use in natural gas analysis Multi-component natural gas mixture
Preparation method	: Mixture prepared by ISO 6142-1:2015 - *Gas Analysis - Preparation of calibration gas mixtures - Part 1 : Gravimetric method for Class I mixtures*
Calibration method	: Mixture calibrated by ISO 6143:2001 - *Gas Analysis - Comparison methods for determining and checking the composition of calibration gas mixtures* using high precision gas chromatography
Metrological traceability	: Mixture classified as a Calibrated Gas Mixture (CGM) on which the values are assigned through an unbroken chain of analytical comparisons to a Primary Reference Gas Mixture

Date of calibration	: 25 August 2021	Cylinder number	: 21/41850
Minimum usage pressure	: 3 bar	Contents pressure	: 109 bar
Usage temperature range	: 15 to 50°C	Cylinder size	: 50 litres
Storage temperature range	: -38 to 50°C	Cylinder material	: steel
		Valve outlet connection	: BS 341 - No.4

Composition

component	amount fraction (%mol/mol)
oxygen	0.00970 ± 0.00017
nitrogen	0.2005 ± 0.0029
carbon dioxide⋆	0.00977 ± 0.00024
methane	85.810 ± 0.026
ethane	12.996 ± 0.032
propane	0.7994 ± 0.0024
iso-butane	0.05039 ± 0.00045
n-butane	0.03031 ± 0.00045
iso-pentane	0.05026 ± 0.00035
n-pentane	0.03022 ± 0.00025
n-hexane	0.01010 ± 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%.

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

To re-order this gas mixture contact CAC Gas & Instrumentation quoting certificate number 21/1161/10A.
tel: 1300 CAC GAS (+61 2 8676 6500) email: cac@cacgas.com.au

EffecTech is accredited by UKAS to undertake the calibration presented in this certificate according to ISO/IEC 17025:2017.

Physical Properties

Reference conditions	**primary** combustion 15 °C metering 15 °C		**secondary** combustion 0 °C metering 0 °C	
mean molar mass	18.204 ± 0.018	kg·kmol^{-1}	18.204 ± 0.018	kg·kmol^{-1}
compression factor	0.9973 ± 0.0010		0.9968 ± 0.0010	
Real gas properties				
superior calorific value	42.041 ± 0.042	MJ·m^{-3}	44.442 ± 0.044	MJ·m^{-3}
	991.40 ± 0.99	kJ·mol^{-1}	992.92 ± 0.99	kJ·mol^{-1}
	54.460 ± 0.054	MJ·kg^{-1}	54.544 ± 0.055	MJ·kg^{-1}
inferior calorific value	37.995 ± 0.038	MJ·m^{-3}	40.109 ± 0.040	MJ·m^{-3}
	895.97 ± 0.90	kJ·mol^{-1}	896.12 ± 0.90	kJ·mol^{-1}
	49.218 ± 0.049	MJ·kg^{-1}	49.227 ± 0.049	MJ·kg^{-1}
relative density	0.62996 ± 0.00063		0.63019 ± 0.00063	
density	0.77196 ± 0.00077	kg·m^{-3}	0.81478 ± 0.00081	kg·m^{-3}
superior Wobbe index	52.969 ± 0.053	MJ·m^{-3}	55.983 ± 0.056	MJ·m^{-3}
Ideal gas properties				
superior calorific value	41.929 ± 0.042	MJ·m^{-3}	44.299 ± 0.044	MJ·m^{-3}
	991.40 ± 0.99	kJ·mol^{-1}	992.92 ± 0.99	kJ·mol^{-1}
	54.460 ± 0.054	MJ·kg^{-1}	54.544 ± 0.055	MJ·kg^{-1}
inferior calorific value	37.893 ± 0.038	MJ·m^{-3}	39.980 ± 0.040	MJ·m^{-3}
	895.97 ± 0.90	kJ·mol^{-1}	896.12 ± 0.90	kJ·mol^{-1}
	49.218 ± 0.049	MJ·kg^{-1}	49.227 ± 0.049	MJ·kg^{-1}
relative density	0.62853 ± 0.00063		0.62853 ± 0.00063	
density	0.76989 ± 0.00077	kg·m^{-3}	0.81217 ± 0.00081	kg·m^{-3}
superior Wobbe index	52.886 ± 0.053	MJ·m^{-3}	55.877 ± 0.056	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).

For the purpose of these calculations, and in accordance with the recommendations of the international standard, the gas mixture is assumed dry (free from moisture).

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%.

CERTIFICATE OF CALIBRATION

Replacement of Certificate of Calibration Serial No 21/1161/10

UKAS accredited calibration laboratory no.0590

Certificate number

21/1161/10A

Replacement History

Certificate number	Reason for replacement
21/1161/10	Original Certificate
21/1161/10A	Certificate regenerated following an investigation on the intracalibration on the danalyzer. The investigation highlighted that the software was predicting a quadractic fit for ethane. This was used in the original certification which resulted in a bias in between ethane and methane values. However, a linear fit is more appropriate. Certificates re-issued according to this revised dataset.

ADVICE on the storage and use of your calibration gas mixture

The calibration gas mixture supplied to you contains components which are condensable under certain conditions of temperature. It is important that these conditions are avoided where possible during storage and usage of the mixture.

Please read this advice in conjunction with recommended storage/usage conditions given on the certificate of calibration.

Storage

*Has the ambient temperature during **storage** dropped below the hydrocarbon dew temperature at contents pressure?*

If so then there will be stratification of your mixture into two phases (vapour and liquid)

The withdrawal of any gas phase content from this two phase mixture will invalidate the certified reference values we have provided with your calibration gas.

Advice before use

There will be no record of the minimum temperature to which your gas mixture has been exposed in transport to you. Hence, there is no guarantee that the gas mixture has not been exposed to temperatures below the hydrocarbon dew temperature of your mixture at contents pressure. If you suspect the gas has been exposed to temperatures below this the contents must be allowed to equilibrate at a greater temperature for a minimum period of about 24 hours. Following this equilibration time your mixture should be entirely homogeneous and gaseous. Often, it is good practice to roll the cylinder, where possible, to encourage mixing during equilibration.

Use

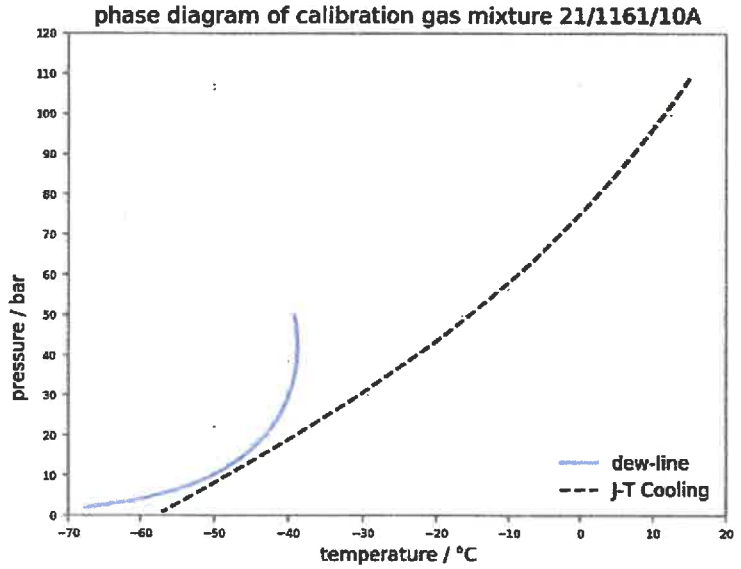
*When in **use** does condensation occur in your gas mixture following depressurisation as a result of cooling?*

Your gas mixture cools when it is depressurised through your pressure regulator. This is called Joule-Thomson (or Joule-Kelvin) cooling. If the gas cools to below the hydrocarbon dew temperature at its pressure then your mixture will stratify into two phases (vapour and liquid).

If this occurs the gas phase composition delivered to your application will not be representative of the certified reference values we have provided with your calibration gas.

Advice during use

The diagram below shows the pressure-temperature phase characteristics of your particular calibration mixture. Conditions shown to the left of the hydrocarbon dewline are in the two phase (liquid and vapour) region, whilst to the right your mixture remains as a single phase vapour. The cooling curve shown does not enter the two-phase region.



This demonstrates that during use your mixture remains entirely in the vapour phase should it be depressurised in a single stage from contents pressure and at a starting temperature of 15°C.

Technical information : The dewline and the cooling curve were calculated using GasVLE™ and constructed using the LRS equation of state (EOS) and the cooling curve generated from a simulated isenthalpic flash calculation assuming adiabatic conditions starting at contents pressure and the stated temperature.

LNG Verification Gas Cylinder ID: 21/41850 Instrument ID: GC8		Verification Run 1 Data File: L2501417001.2.dx	Verification Run 2 Data File: L2501417001.3.dx	GPA 2261 : 2000 (Acceptance Criteria)					ISO 6974 : 5 (Acceptance Criteria)					GPA 2261 : 1964 (Acceptance Criteria)			
				Repeatability		Reproducibility			Repeatability		Reproducibility			Repeatability	Reproducibility		
Compound	Certified Value (mol%)	Normalised mol%	Normalised mol%	Difference between runs [ABS (Run1 -Run 2)]	GPA 2261 : 2000 Repeatability Limit	QC Mean Normalised mol% (Run1+Run2)/2	Difference (QC Mean - Certified Value)	GPA 2261 : 2000 Reproducibility - Limit	Difference between runs [ABS (Run1 -Run 2)]	Calculated ISO 6974-5 Repeatability limit, based on mean CRM value	QC Mean Normalised mol% (Run1+Run2)/2	Difference (QC Mean - Certified Value)	Calculated ISO 6974-5 Reproducibility Limit	GPA 2261 : 1964 Repeatability	QC Mean Normalised mol% (Run1+Run2)/2	Difference (QC Mean - Certified Value)	GPA 2261 : 1964 Reproducibility - Limit
Methane	85.810	85.81	85.82	0.01	0.17	85.82	0.01	0.60	0.01	0.03	85.82	0.01	0.07	N/A	85.82	0.01	0.30
Ethane	12.996	13.01	13.00	0.01	0.13	13.01	0.01	0.26	0.01	0.02	13.01	0.01	0.04	N/A	13.01	0.01	0.10
Propane	0.7994	0.79	0.79	0.00	0.01	0.79	0.01	0.02	0.00	0.01	0.79	0.01	0.02	N/A	0.79	0.01	0.03
Isobutane	0.05039	0.05	0.05	0.00	0.00	0.05	0.00	0.00	0.00	0.01	0.05	0.00	0.01	N/A	0.05	0.00	0.03
n-Butane	0.03031	0.03	0.03	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.00	0.01	N/A	0.03	0.00	0.03
Isopentane	0.05026	0.05	0.05	0.00	0.00	0.05	0.00	0.00	0.00	0.01	0.05	0.00	0.01	N/A	0.05	0.00	0.03
n-Pentane	0.03022	0.03	0.03	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.00	0.01	N/A	0.03	0.00	0.03
n-Hexane	0.01010	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01	N/A	0.01	0.00	0.00
Carbon dioxide	0.00977	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01	N/A	0.01	0.00	0.03
Oxygen	0.00970	0.01	0.01	0.00	N/A	0.01	0.00	N/A	0.00	0.00	0.01	0.00	0.01	N/A	0.01	0.00	0.03
Nitrogen	0.2005	0.20	0.20	0.00	0.00	0.20	0.00	0.01	0.00	0.01	0.20	0.00	0.01	N/A	0.20	0.00	0.03
Normalised Total	100.00	100.00	100.00														
Un-Normalised Total (+/-1%)		99.92	100.00														

Analyst : CW Date : 25/03/2025

Checked by : RC Date : 25/3/25

Calculated value
Within Specification
Outside Specification
Cylinder certified value and calculated precision data
Data entry

Single Injection Report

Agilent

Sample name:	20250325 LNG QC Run 2		
Data file:	L2501417001.2.dx	**Operator:**	ilnglab
Instrument:	GC08	**Injection date:**	2025-03-25 07:06:04+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC08_ACQUISITION_NAT_GAS_20240819.amx		
Injection Acq Method Modified Date	2024-08-19 07:03:00+09:30		
Processing method:	NATURAL_GAS_PROCESSING_20241204.pmx		
Injection DA Method Latest File Change	2024-12-04 13:56:54+09:30		

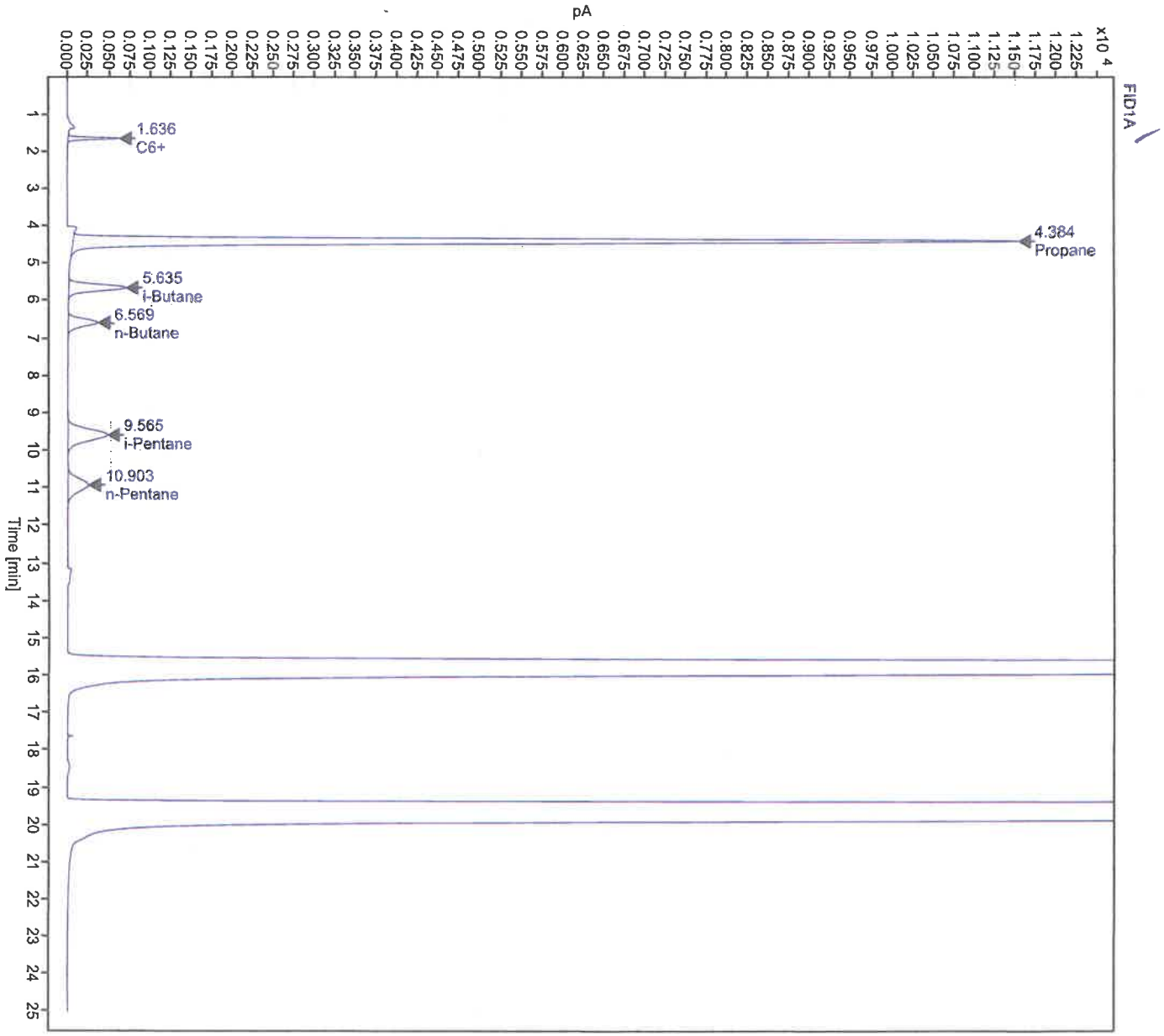
SO
25/3/25

CW
25 MAR 2025

25/3/25

Single Injection Report

Agilent

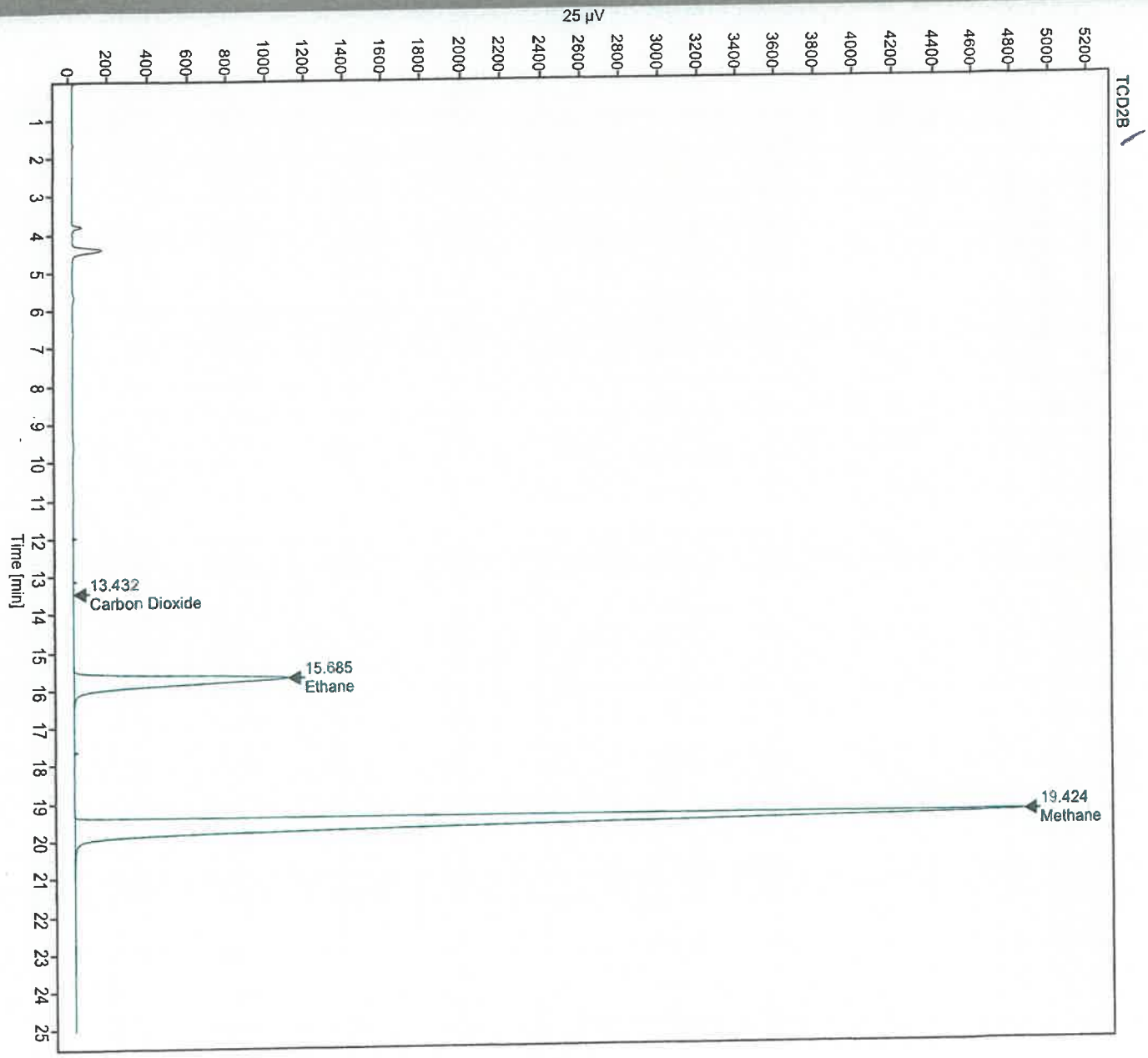


CW
25 MAR 2025

SO
25/3/25

Single Injection Report

Agilent

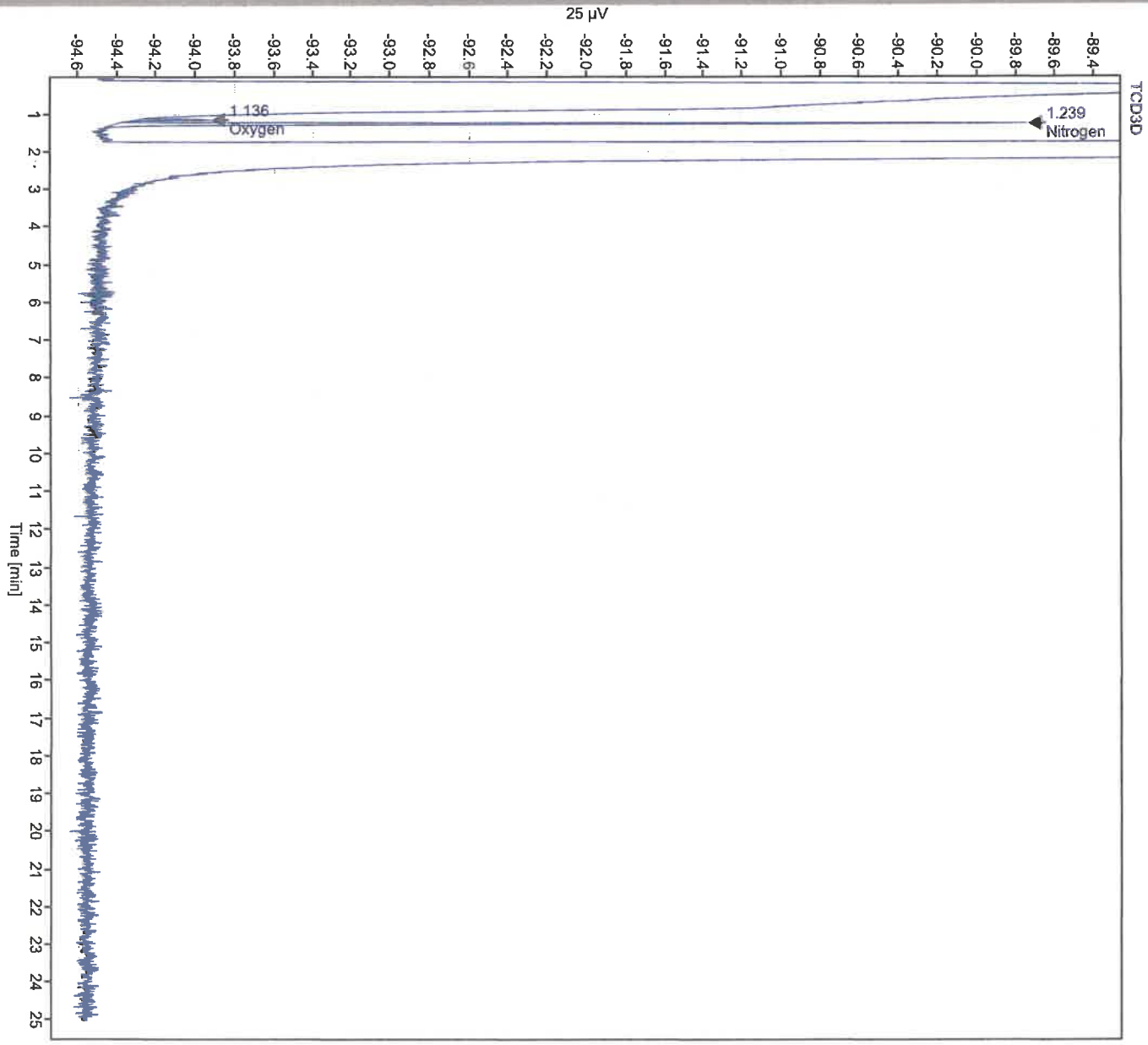


CW
25 MAR 2025

SO
2513/25

Single Injection Report

Agilent



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CW
25 MAR 2025

Single Injection Report

Agilent

Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]	mol% (2dp)
Oxygen	TCD3	1.136	0.012073056	0.82780	0.009994	0.010002	0.01
Nitrogen	TCD3	1.239	0.016461358	12.26534	0.201904	0.202063	0.20
C6+	FID1	1.636	0.000004008	2502.49648	0.010030	0.010038	0.01
Propane	FID1	4.384	0.000007961	99731.34998	0.793961	0.794586	0.79
i-Butane	FID1	5.635	0.000005976	8337.81116	0.049827	0.049866	0.05
n-Butane	FID1	6.569	0.000005890	5051.33984	0.029752	0.029776	0.03
i-Pentane	FID1	9.565	0.000004759	10425.47645	0.049615	0.049654	0.05
n-Pentane	FID1	10.903	0.000004831	6215.02157	0.030025	0.030048	0.03
Carbon Dioxide	TCD2	13.432	0.000915124	11.35201	0.010389	0.010397	0.01
Ethane	TCD2	15.685	0.000761410	17067.38086	12.995274	13.005505	13.01
Methane	TCD2	19.424	0.001159081	73972.88637	85.740567	85.808065	85.81
				Total mol%	99.921338	100.000000	100.00

99.92

CW
25 MAR 2025

SO
25/3/25

Single Injection Report

Agilent

Sample name:	20250325 LNG QC Run 3		
Data file:	L2501417001.3.dx	**Operator:**	ilnglab
Instrument:	GC08	**Injection date:**	2025-03-25 07:31:33+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC08_ACQUISITION_NAT_GAS_20240819.amx		
Injection Acq Method Modified Date	2024-08-19 07:03:00+09:30		
Processing method:	NATURAL_GAS_PROCESSING_20241204.pmx		
Injection DA Method Latest File Change	2024-12-04 13:56:54+09:30		

CW
25 MAR 2025

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SO
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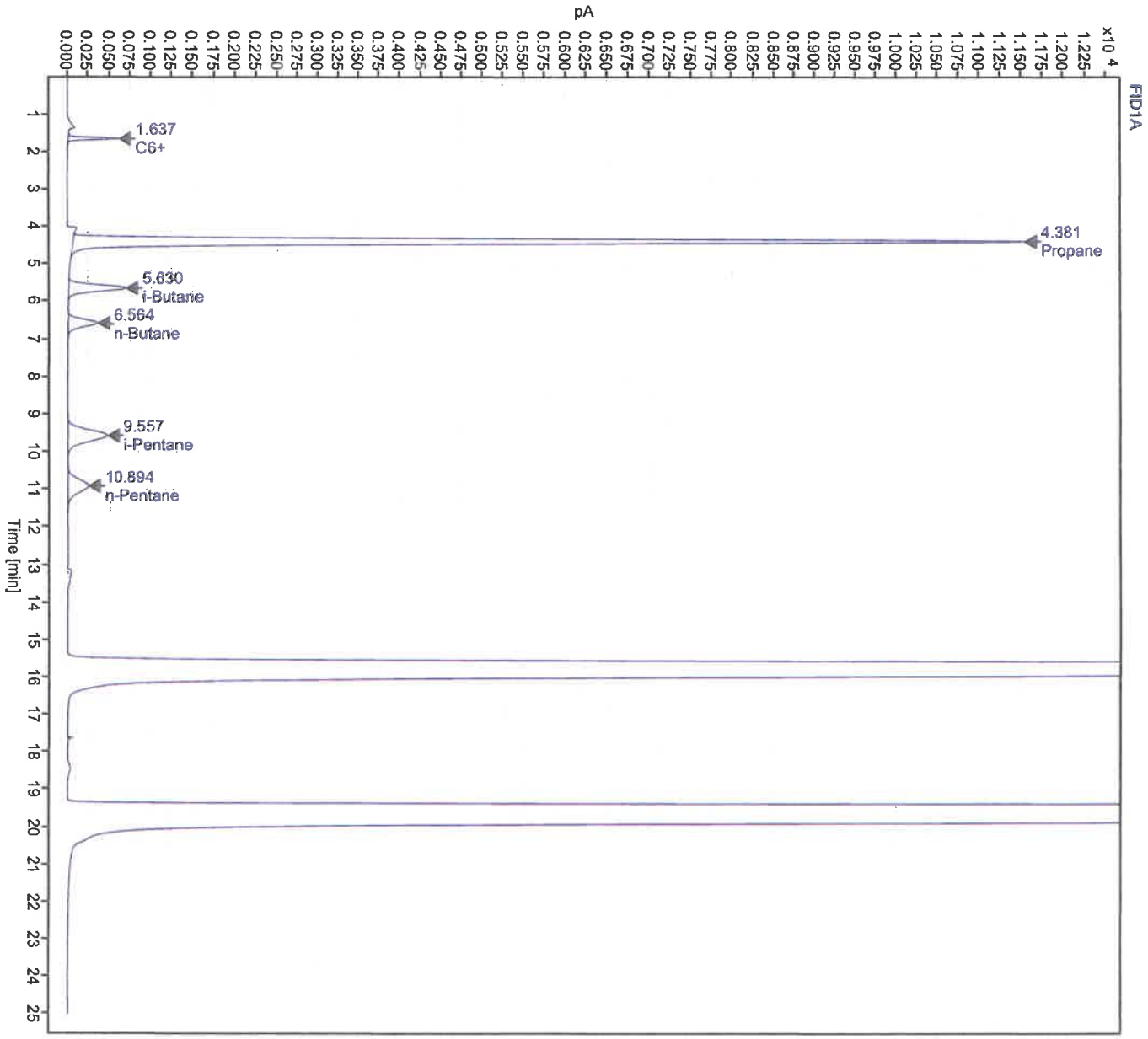
Single Injection Report

Agilent



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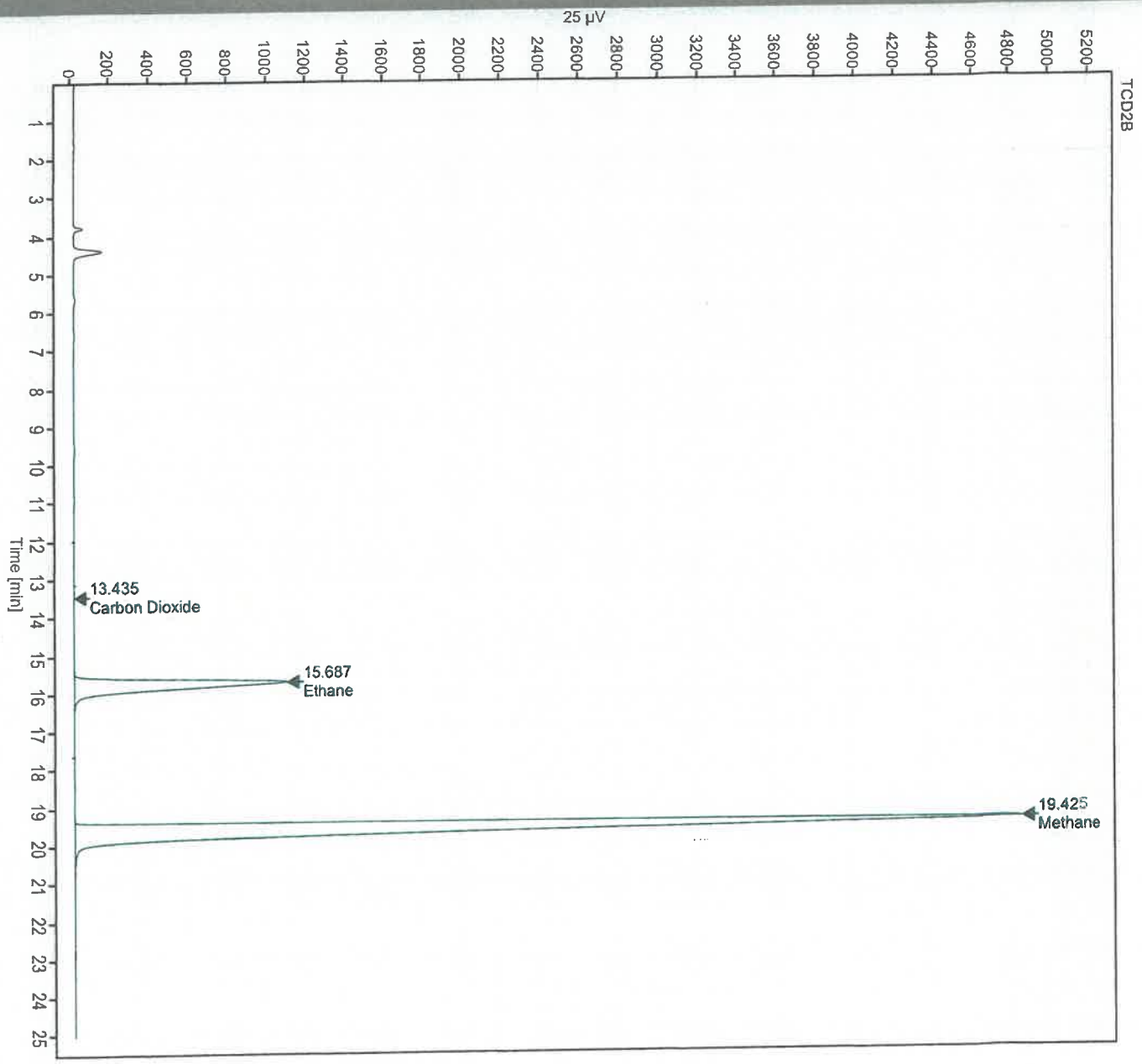
Single Injection Report

Agilent



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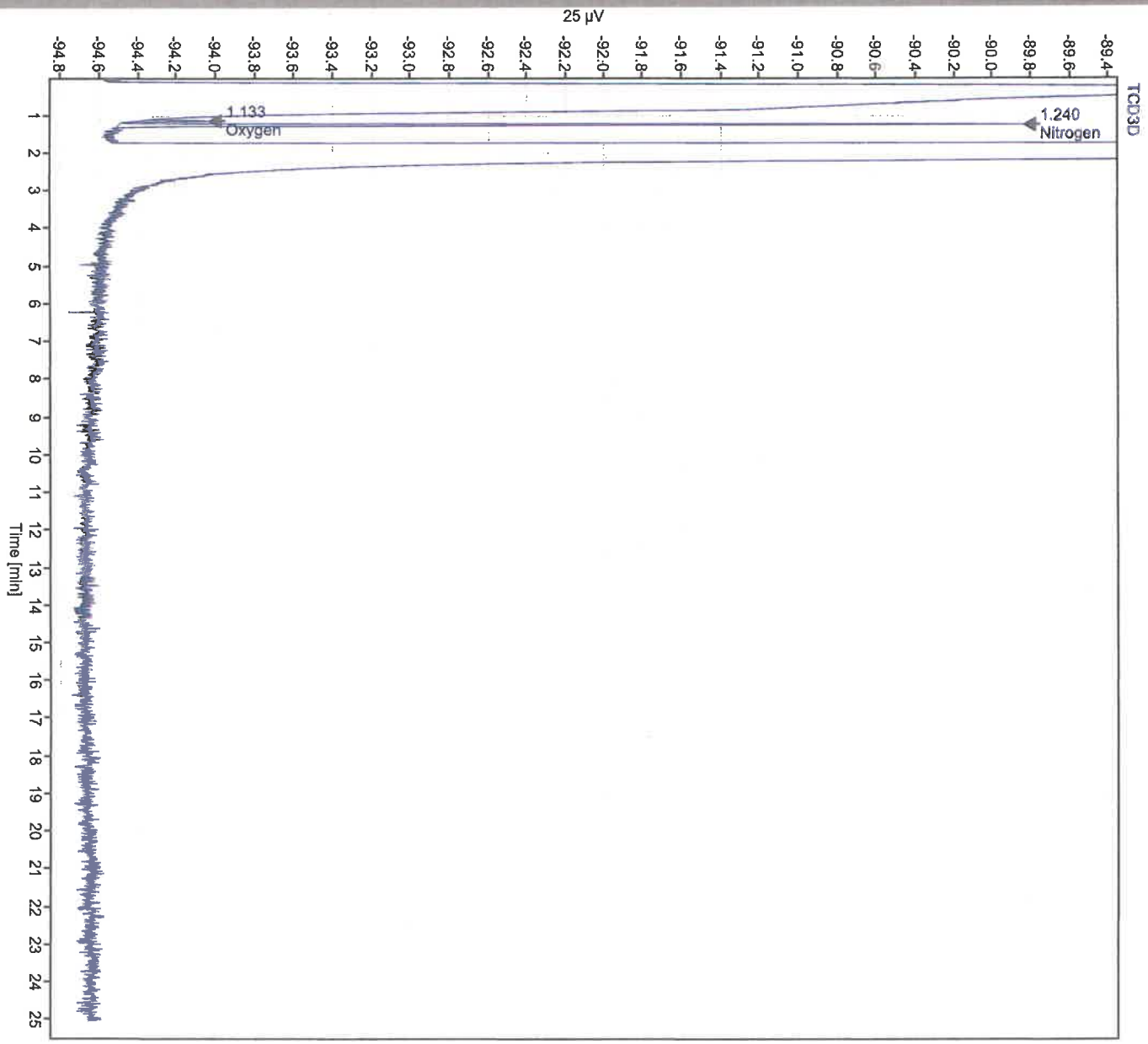
Single Injection Report

Agilent



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Single Injection Report

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Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]	mol% (2dp
Oxygen	TCD3	1.133	0.012073056	0.78546	0.009483	0.009483	0.01 ✓
Nitrogen	TCD3	1.240	0.016461358	12.16808	0.200303	0.200311	0.20 ✓
C6+	FID1	1.637	0.000004008	2481.12505	0.009944	0.009945	0.01 ✓
Propane	FID1	4.381	0.000007961	99736.88343	0.794005	0.794035	0.79 ✓
i-Butane	FID1	5.630	0.000005976	8336.85989	0.049821	0.049823	0.05 ✓
n-Butane	FID1	6.564	0.000005890	5047.50340	0.029730	0.029731	0.03 ✓
i-Pentane	FID1	9.557	0.000004759	10408.12653	0.049532	0.049534	0.05 ✓
n-Pentane	FID1	10.894	0.000004831	6198.06492	0.029943	0.029944	0.03 ✓
Carbon Dioxide	TCD2	13.435	0.000915124	11.13574	0.010191	0.010191	0.01 ✓
Ethane	TCD2	15.687	0.000761410	17072.97049	12.999530	13.000015	13.00 ✓
Methane	TCD2	19.425	0.001159081	74036.05948	85.813790	85.816989	85.82 ✓
				Total mol%	99.996273	100.000000	100.00

100.00 ✓

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CERTIFIED REFERENCE MATERIAL

Approved signatory
Name: **Gautami Snewin**
Signature

Issued by **EffecTech**
Date of issue **12 April 2023**

Certificate number **23/0472/01**

EffecTech
Global Leaders in Gas Measurement

Dove House
Dove Fields
Uttoxeter
Staffordshire ST14 8HU
United Kingdom

www.effectech.co.uk

ilac-MRA

UKAS REFERENCE MATERIALS 5710

Customer	: CAC Gas & Instrumentation Pty. Limited Unit 3 / 36 Holbeche Rd., Arndell Park, NSW 2148, Australia.
Customer reference	: PO No.PO6534 (Part Code: 10AL-INPX-SPC6O2PT)
Product description	: Certified Reference Material (CRM) for use in natural gas analysis Multi-component natural gas mixture
Preparation method	: Mixture prepared by ISO 6142-1:2015 - *Gas Analysis - Preparation of calibration gas mixtures - Part 1 : Gravimetric method for Class I mixtures*
Value assignment	: Values assigned by ISO 6143:2001 - *Gas Analysis - Comparison methods for determining and checking the composition of calibration gas mixtures* using high precision gas chromatography
Metrological traceability	: Mixture classified as a Certified Reference Material (CRM) on which the values are assigned through an unbroken chain of analytical comparisons to a Primary Reference Gas Mixture
Stability	: EffecTech stability studies of similar gas mixtures in this type of cylinder/valve combination have demonstrated a shelf-life of 5 years providing the contents pressure and usage/storage temperature remain within the limits stated in the table below.
Handling and Use	: Supplementary advice is annexed to this certificate on the handling, storage and use of this certified reference material. General instructions for the proper use of gas mixtures can be found in ISO 16664: *Gas Analysis - Handling of calibration gases and gas mixtures*

Date of production	: 27 March 2023	Cylinder number	: D172603
Expiry date	: 27 March 2028	Contents pressure	: 84 bar
Minimum usage pressure	: 3 bar	Cylinder size	: 10 litres
Usage temperature range	: 0 to 50 °C	Cylinder material	: aluminium
Storage temperature range	: -40 to 50 °C	Valve outlet connection	: BS 341 - No.4

Composition

component	amount fraction (%mol/mol)
oxygen	0.00995 ± 0.00017
nitrogen	0.3781 ± 0.0079
carbon dioxide⋆	0.00993 ± 0.00020
methane	84.756 ± 0.025
ethane	13.713 ± 0.034
propane	0.9921 ± 0.0034
iso-butane	0.04939 ± 0.00045
n-butane	0.01987 ± 0.00045
iso-pentane	0.05067 ± 0.00036
n-pentane	0.02026 ± 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 contents of this certificate comply with the mandatory requirements of ISO Guide 31:2015 - *Reference materials — Contents of certificates, labels and accompanying documentation* and ISO 6141:2015 - *Gas Analysis - Contents of certificates for calibration gas mixtures*

To re-order this gas mixture contact CAC Gas & Instrumentation quoting certificate number 23/0472/01.
tel: 1300 CAC GAS (+61 2 8676 6500) email: cac@cacgas.com.au

EffecTech is accredited by UKAS as a producer of this certified reference material according to ISO 17034:2016.

The laboratory activities reported were performed at the location of the issuing body
The reference values reported relate only to the specific mixture identified in this certificate

CERTIFIED REFERENCE MATERIAL

UKAS accredited reference material producer no.5710

Certificate number

23/0472/01

Physical Properties

Reference conditions	**primary** combustion 15 °C metering 15 °C		**secondary** combustion 0 °C metering 0 °C	
mean molar mass	18.363 ± 0.018	$kg \cdot kmol^{-1}$	18.363 ± 0.018	$kg \cdot kmol^{-1}$
compression factor	0.9973 ± 0.0010		0.9967 ± 0.0010	
Real gas properties				
superior calorific value	42.256 ± 0.042	$MJ \cdot m^{-3}$	44.668 ± 0.045	$MJ \cdot m^{-3}$
	996.4 ± 1.0	$kJ \cdot mol^{-1}$	997.9 ± 1.0	$kJ \cdot mol^{-1}$
	54.260 ± 0.054	$MJ \cdot kg^{-1}$	54.344 ± 0.054	$MJ \cdot kg^{-1}$
inferior calorific value	38.197 ± 0.038	$MJ \cdot m^{-3}$	40.323 ± 0.040	$MJ \cdot m^{-3}$
	900.70 ± 0.90	$kJ \cdot mol^{-1}$	900.85 ± 0.90	$kJ \cdot mol^{-1}$
	49.048 ± 0.049	$MJ \cdot kg^{-1}$	49.057 ± 0.049	$MJ \cdot kg^{-1}$
relative density	0.63551 ± 0.00064		0.63574 ± 0.00064	
density	0.77876 ± 0.00078	$kg \cdot m^{-3}$	0.82196 ± 0.00082	$kg \cdot m^{-3}$
superior Wobbe index	53.006 ± 0.053	$MJ \cdot m^{-3}$	56.022 ± 0.056	$MJ \cdot m^{-3}$
Ideal gas properties				
superior calorific value	42.140 ± 0.042	$MJ \cdot m^{-3}$	44.523 ± 0.045	$MJ \cdot m^{-3}$
	996.4 ± 1.0	$kJ \cdot mol^{-1}$	997.9 ± 1.0	$kJ \cdot mol^{-1}$
	54.260 ± 0.054	$MJ \cdot kg^{-1}$	54.344 ± 0.054	$MJ \cdot kg^{-1}$
inferior calorific value	38.093 ± 0.038	$MJ \cdot m^{-3}$	40.191 ± 0.040	$MJ \cdot m^{-3}$
	900.70 ± 0.90	$kJ \cdot mol^{-1}$	900.85 ± 0.90	$kJ \cdot mol^{-1}$
	49.048 ± 0.049	$MJ \cdot kg^{-1}$	49.057 ± 0.049	$MJ \cdot kg^{-1}$
relative density	0.63404 ± 0.00063		0.63404 ± 0.00063	
density	0.77663 ± 0.00078	$kg \cdot m^{-3}$	0.81928 ± 0.00082	$kg \cdot m^{-3}$
superior Wobbe index	52.922 ± 0.053	$MJ \cdot m^{-3}$	55.914 ± 0.056	$MJ \cdot m^{-3}$

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).

For the purpose of these calculations, and in accordance with the recommendations of the international standard, the gas mixture is assumed dry (free from moisture).

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).

ADVICE on the storage and use of your calibration gas mixture

The calibration gas mixture supplied to you contains components which are condensable under certain conditions of temperature. It is important that these conditions are avoided where possible during storage and usage of the mixture.

Please read this advice in conjunction with recommended storage/usage conditions given on the certificate of calibration.

Storage

*Has the ambient temperature during **storage** dropped below the hydrocarbon dew temperature at contents pressure?*

If so then there will be stratification of your mixture into two phases (vapour and liquid)

The withdrawal of any gas phase content from this two phase mixture will invalidate the certified reference values we have provided with your calibration gas.

Advice before use

There will be no record of the minimum temperature to which your gas mixture has been exposed in transport to you. Hence, there is no guarantee that the gas mixture has not been exposed to temperatures below the hydrocarbon dew temperature of your mixture at contents pressure. If you suspect the gas has been exposed to temperatures below this the contents must be allowed to equilibrate at a greater temperature for a minimum period of about 24 hours. Following this equilibration time your mixture should be entirely homogeneous and gaseous. Often, it is good practice to roll the cylinder, where possible, to encourage mixing during equilibration.

Use

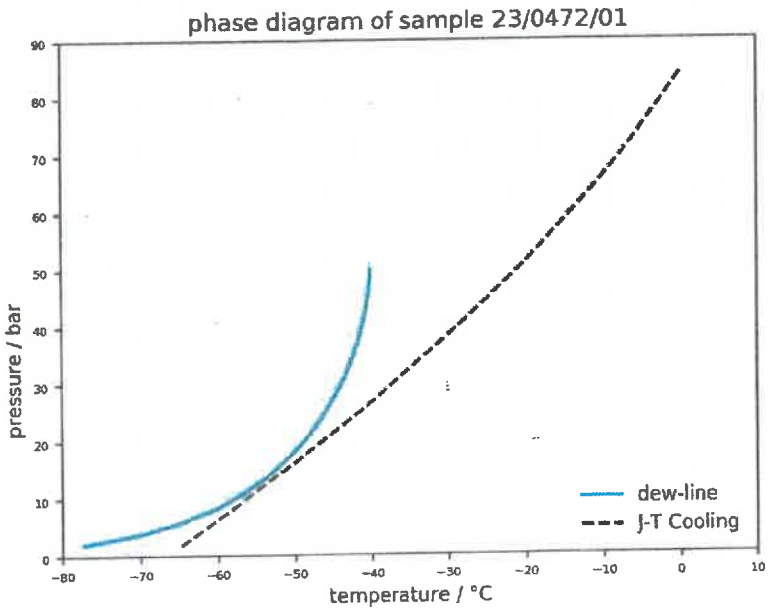
*When in **use** does condensation occur in your gas mixture following depressurisation as a result of cooling?*

Your gas mixture cools when it is depressurised through your pressure regulator. This is called Joule-Thomson (or Joule-Kelvin) cooling. If the gas cools to below the hydrocarbon dew temperature at its pressure then your mixture will stratify into two phases (vapour and liquid).

If this occurs the gas phase composition delivered to your application will not be representative of the certified reference values we have provided with your calibration gas.

Advice during use

The diagram below shows the pressure-temperature phase characteristics of your particular calibration mixture. Conditions shown to the left of the hydrocarbon dewline are in the two phase (liquid and vapour) region, whilst to the right your mixture remains as a single phase vapour. The cooling curve shown does not enter the two-phase region.



This demonstrates that during use your mixture remains entirely in the vapour phase should it be depressurised in a single stage from contents pressure and at a starting temperature of 0°C.

Technical information : The dewline and the cooling curve were calculated using GasVLE™ and constructed using the LRS equation of state (EOS) and the cooling curve generated from a simulated isenthalpic flash calculation assuming adiabatic conditions starting at contents pressure and the stated temperature.

Terminal Correlation Sample Cylinder ID: D172603 Instrument ID: GC8		Run 1 L2501422001.2dx	Run 2 L2501422001.3dx	GPA 2261 : 2000 (Acceptance Criteria)					ISO 6974 : 5 (Acceptance Criteria)					GPA 2261 : 1964 (Acceptance Criteria)			
				Repeatability		Reproducibility			Repeatability		Reproducibility			Repeatability	Reproducibility		
Compound	Certified Value (mol%)	Normalised mol%	Normalised mol%	Difference between runs [ABS (Run1 -Run 2)]	GPA 2261 : 2000 Repeatability Limit	QC Mean Normalised mol% (Run1+Run2)/2	Difference (QC Mean - Certified Value)	GPA 2261 : 2000 Reproducibility - Limit	Difference between runs [ABS (Run1 -Run 2)]	Calculated ISO 6974-5 Repeatability limit, based on mean CRM value	Termianl Correlation Mean Normalised mol% (Run1+Run2)/2	Difference (QC Mean - Certified Value)	Calculated ISO 6974-5 Reproducibility Limit	GPA 2261 : 1964 Repeatability	QC Mean Normalised mol% (Run1+Run2)/2	Difference (QC Mean - Certified Value)	GPA 2261 : 1964 Reproducibility - Limit
Methane	84.756	84.78	84.76	0.02	0.17	84.77	0.01	0.59	0.02	0.03	84.77	0.01	0.07	N/A	84.77	0.02	0.30
Ethane	13.713	13.70	13.72	0.02	0.14	13.71	0.00	0.27	0.02	0.02	13.71	0.00	0.04	N/A	13.71	0.00	0.10
Propane	0.9921	0.97	0.97	0.00	0.01	0.97	0.02	0.02	0.00	0.01	0.97	0.02	0.02	N/A	0.97	0.02	0.03
Isobutane	0.04939	0.05	0.05	0.00	0.00	0.05	0.00	0.00	0.00	0.01	0.05	0.00	0.01	N/A	0.05	0.00	0.03
n-Butane	0.01987	0.02	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.01	N/A	0.02	0.00	0.03
Isopentane	0.05067	0.05	0.05	0.00	0.00	0.05	0.00	0.00	0.00	0.01	0.05	0.00	0.01	N/A	0.05	0.00	0.03
n-Pentane	0.02026	0.02	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.01	N/A	0.02	0.00	0.03
n-Hexane	0.00000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00	0.00	N/A	N/A	0.00	0.00	0.00
Carbon dioxide	0.00993	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.01	N/A	0.01	0.00	0.03
Oxygen	0.00995	0.01	0.01	0.00	N/A	0.01	0.00	N/A	0.00	0.00	0.01	0.00	0.01	N/A	0.01	0.00	0.03
Nitrogen	0.3781	0.39	0.39	0.00	0.01	0.39	0.01	0.03	0.00	0.01	0.39	0.01	0.02	N/A	0.39	0.01	0.03
Normalised Total	100.00	100.00	100.00														
Un-Normalised Total (+/-1%)		99.94	99.91														

Terminal Correlation (GC8) GHV calculation PT Provider cylinder certified value		
Gross Heating Value (Vol)	996.41	MJ/Kmol
Gross Heating Value (Vol)	1128.78	BTU/scf

Terminal Correlation (GC8) GHV calculation GC8 Average Result		
Gross Heating Value (Vol)	995.99	MJ/Kmol
Gross Heating Value (Vol)	1128.30	BTU/scf
Gross heating value Difference	0.48	BTU/scf
Allowable Difference	5	BTU/scf

Analyst : CW *Date :* 25/03/2025

Checked by : [signature] *Date :* 25/3/25

Calculated value
Within Specification
Outside Specification
Cylinder certified value and calculated precision data
Data entry

Single Injection Report

Agilent

Sample name:	20250325 -410-MISC (CPC Terminal Correlation Standard (D172603) Run 2		
Data file:	L2501422001.2.dx	**Operator:**	ilnglab
Instrument:	GC08	**Injection date:**	2025-03-25 11:01:44+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC08_ACQUISITION_NAT_GAS_20240819.amx		
Injection Acq Method Modified Date	2024-08-19 07:03:00+09:30		
Processing method:	NATURAL_GAS_PROCESSING_20241204.pmx		
Injection DA Method Latest File Change	2024-12-04 13:56:54+09:30		

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Single Injection Report

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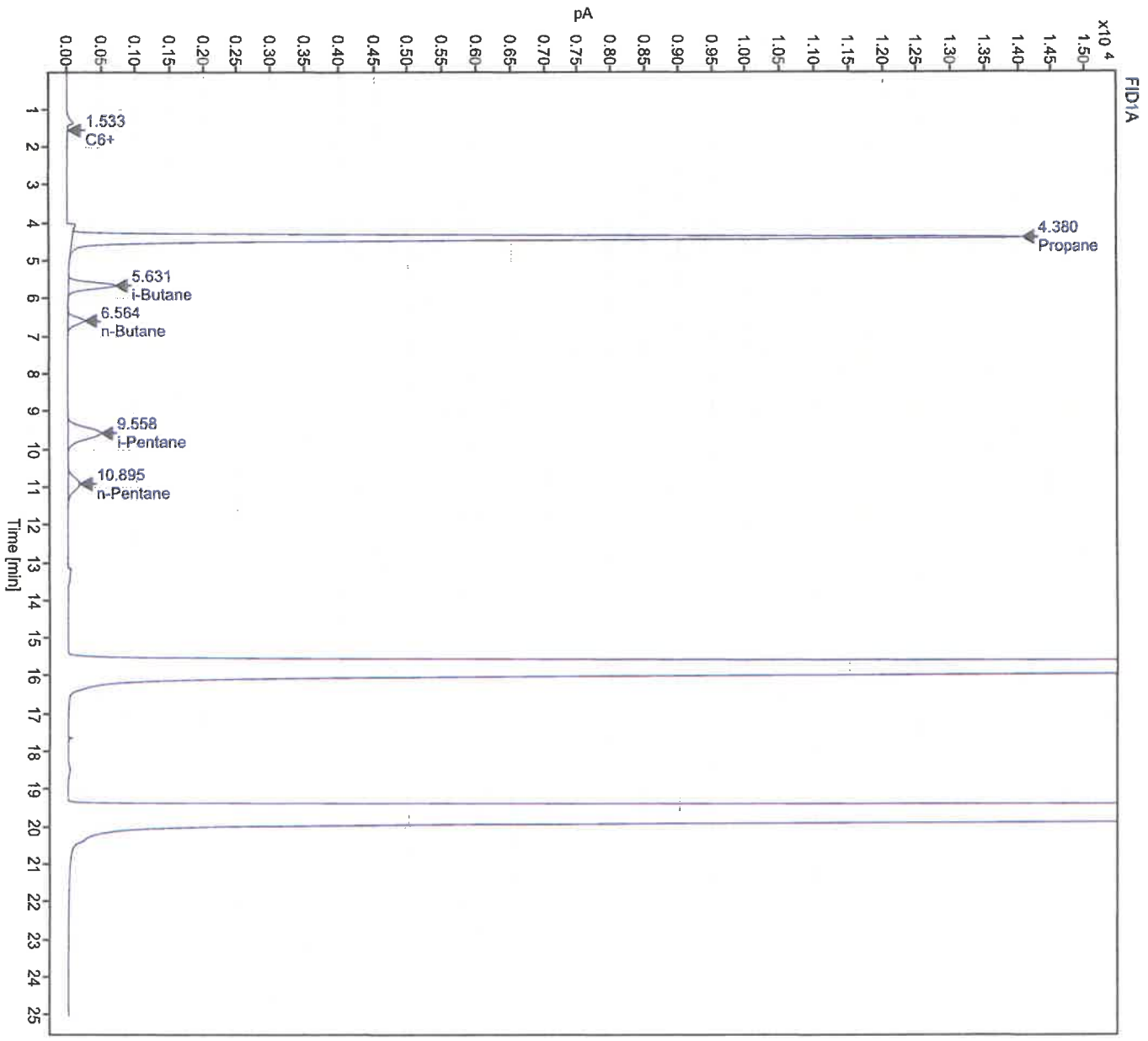

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25 MAR 2025

Single Injection Report

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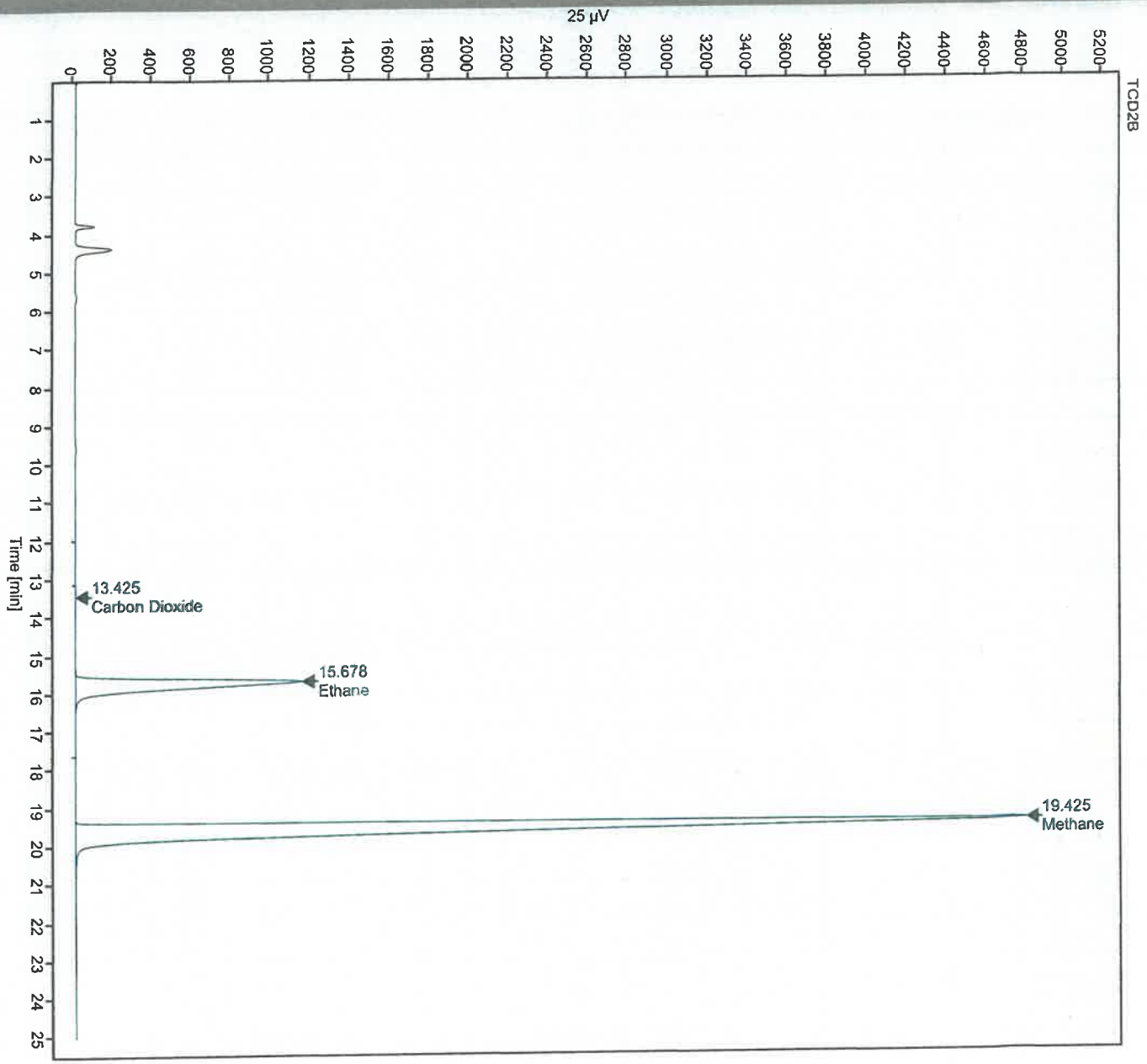

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Single Injection Report

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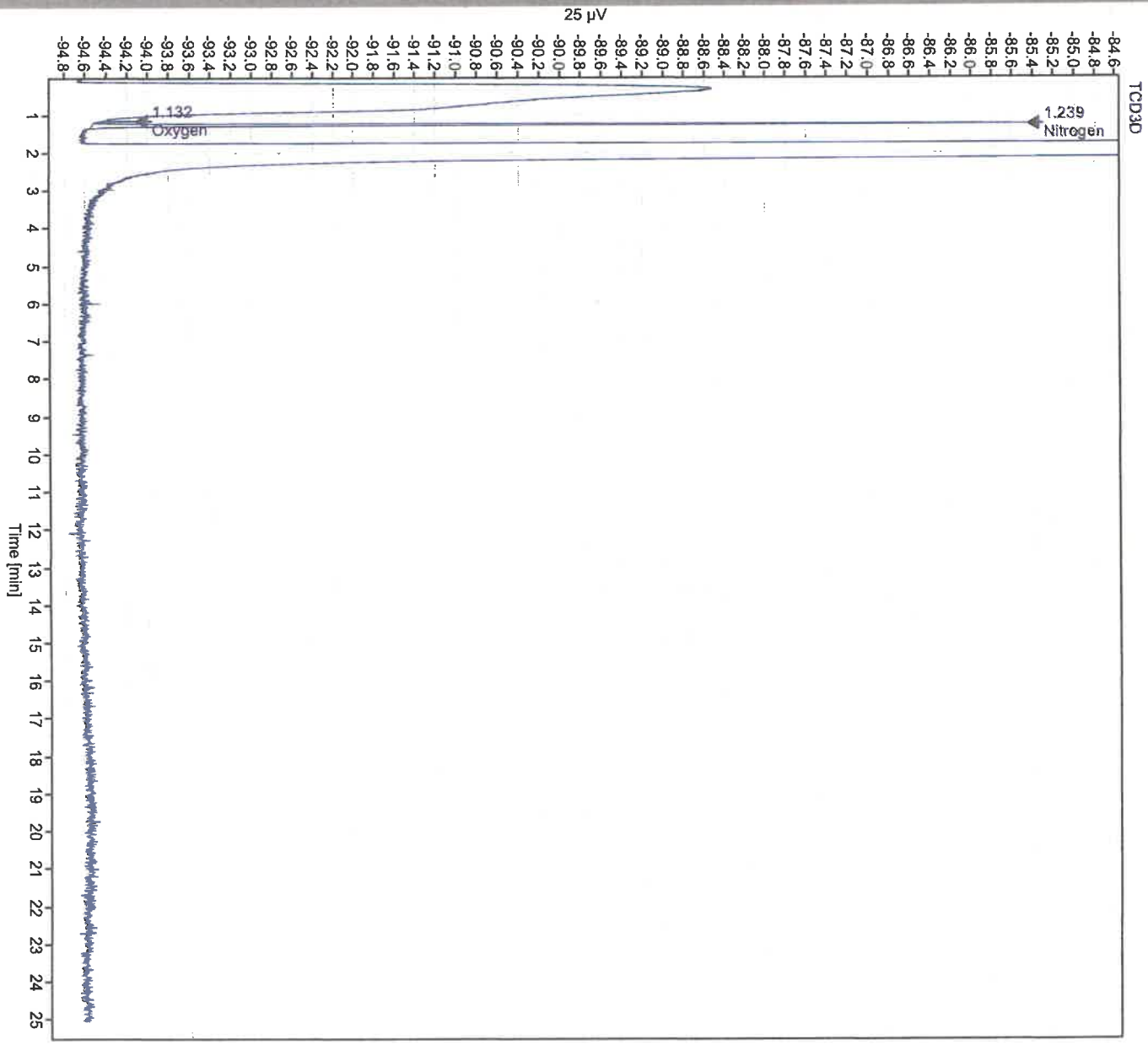

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25 MAR 2025

Single Injection Report

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Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]	mol% (2dp)
Oxygen	TCD3	1.132	0.012073056	0.69085	0.008341	0.008346	0.01
Nitrogen	TCD3	1.239	0.016461358	23.52897	0.387319	0.387553	0.39
C6+	FID1	1.533	0.000004008	27.51701	0.000110	0.000110	0.00
Propane	FID1	4.380	0.000007961	121967.54921	0.970984	0.971570	0.97
i-Butane	FID1	5.631	0.000005976	8208.89926	0.049056	0.049086	0.05
n-Butane	FID1	6.564	0.000005890	3239.23584	0.019079	0.019091	0.02
i-Pentane	FID1	9.558	0.000004759	10355.73014	0.049283	0.049313	0.05
n-Pentane	FID1	10.895	0.000004831	4044.26459	0.019538	0.019550	0.02
Carbon Dioxide	TCD2	13.425	0.000915124	10.96600	0.010035	0.010041	0.01
Ethane	TCD2	15.678	0.000761410	17987.97449	13.696224	13.704491	13.70
Methane	TCD2	19.425	0.001159081	73100.76458	84.729707	84.780851	84.78
				Total mol%	99.939676	100.000000	100.00

99.94

SO
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25 MAR 2025

Single Injection Report

Agilent

Sample name:	20250325 -410-MISC (CPC Terminal Correlation Standard (D172603) Run 3		
Data file:	L2501422001.3.dx	**Operator:**	ilnglab
Instrument:	GC08	**Injection date:**	2025-03-25 11:27:12+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC08_ACQUISITION_NAT_GAS_20240819.amx		
Injection Acq Method Modified Date	2024-08-19 07:03:00+09:30		
Processing method:	NATURAL_GAS_PROCESSING_20241204.pmx		
Injection DA Method Latest File Change	2024-12-04 13:56:54+09:30		

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Single Injection Report

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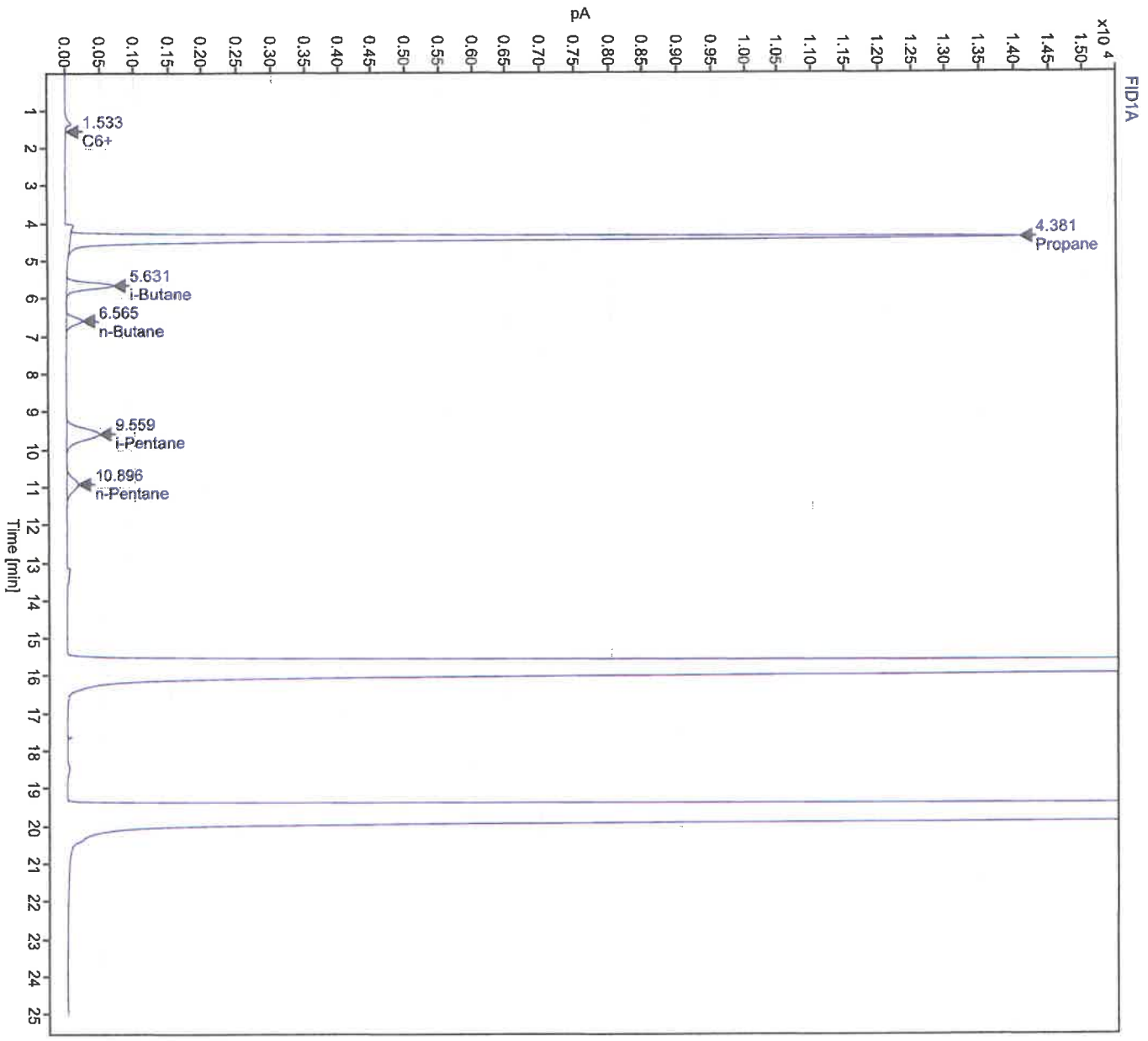

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Single Injection Report

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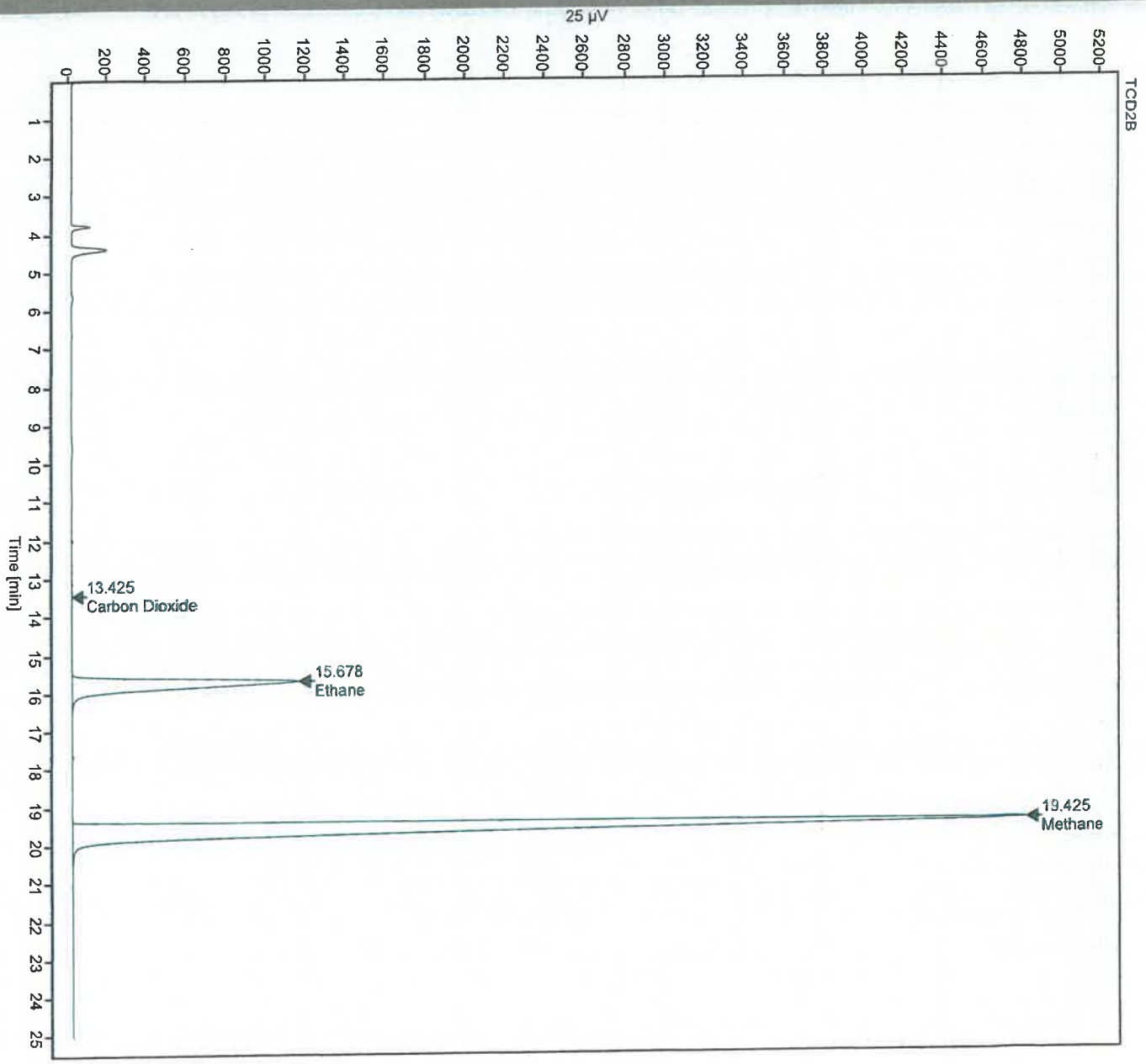

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25 MAR 2025

Single Injection Report

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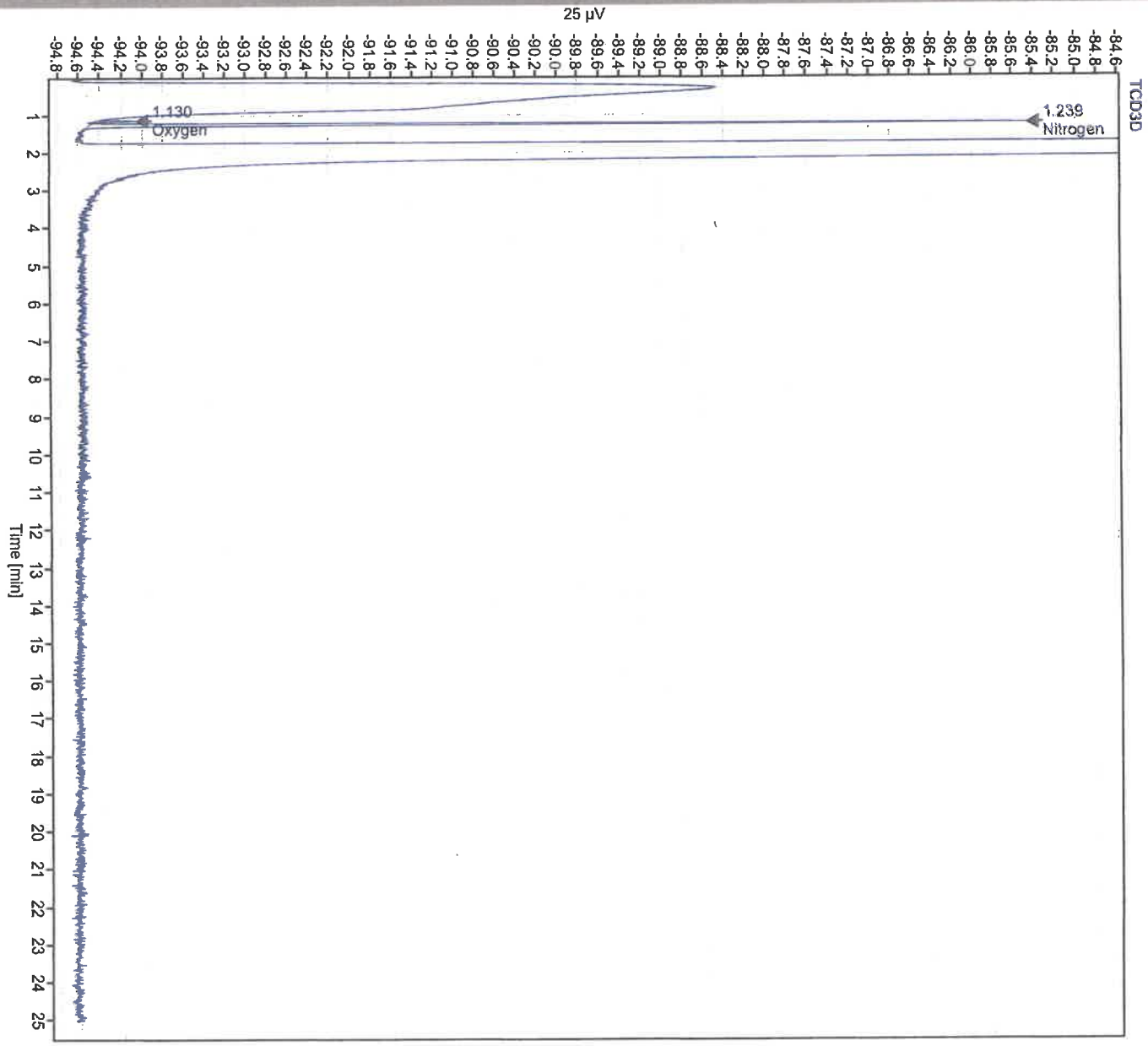

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25 MAR 2025

Single Injection Report

Agilent

Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]	mol% (2 dp
Oxygen	TCD3	1.130	0.012073056	0.77285	0.009331	0.009339	0.01
Nitrogen	TCD3	1.239	0.016461358	23.46172	0.386212	0.386545	0.39
C6+	FID1	1.533	0.000004008	27.63904	0.000111	0.000111	0.00
Propane	FID1	4.381	0.000007961	122249.18276	0.973226	0.974066	0.97
i-Butane	FID1	5.631	0.000005976	8236.28087	0.049220	0.049262	0.05
n-Butane	FID1	6.565	0.000005890	3251.90124	0.019154	0.019170	0.02
i-Pentane	FID1	9.559	0.000004759	10410.08558	0.049542	0.049584	0.05
n-Pentane	FID1	10.896	0.000004831	4067.41016	0.019650	0.019667	0.02
Carbon Dioxide	TCD2	13.425	0.000915124	10.99190	0.010059	0.010068	0.01
Ethane	TCD2	15.678	0.000761410	18000.65100	13.705876	13.717702	13.72
Methane	TCD2	19.425	0.001159081	73067.72276	84.691409	84.764487	84.76
				Total mol%	99.913788	100.000000	100.00

99.91

CW
25 MAR 2025

SO
25/3/25

INPEX Operations Australia Pty Ltd
ACN 150 217 262

22/100 St Georges Terrace Perth
Western Australia 6000

Tel +61 8 6213 6000

INPEX.com.au

OFFLINE ANALYSER VERIFICATION AND TERMINAL CORRELATION RESULTS – GC9

25/3/2025

CERTIFICATE OF CALIBRATION

Approved signatory
Name: **Simon Yau**
Signature

Issued by **EffecTech**
Date of Issue **03 June 2020**

Certificate Number **20/0378/03**

EffecTech
Global Leaders In Gas Measurement

Dove House
Dove Fields
Uttoxeter
Staffordshire ST14 8HU
United Kingdom

www.effectech.co.uk

ilac-MRA
UKAS CALIBRATION
0590

Customer	: CAC Gas & Instrumentation Pty. Ltd. Unit 3 / 36 Holbeche Rd., Arndell Park, NSW 2148, Australia.
Customer reference	: PO No.PO4283 (Part Code: 50ST-INPX-LNGCALCH4)
Product Description	: Certified Reference Material (CRM) for use as a calibration gas mixture in natural gas analysis Multi-component natural gas mixture
Preparation method	: Mixture prepared by ISO 6142-1:2015 - *Gas Analysis - Preparation of calibration gas mixtures - Part 1 : Gravimetric method for Class I mixtures*
Calibration method	: Mixture calibrated by ISO 6143:2001 - *Gas Analysis - Comparison methods for determining and checking the composition of calibration gas mixtures* using high precision gas chromatography
Traceability	: Mixture classified as a Calibrated Gas Mixture (CGM) at Level-3 in the metrological hierarchy of traceability by direct analytical comparison with a Secondary Reference Gas Mixture (SRGM)
Cylinder number	: 20/4435
Date of calibration	: 28 May 2020
Contents pressure	: 100 bar
Cylinder size	: 50 litres
Cylinder material	: steel
Valve outlet connection	: BS341 - No.4

Minimum usage pressure	: 3 bar
Usage temperature range	: 15 to 50 °C
Storage (transport) temperature range	: -33 to 50 °C

Composition

component	amount fraction (%mol/mol)
oxygen	0.00977 ± 0.00017
nitrogen	0.5992 ± 0.0020
carbon dioxide*	0.01000 ± 0.00020
methane	83.902 ± 0.028
ethane	13.965 ± 0.035
propane	1.3021 ± 0.0042
iso-butane	0.05991 ± 0.00045
n-butane	0.04060 ± 0.00045
iso-pentane	0.06046 ± 0.00040
n-pentane	0.04026 ± 0.00030
n-hexane	0.01004 ± 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 UKAS requirements.The reference values presented in this certificate apply to the calibration of the individual and unique gas mixture identified above

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

The following information provided on stability and the expiry date is outside the scope of UKAS accreditation but is required to fulfil the mandatory requirements of ISO 6141:2015 - *Gas Analysis - Contents of certificates for calibration gas mixtures*

Stability	: EffecTech stability studies of similar gas mixtures in this type of cylinder/valve combination have demonstrated a shelf-life of 5 years, providing the contents pressure and usage/storage temperature remain within the limits stated in the table above.
Expiry date	: 28 May 2025

To re-order this gas mixture contact CAC Gas & Instrumentation quoting certificate number 20/0378/03.
tel: 1300 CAC GAS (+61 2 8676 6500) email: cac@cacgas.com.au

CERTIFICATE OF CALIBRATION

UKAS Accredited Calibration Laboratory No. 0590

Certificate number

20/0378/03

Physical Properties

Physical properties are calculated from composition in accordance with the international standard ISO 6976:1995 (E) including amendment No.1 - May 1998.

Properties are calculated at a reference pressure of 1.01325 bar and at reference temperatures stated.

Note :- In accordance with the recommendations of the international standard, the gas mixture is assumed dry (free from moisture) for the purpose of these calculations.

Reference conditions	**primary** combustion 15°C metering 15°C	**secondary** combustion 0°C metering 0°C
mean molecular mass	18.549 ± 0.019 kg·kmol^{-1}	18.549 ± 0.019 kg·kmol^{-1}
compression factor	0.9972 ± 0.0010	0.9967 ± 0.0010
Real gas properties		
superior calorific value	42.494 ± 0.042 MJ·m^{-3}	44.921 ± 0.045 MJ·m^{-3}
	1002.0 ± 1.0 kJ·mol^{-1}	1003.5 ± 1.0 kJ·mol^{-1}
	54.018 ± 0.054 MJ·kg^{-1}	54.101 ± 0.054 MJ·kg^{-1}
inferior calorific value	38.422 ± 0.038 MJ·m^{-3}	40.561 ± 0.041 MJ·m^{-3}
	905.97 ± 0.91 kJ·mol^{-1}	906.13 ± 0.91 kJ·mol^{-1}
	48.842 ± 0.049 MJ·kg^{-1}	48.850 ± 0.049 MJ·kg^{-1}
relative density	0.64197 ± 0.00064	0.64221 ± 0.00064
density	0.78667 ± 0.00079 kg·m^{-3}	0.83032 ± 0.00083 kg·m^{-3}
Wobbe index	53.037 ± 0.053 MJ·m^{-3}	56.055 ± 0.056 MJ·m^{-3}
Ideal gas properties		
superior calorific value	42.376 ± 0.042 MJ·m^{-3}	44.772 ± 0.045 MJ·m^{-3}
	1002.0 ± 1.0 kJ·mol^{-1}	1003.5 ± 1.0 kJ·mol^{-1}
	54.018 ± 0.054 MJ·kg^{-1}	54.101 ± 0.054 MJ·kg^{-1}
inferior calorific value	38.316 ± 0.038 MJ·m^{-3}	40.427 ± 0.040 MJ·m^{-3}
	905.97 ± 0.91 kJ·mol^{-1}	906.13 ± 0.91 kJ·mol^{-1}
	48.842 ± 0.049 MJ·kg^{-1}	48.850 ± 0.049 MJ·kg^{-1}
relative density	0.64045 ± 0.00064	0.64045 ± 0.00064
density	0.78449 ± 0.00078 kg·m^{-3}	0.82757 ± 0.00083 kg·m^{-3}
Wobbe index	52.952 ± 0.053 MJ·m^{-3}	55.945 ± 0.056 MJ·m^{-3}

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 UKAS requirements.

ADVICE on the storage and use of your calibration gas mixture

The calibration gas mixture supplied to you contains components which are condensable under certain conditions of temperature. It is important that these conditions are avoided where possible during storage and usage of the mixture.

Please read this advice in conjunction with recommended storage/usage conditions given son the certificate of calibration.

Storage

*Has the ambient temperature during **storage** dropped below the hydrocarbon dew temperature at contents pressure?*

If so then there will be stratification of your mixture into two phases (vapour and liquid)

The withdrawal of any gas phase content from this two phase mixture will invalidate the certified reference values we have provided with your calibration gas.

Advice before use

There will be no record of the minimum temperature to which your gas mixture has been exposed in transport to you. Hence, there is no guarantee that the gas mixture has not been exposed to temperatures below the hydrocarbon dew temperature of your mixture at contents pressure. If you suspect the gas has been exposed to temperatures below this the contents must be allowed to equilibrate at a greater temperature for a minimum period of about 24 hours. Following this equilibration time your mixture should be entirely homogeneous and gaseous. Often, it is good practice to roll the cylinder, where possible, to encourage mixing during equilibration.

Use

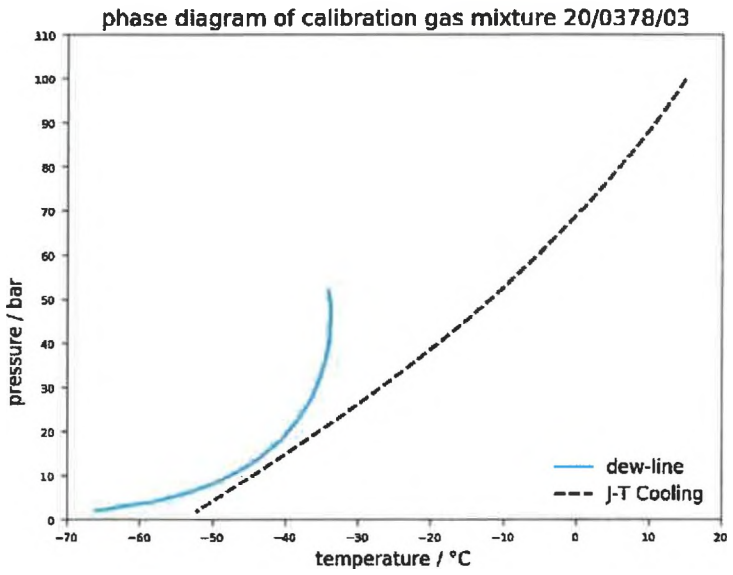
*When in **use** does condensation occur in your gas mixture following depressurisation as a result of cooling?*

Your gas mixture cools when it is depressurised through your pressure regulator. This is called Joule-Thomson (or Joule-Kelvin) cooling. If the gas cools to below the hydrocarbon dew temperature at its pressure then your mixture will stratify into two phases (vapour and liquid).

If this occurs the gas phase composition delivered to your application will not be representative of the certified reference values we have provided with your calibration gas.

Advice during use

The diagram below shows the pressure-temperature phase characteristics of your particular calibration mixture. Conditions shown to the left of the hydrocarbon dewline are in the two phase (liquid and vapour) region, whilst to the right your mixture remains as a single phase vapour. The cooling curve shown does not enter the two-phase region.



This demonstrates that during use your mixture remains entirely in the vapour phase should it be depressurised in a single stage from contents pressure and at a starting temperature of 15°C.

Technical information : The dewline and the cooling curve were calculated using GasVLE™ and constructed using the LRS equation of state (EOS) and the cooling curve generated from a simulated isenthalpic flash calculation assuming adiabatic conditions starting at contents pressure and the stated temperature.

LNG Calibration Standard Instrument: GC9		Data File: L2500954001.3.dx	Data File: L2500954001.4.dx	Data File: L2500954001.5.dx	Cal Date: 25/02/2025	Cylinder No: 20/4435 Expiry 28/05/2025			
Compound	Certified Value	Area	Area	Area	Av. Peak area across 3 Cal runs-2 d.p				
Detector (TCD/FID)	mol %	25uV*s (TCD)/ pA*s (FID)	25uV*s (TCD)/ pA*s (FID)	25uV*s (TCD)/ pA*s (FID)	Average Peak Area (Run1+Run2+Run3)/3	Response Factor (Certified Value/Average Peak Area)	0.5% of average peak area (GPA2261:2000 - Clause 6.3)	Acceptance Criteria - Peak Area Min	Acceptance Criteria - Peak Area Max
Methane	83.902	66766.94967	66742.91932	66749.38914	66753.09	1.25690E-03	333.77	66419.32	67086.85
Ethane	13.965	16820.48365	16811.34173	16809.90697	16813.91	8.30562E-04	84.07	16729.84	16897.98
Propane	1.3021	127768.94335	127754.57151	127833.23363	127785.58	1.01897E-05	638.93	127146.65	128424.51
Isobutane	0.05991	7852.20566	7849.62561	7849.91995	7850.58	7.63128E-06	39.25	7811.33	7889.84
n-Butane	0.04060	5419.91485	5421.65705	5426.72667	5422.77	7.48695E-06	27.11	5395.65	5449.88
Isopentane	0.06046	9957.82587	9960.56254	9967.77293	9962.05	6.06903E-06	49.81	9912.24	10011.86
n-Pentane	0.04026	6570.56735	6578.18533	6586.01580	6578.26	6.12016E-06	32.89	6545.36	6611.15
n-Hexane	0.01004	2006.96051	2011.11673	2015.64882	2011.24	4.99194E-06	10.06	2001.19	2021.30
Carbon dioxide	0.01000	11.15014	11.15304	11.18721	11.16	8.95779E-04	0.06	11.11	11.22
Oxygen	0.00977	1.53087	1.11041	0.88640	1.18	8.30858E-03	0.01	1.17	1.18
Nitrogen	0.5992	41.61097	41.50009	41.58044	41.56	1.44164E-02	0.21	41.36	41.77
Total	99.999								

Analyst : FM *Date :* 25/02/2025

Checked by : CW *Date :* 25/02/2025

Legend

Within Specification

Outside Specification

Cylinder certified value and calculated precision data

Calculated value

Data entry

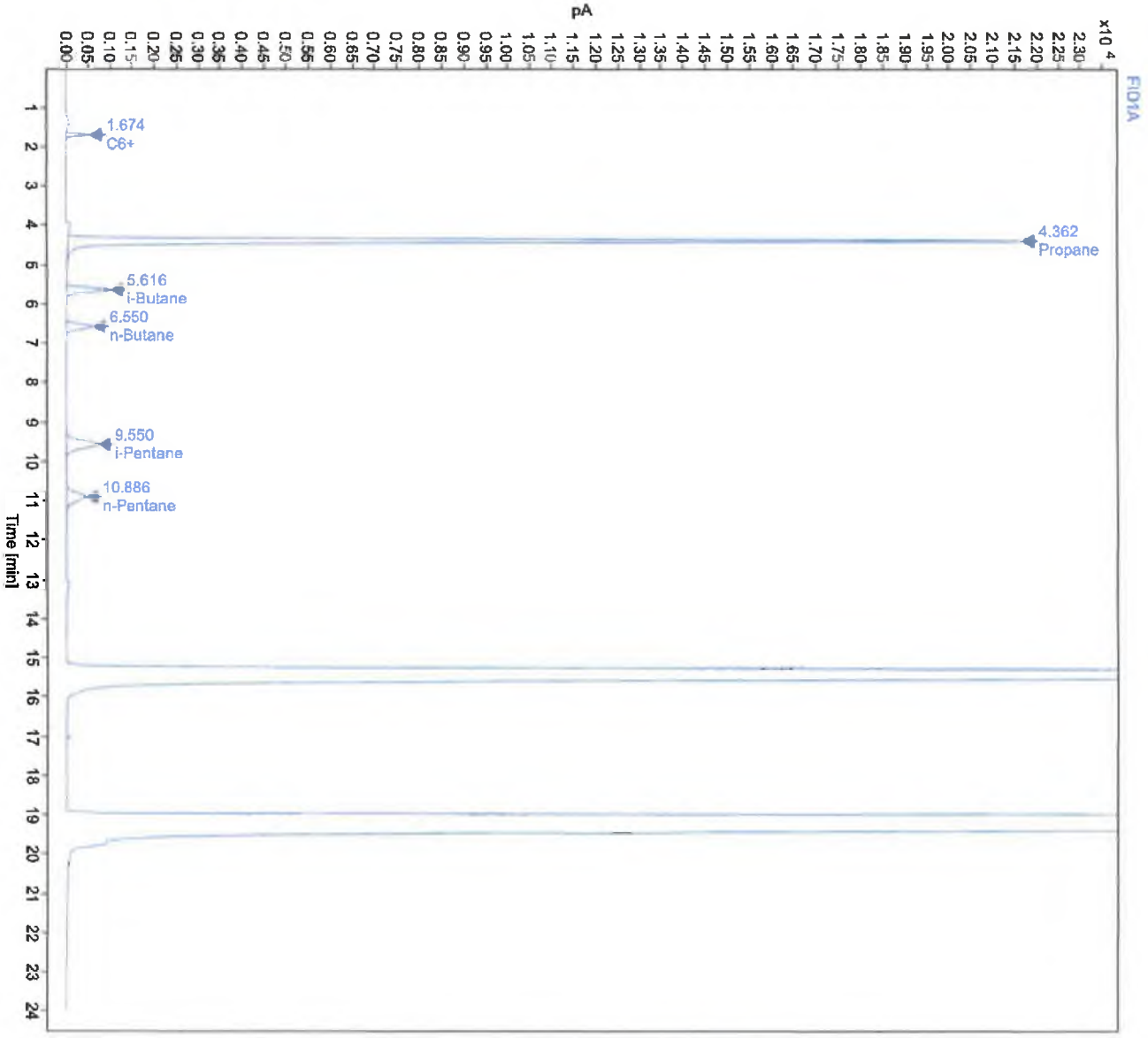
Single Injection Report

Agilent

Sample name:	20250225 LNG CAL Run 3		
Data file:	L2500954001.3.dx	**Operator:**	ilnglab
Instrument:	GC09	**Injection date:**	2025-02-25 11:37:40+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC09_AQUISITION_NAT_GAS_20241111.amx		
Injection Acq Method Modified Date	2024-11-11 10:14:35+09:30		
Processing method:	GC-09_NATURAL_GAS_PROCESSING_20250202.pmx		
Injection DA Method Latest File Change	2025-02-02 08:50:24+09:30		

FM 25/2/25

CW
25 FEB 2025

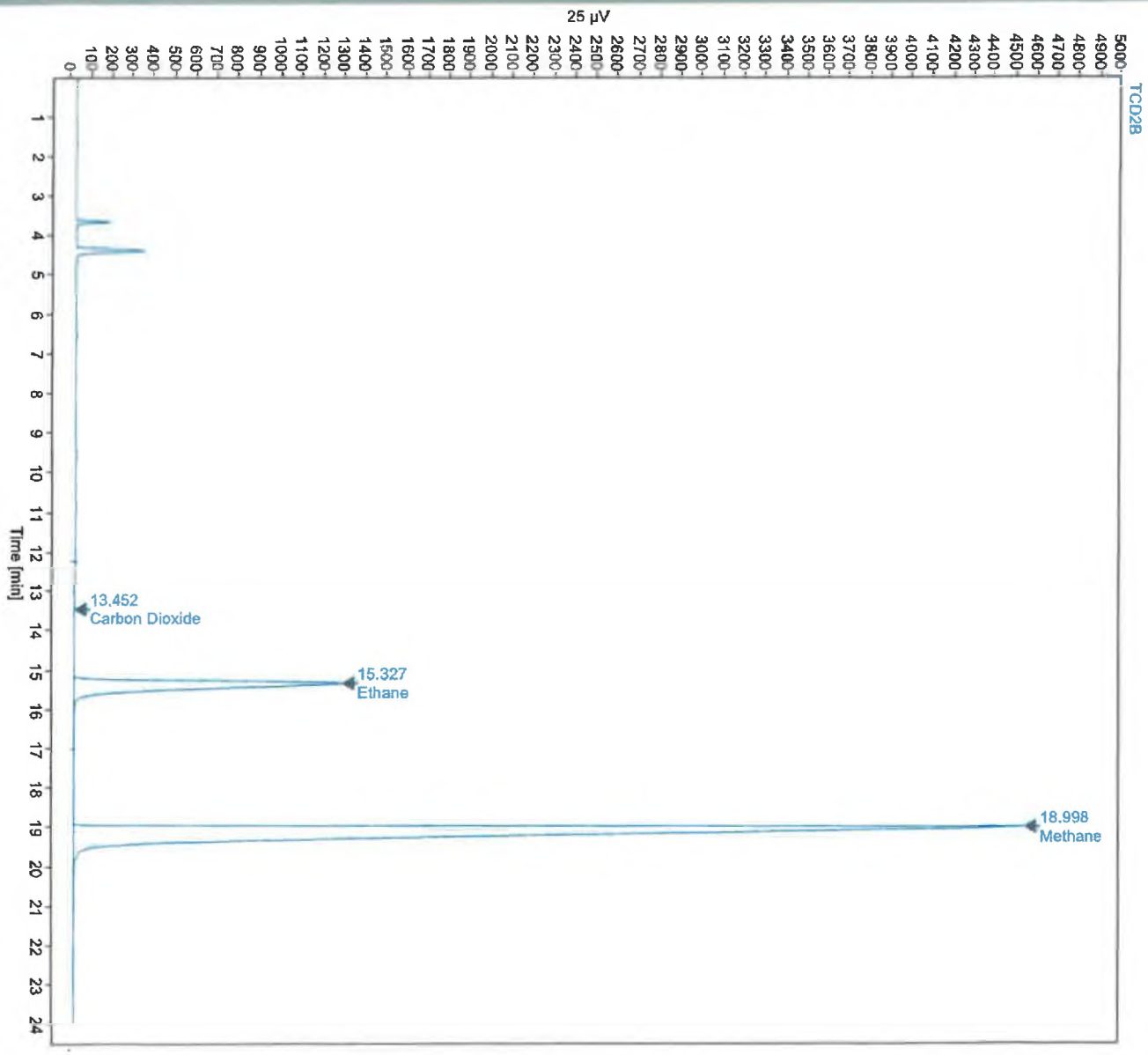


FM 25/2/25

CW
25 FEB 2025

Single Injection Report

Agilent



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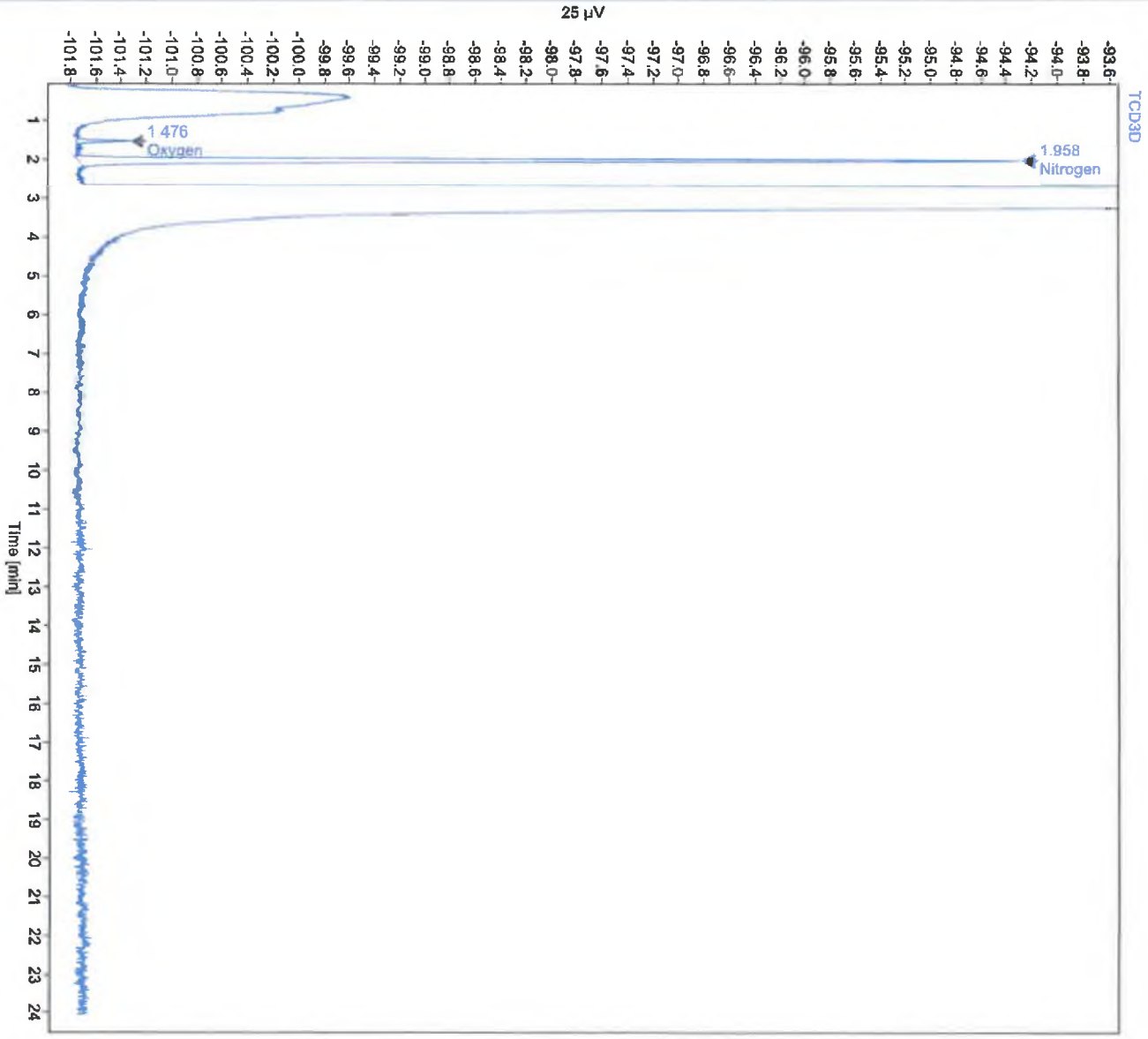
25 FEB 2025



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CW
25 FEB 2025

Single Injection Report

Agilent

Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]
Oxygen	TCD3	1.476	0.008261877	1.53087	0.012648	0.012512
C6+	FID1	1.674	0.000005051	2006.96051	0.010137	0.010028
Nitrogen	TCD3	1.958	0.014532120	41.61097	0.604696	0.598195
Propane	FID1	4.362	0.000010254	127768.94335	1.310143	1.296058
i-Butane	FID1	5.616	0.000007679	7852.20566	0.060297	0.059649
n-Butane	FID1	6.550	0.000007538	5419.91485	0.040855	0.040416
i-Pentane	FID1	9.550	0.000006112	9957.82587	0.060862	0.060208
n-Pentane	FID1	10.886	0.000006167	6570.56735	0.040521	0.040085
Carbon Dioxide	TCD2	13.452	0.000907565	11.15014	0.010119	0.010011
Ethane	TCD2	15.327	0.000839552	16820.48365	14.121671	13.969855
Methane	TCD2	18.998	0.001270311	66766.94967	84.814791	83.902984
				Total mol%	101.086739	100.000000

FM 25/2/25

CW
25 FEB 2025

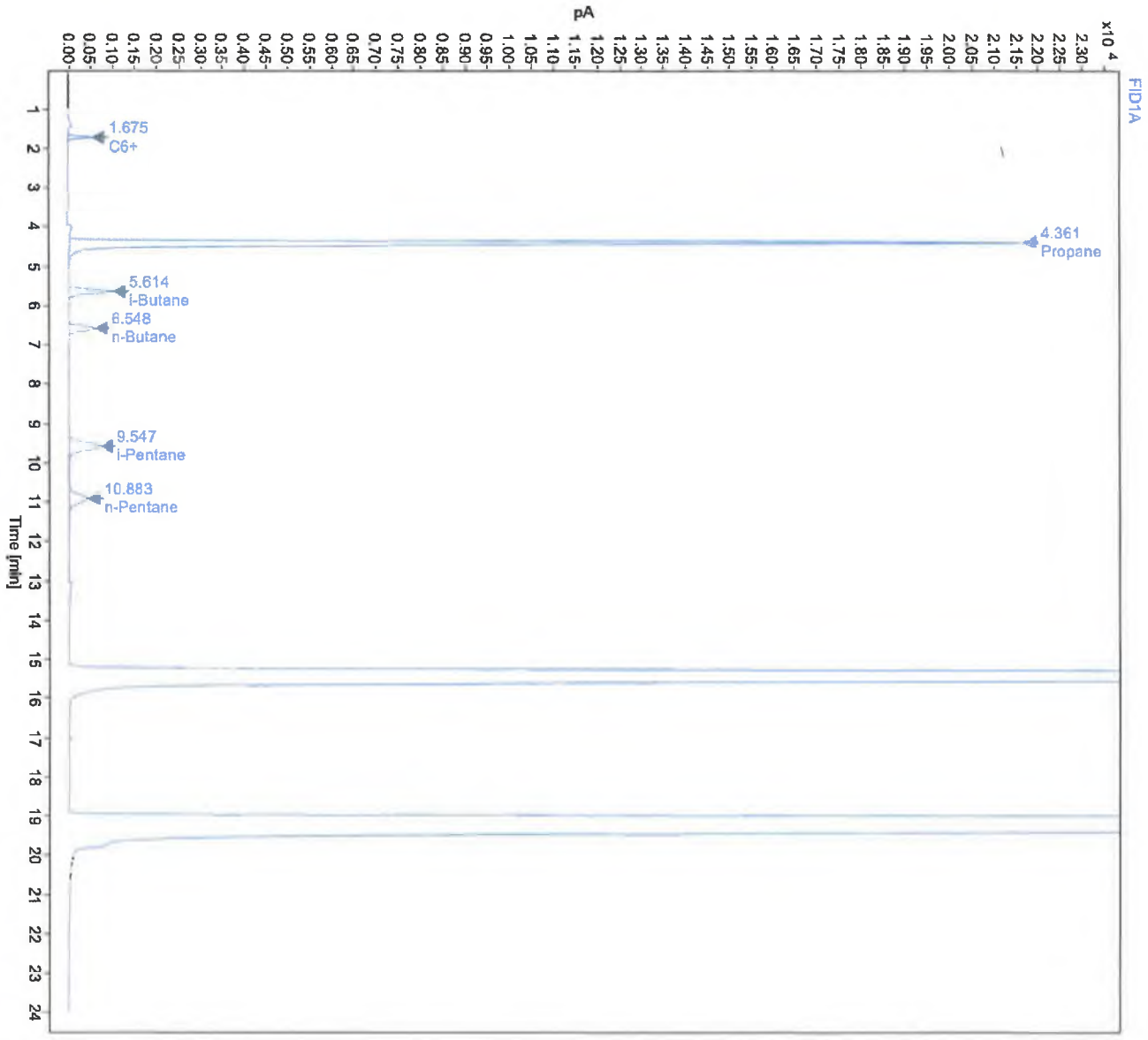
Single Injection Report

Agilent

Sample name:	20250225 LNG CAL Run 4		
Data file:	L2500954001.4.dx	**Operator:**	ilnglab
Instrument:	GC09	**Injection date:**	2025-02-25 12:02:07+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC09_AQUISITION_NAT_GAS_20241111.amx		
Injection Acq Method Modified Date	2024-11-11 10:14:35+09:30		
Processing method:	GC-09_NATURAL_GAS_PROCESSING_20250202.pmx		
Injection DA Method Latest File Change	2025-02-02 08:50:24+09:30		

FM 25/2/25

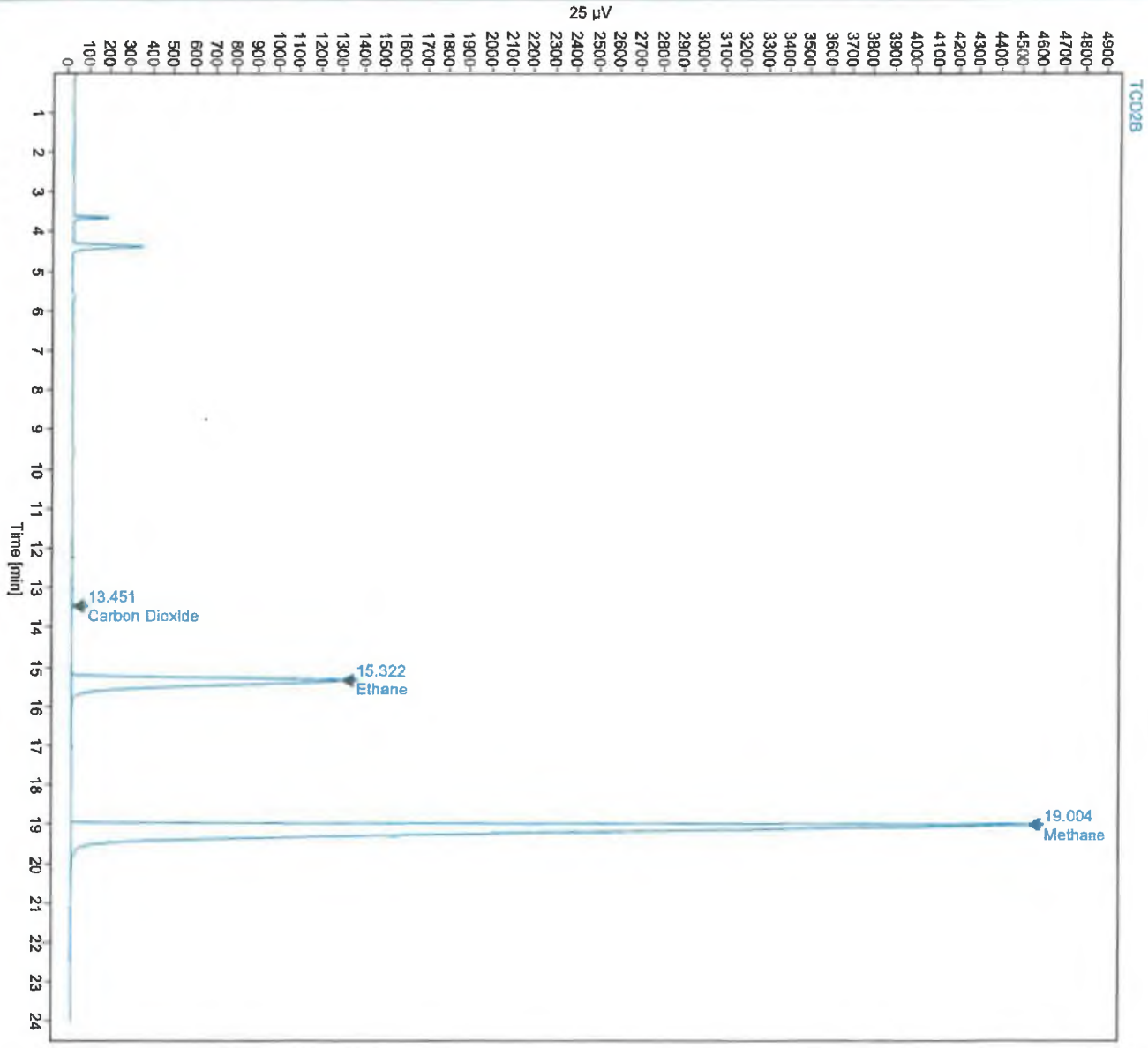
CW
25 FEB 2025



FM 25/2/25

CW

25 FEB 2025



FM 25/2/25

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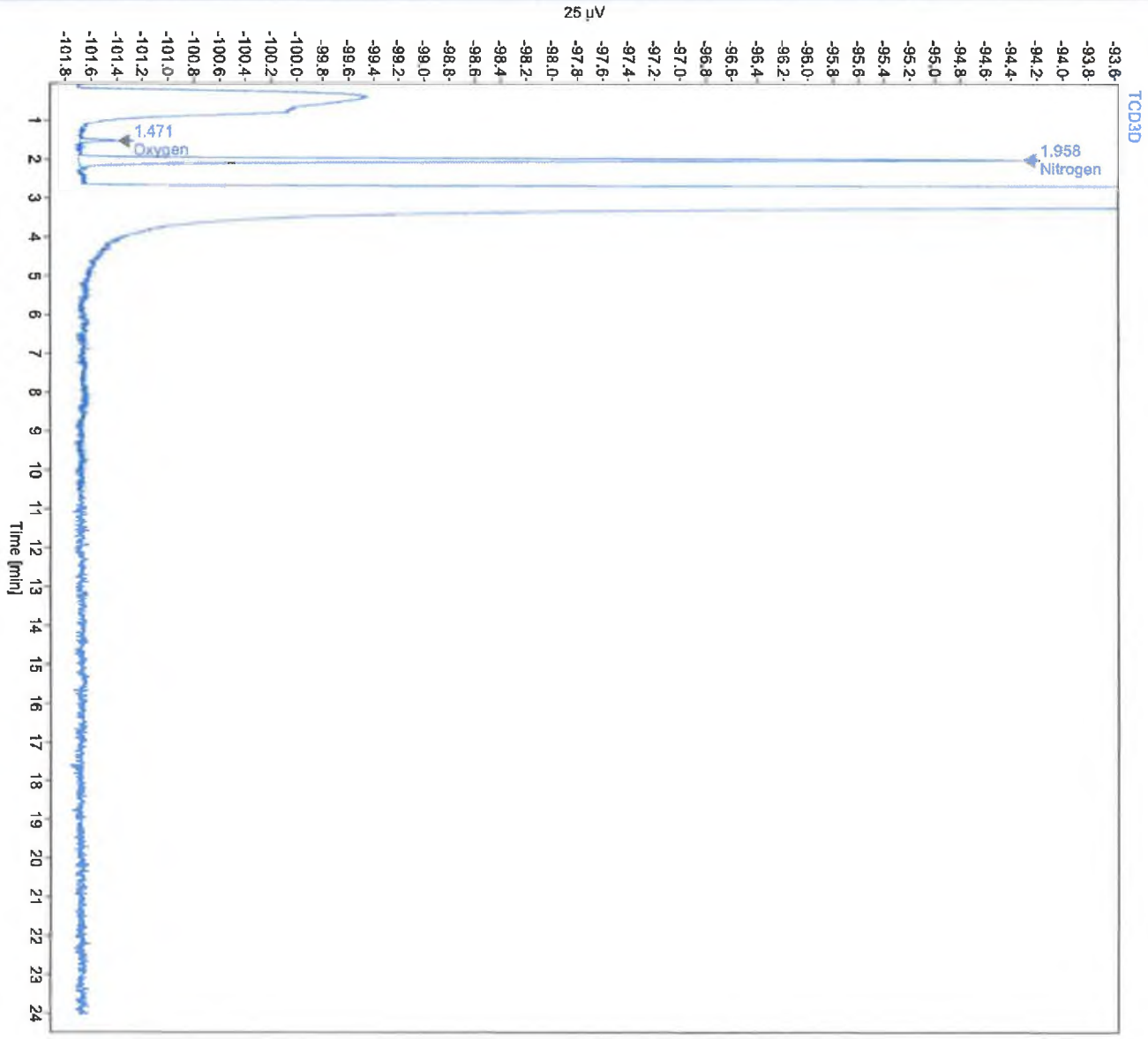
25 FEB 2025



FM 25/2/25

CW
25 FEB 2025

Single Injection Report

Agilent

Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]
Oxygen	TCD3	1.471	0.008261877	1.11041	0.009174	0.009079
C6+	FID1	1.675	0.000005051	2011.11673	0.010158	0.010053
Nitrogen	TCD3	1.958	0.014532120	41.50009	0.603084	0.596857
Propane	FID1	4.361	0.000010254	127754.57151	1.309995	1.296468
i-Butane	FID1	5.614	0.000007679	7849.62561	0.060277	0.059655
n-Butane	FID1	6.548	0.000007538	5421.65705	0.040868	0.040446
i-Pentane	FID1	9.547	0.000006112	9960.56254	0.060879	0.060250
n-Pentane	FID1	10.883	0.000006167	6578.18533	0.040568	0.040149
Carbon Dioxide	TCD2	13.451	0.000907565	11.15304	0.010122	0.010018
Ethane	TCD2	15.322	0.000839552	16811.34173	14.113996	13.968253
Methane	TCD2	19.004	0.001270311	66742.91932	84.784265	83.908772
				Total mol%	101.043386	100.000000

FM 25/2/25

CW
25 FEB 2025

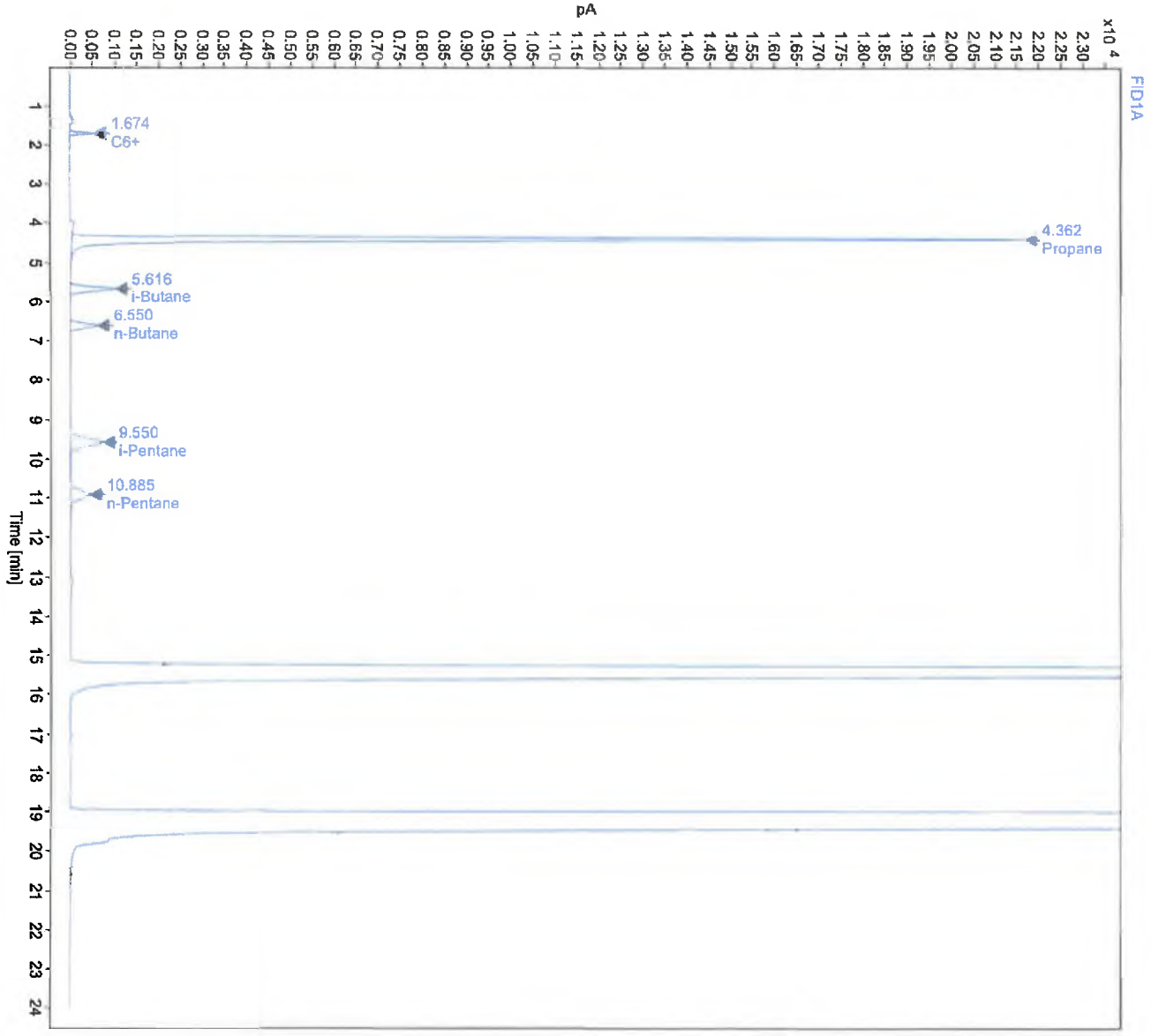
Single Injection Report

Agilent

Sample name:	20250225 LNG CAL Run 5		
Data file:	L2500954001.5.dx	**Operator:**	ilnglab
Instrument:	GC09	**Injection date:**	2025-02-25 12:26:33+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC09_AQUISITION_NAT_GAS_20241111.amx		
Injection Acq Method Modified Date	2024-11-11 10:14:35+09:30		
Processing method:	GC-09_NATURAL_GAS_PROCESSING_20250202.pmx		
Injection DA Method Latest File Change	2025-02-02 08:50:24+09:30		

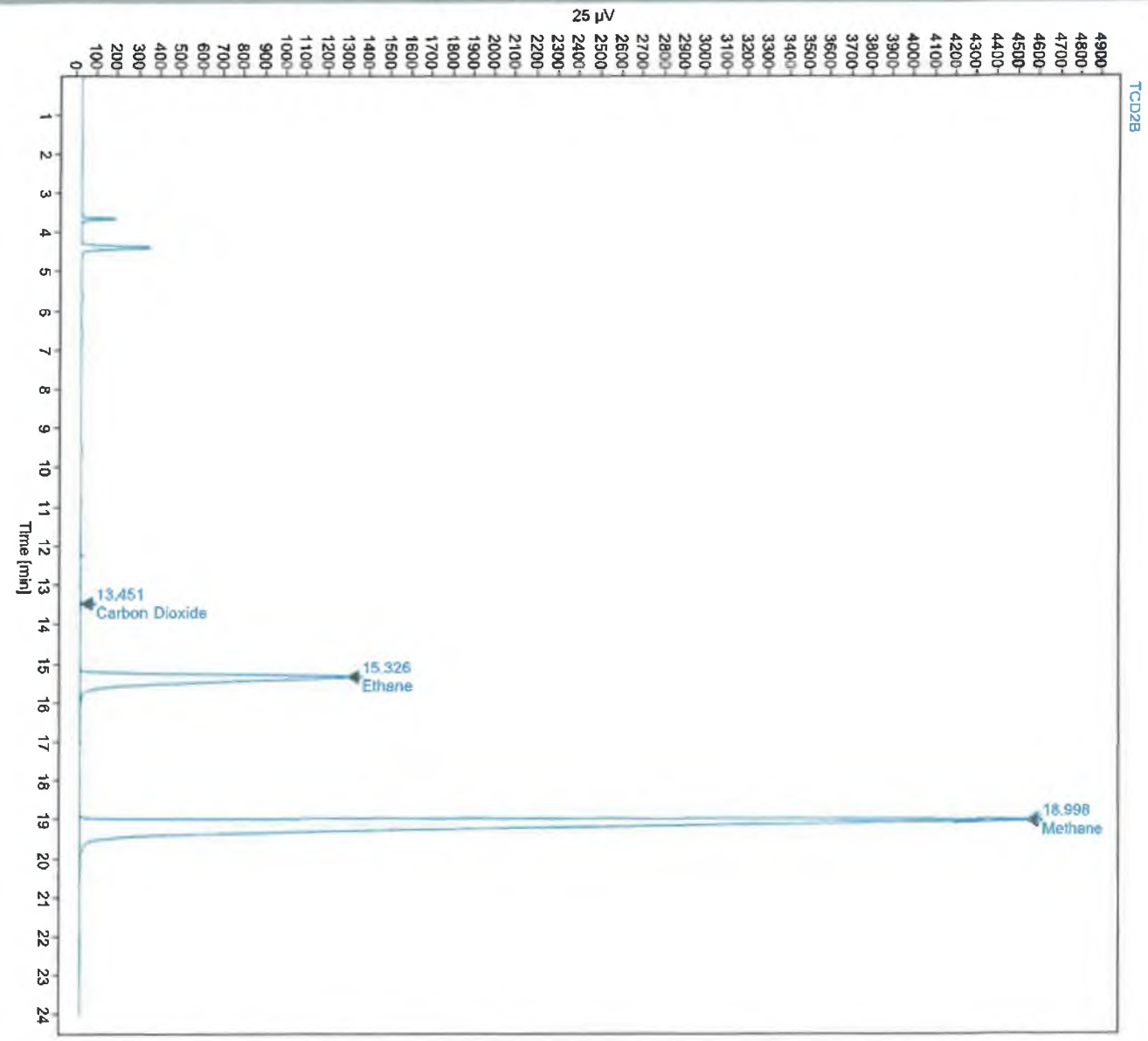
FM 25/2/25

CW
25 FEB 2025



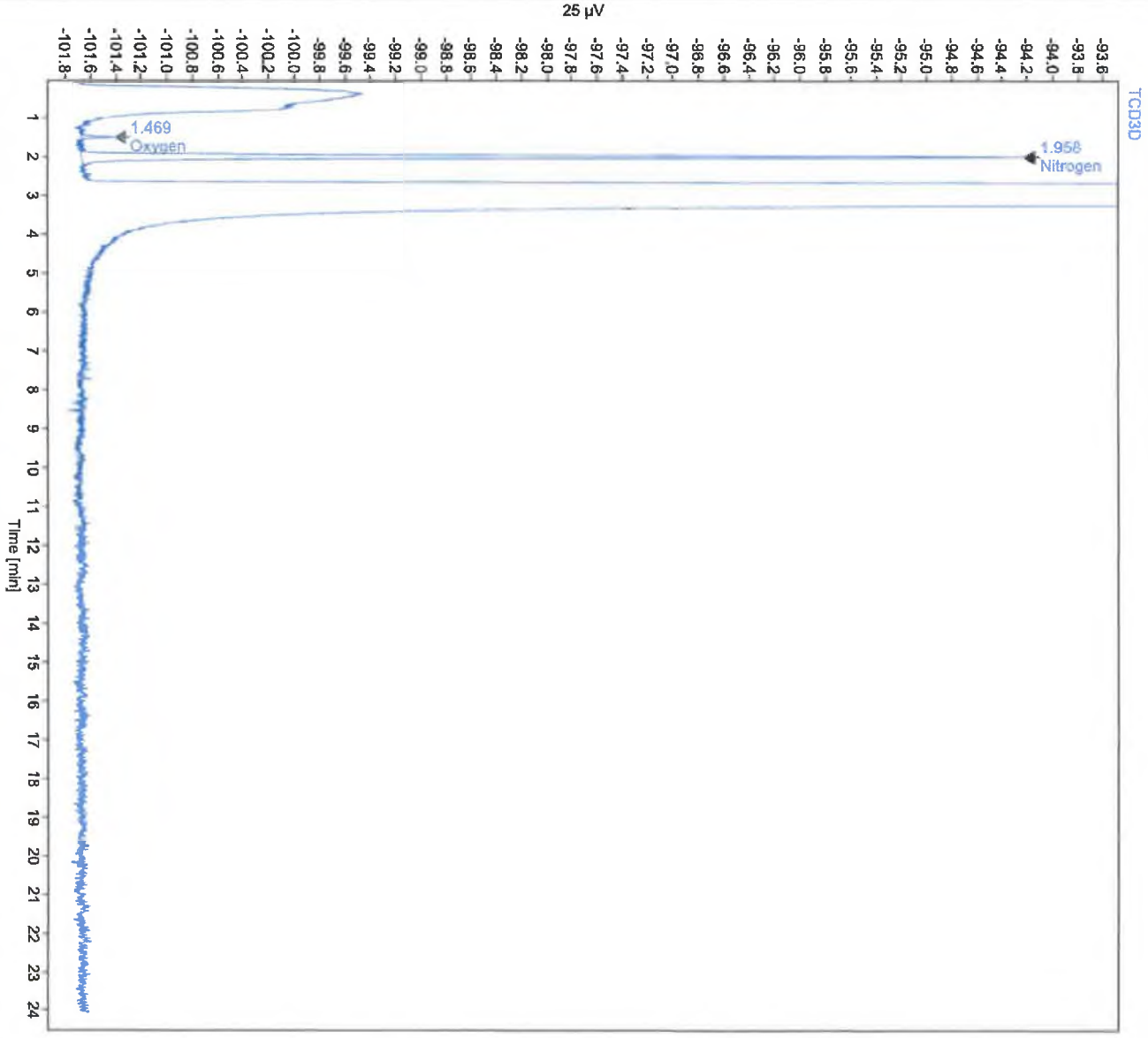
FM 25/2/25

CW
25 FEB 2025



FM 25/2/25

CW
25 FEB 2025



EM 25/2/25

CW
25 FEB 2025

Single Injection Report

Agilent

Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]
Oxygen	TCD3	1.469	0.008261877	0.88640	0.007323	0.007247
C6+	FID1	1.674	0.000005051	2015.64882	0.010181	0.010075
Nitrogen	TCD3	1.958	0.014532120	41.58044	0.604252	0.597969
Propane	FID1	4.362	0.000010254	127833.23363	1.310802	1.297172
i-Butane	FID1	5.616	0.000007679	7849.91995	0.060280	0.059653
n-Butane	FID1	6.550	0.000007538	5426.72667	0.040907	0.040481
i-Pentane	FID1	9.550	0.000006112	9967.77293	0.060923	0.060290
n-Pentane	FID1	10.885	0.000006167	6586.01580	0.040616	0.040194
Carbon Dioxide	TCD2	13.451	0.000907565	11.18721	0.010153	0.010048
Ethane	TCD2	15.326	0.000839552	16809.90697	14.112791	13.966048
Methane	TCD2	18.998	0.001270311	66749.38914	84.792483	83.910823
				Total mol%	101.050711	100.000000

FM 25/2/25

CW
25 FEB 2025

CERTIFICATE OF CALIBRATION

Replacement of Certificate of Calibration Serial No 21/1161/10

Approved signatory
Name: **Alan Boulton**
Signature

Issued by **EffecTech**
Date of issue **27 July 2022** Certificate number **21/1161/10A**

EffecTech
Global Leaders in Gas Measurement

Dove House
Dove Fields
Uttoxeter
Staffordshire ST14 8HU
United Kingdom www.effectech.co.uk

0590

Customer	: CAC Gas & Instrumentation Pty. Ltd. Unit 3 / 36 Holbeche Rd., Arndell Park, NSW 2148, Australia.
Customer reference	: PO No.PO5181 (Part Code: 50ST-INPX-LNGQC1CH4)
Product description	: Calibrated Gas Mixture (CGM) for use in natural gas analysis Multi-component natural gas mixture
Preparation method	: Mixture prepared by ISO 6142-1:2015 - *Gas Analysis - Preparation of calibration gas mixtures - Part 1 : Gravimetric method for Class I mixtures*
Calibration method	: Mixture calibrated by ISO 6143:2001 - *Gas Analysis - Comparison methods for determining and checking the composition of calibration gas mixtures* using high precision gas chromatography
Metrological traceability	: Mixture classified as a Calibrated Gas Mixture (CGM) on which the values are assigned through an unbroken chain of analytical comparisons to a Primary Reference Gas Mixture

Date of calibration	: 25 August 2021	Cylinder number	: 21/41850
Minimum usage pressure	: 3 bar	Contents pressure	: 109 bar
Usage temperature range	: 15 to 50°C	Cylinder size	: 50 litres
Storage temperature range	: -38 to 50°C	Cylinder material	: steel
		Valve outlet connection	: BS 341 - No.4

Composition

component	amount fraction (%mol/mol)
oxygen	0.00970 ± 0.00017
nitrogen	0.2005 ± 0.0029
carbon dioxide⋆	0.00977 ± 0.00024
methane	85.810 ± 0.026
ethane	12.996 ± 0.032
propane	0.7994 ± 0.0024
iso-butane	0.05039 ± 0.00045
n-butane	0.03031 ± 0.00045
iso-pentane	0.05026 ± 0.00035
n-pentane	0.03022 ± 0.00025
n-hexane	0.01010 ± 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%.

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

To re-order this gas mixture contact CAC Gas & Instrumentation quoting certificate number 21/1161/10A.
tel: 1300 CAC GAS (+61 2 8676 6500) email: cac@cacgas.com.au

EffecTech is accredited by UKAS to undertake the calibration 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 mixture identified in this certificate

CERTIFICATE OF CALIBRATION

Replacement of Certificate of Calibration Serial No 21/1161/10

UKAS accredited calibration laboratory no.0590

Certificate number

21/1161/10A

Physical Properties

Reference conditions	**primary** combustion 15 °C metering 15 °C		**secondary** combustion 0 °C metering 0 °C	
mean molar mass	18.204 ± 0.018	$kg \cdot kmol^{-1}$	18.204 ± 0.018	$kg \cdot kmol^{-1}$
compression factor	0.9973 ± 0.0010		0.9968 ± 0.0010	
Real gas properties				
superior calorific value	42.041 ± 0.042	$MJ \cdot m^{-3}$	44.442 ± 0.044	$MJ \cdot m^{-3}$
	991.40 ± 0.99	$kJ \cdot mol^{-1}$	992.92 ± 0.99	$kJ \cdot mol^{-1}$
	54.460 ± 0.054	$MJ \cdot kg^{-1}$	54.544 ± 0.055	$MJ \cdot kg^{-1}$
inferior calorific value	37.995 ± 0.038	$MJ \cdot m^{-3}$	40.109 ± 0.040	$MJ \cdot m^{-3}$
	895.97 ± 0.90	$kJ \cdot mol^{-1}$	896.12 ± 0.90	$kJ \cdot mol^{-1}$
	49.218 ± 0.049	$MJ \cdot kg^{-1}$	49.227 ± 0.049	$MJ \cdot kg^{-1}$
relative density	0.62996 ± 0.00063		0.63019 ± 0.00063	
density	0.77196 ± 0.00077	$kg \cdot m^{-3}$	0.81478 ± 0.00081	$kg \cdot m^{-3}$
superior Wobbe index	52.969 ± 0.053	$MJ \cdot m^{-3}$	55.983 ± 0.056	$MJ \cdot m^{-3}$
Ideal gas properties				
superior calorific value	41.929 ± 0.042	$MJ \cdot m^{-3}$	44.299 ± 0.044	$MJ \cdot m^{-3}$
	991.40 ± 0.99	$kJ \cdot mol^{-1}$	992.92 ± 0.99	$kJ \cdot mol^{-1}$
	54.460 ± 0.054	$MJ \cdot kg^{-1}$	54.544 ± 0.055	$MJ \cdot kg^{-1}$
inferior calorific value	37.893 ± 0.038	$MJ \cdot m^{-3}$	39.980 ± 0.040	$MJ \cdot m^{-3}$
	895.97 ± 0.90	$kJ \cdot mol^{-1}$	896.12 ± 0.90	$kJ \cdot mol^{-1}$
	49.218 ± 0.049	$MJ \cdot kg^{-1}$	49.227 ± 0.049	$MJ \cdot kg^{-1}$
relative density	0.62853 ± 0.00063		0.62853 ± 0.00063	
density	0.76989 ± 0.00077	$kg \cdot m^{-3}$	0.81217 ± 0.00081	$kg \cdot m^{-3}$
superior Wobbe index	52.886 ± 0.053	$MJ \cdot m^{-3}$	55.877 ± 0.056	$MJ \cdot m^{-3}$

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).

For the purpose of these calculations, and in accordance with the recommendations of the international standard, the gas mixture is assumed dry (free from moisture).

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%.

CERTIFICATE OF CALIBRATION

Replacement of Certificate of Calibration Serial No 21/1161/10

UKAS accredited calibration laboratory no.0590

Certificate number

21/1161/10A

Replacement History

Certificate number	Reason for replacement
21/1161/10	Original Certificate
21/1161/10A	Certificate regenerated following an investigation on the intracalibration on the danalyzer. The investigation highlighted that the software was predicting a quadractic fit for ethane. This was used in the original certification which resulted in a bias in between ethane and methane values. However, a linear fit is more appropriate. Certificates re-issued according to this revised dataset.

ADVICE on the storage and use of your calibration gas mixture

The calibration gas mixture supplied to you contains components which are condensable under certain conditions of temperature. It is important that these conditions are avoided where possible during storage and usage of the mixture.

Please read this advice in conjunction with recommended storage/usage conditions given on the certificate of calibration.

Storage

*Has the ambient temperature during **storage** dropped below the hydrocarbon dew temperature at contents pressure?*

If so then there will be stratification of your mixture into two phases (vapour and liquid)

The withdrawal of any gas phase content from this two phase mixture will invalidate the certified reference values we have provided with your calibration gas.

Advice before use

There will be no record of the minimum temperature to which your gas mixture has been exposed in transport to you. Hence, there is no guarantee that the gas mixture has not been exposed to temperatures below the hydrocarbon dew temperature of your mixture at contents pressure. If you suspect the gas has been exposed to temperatures below this the contents must be allowed to equilibrate at a greater temperature for a minimum period of about 24 hours. Following this equilibration time your mixture should be entirely homogeneous and gaseous. Often, it is good practice to roll the cylinder, where possible, to encourage mixing during equilibration.

Use

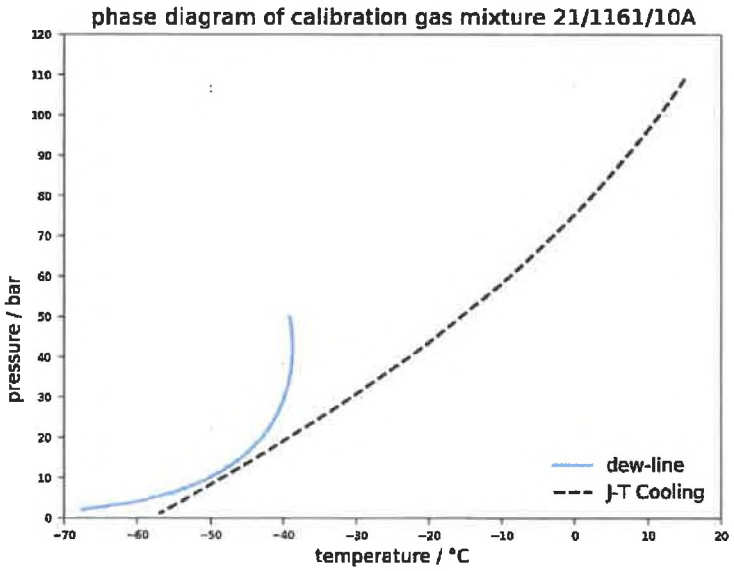
*When in **use** does condensation occur in your gas mixture following depressurisation as a result of cooling?*

Your gas mixture cools when it is depressurised through your pressure regulator. This is called Joule-Thomson (or Joule-Kelvin) cooling. If the gas cools to below the hydrocarbon dew temperature at its pressure then your mixture will stratify into two phases (vapour and liquid).

If this occurs the gas phase composition delivered to your application will not be representative of the certified reference values we have provided with your calibration gas.

Advice during use

The diagram below shows the pressure-temperature phase characteristics of your particular calibration mixture. Conditions shown to the left of the hydrocarbon dewline are in the two phase (liquid and vapour) region, whilst to the right your mixture remains as a single phase vapour. The cooling curve shown does not enter the two-phase region.



This demonstrates that during use your mixture remains entirely in the vapour phase should it be depressurised in a single stage from contents pressure and at a starting temperature of 15°C.

Technical information : The dewline and the cooling curve were calculated using GasVLE™ and constructed using the LRS equation of state (EOS) and the cooling curve generated from a simulated isenthalpic flash calculation assuming adiabatic conditions starting at contents pressure and the stated temperature.

Single Injection Report

Agilent

Sample name:	20250325 LNG QC Run 2		
Data file:	L2501418001.2.dx	**Operator:**	ilnglab
Instrument:	GC09	**Injection date:**	2025-03-25 07:05:24+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC09_AQUISITION_NAT_GAS_20241111.amx		
Injection Acq Method Modified Date	2024-11-11 10:14:35+09:30		
Processing method:	GC-09_ NATURAL_GAS_PROCESSING_20250225.pmx		
Injection DA Method Latest File Change	2025-02-25 15:59:47+09:30		

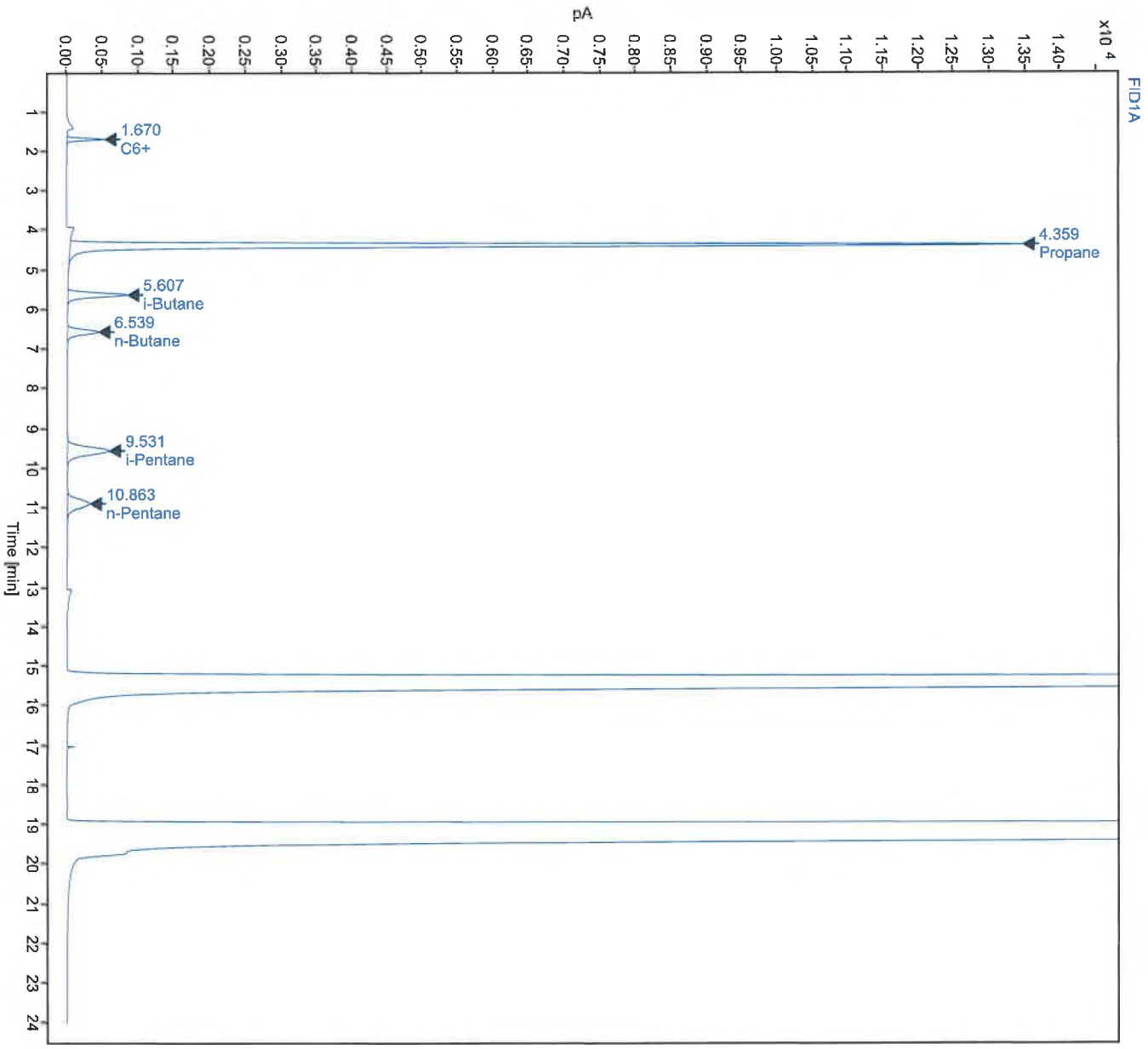
CW
25 MAR 2025

25/3/25

SO
25/3/25

Single Injection Report

Agilent



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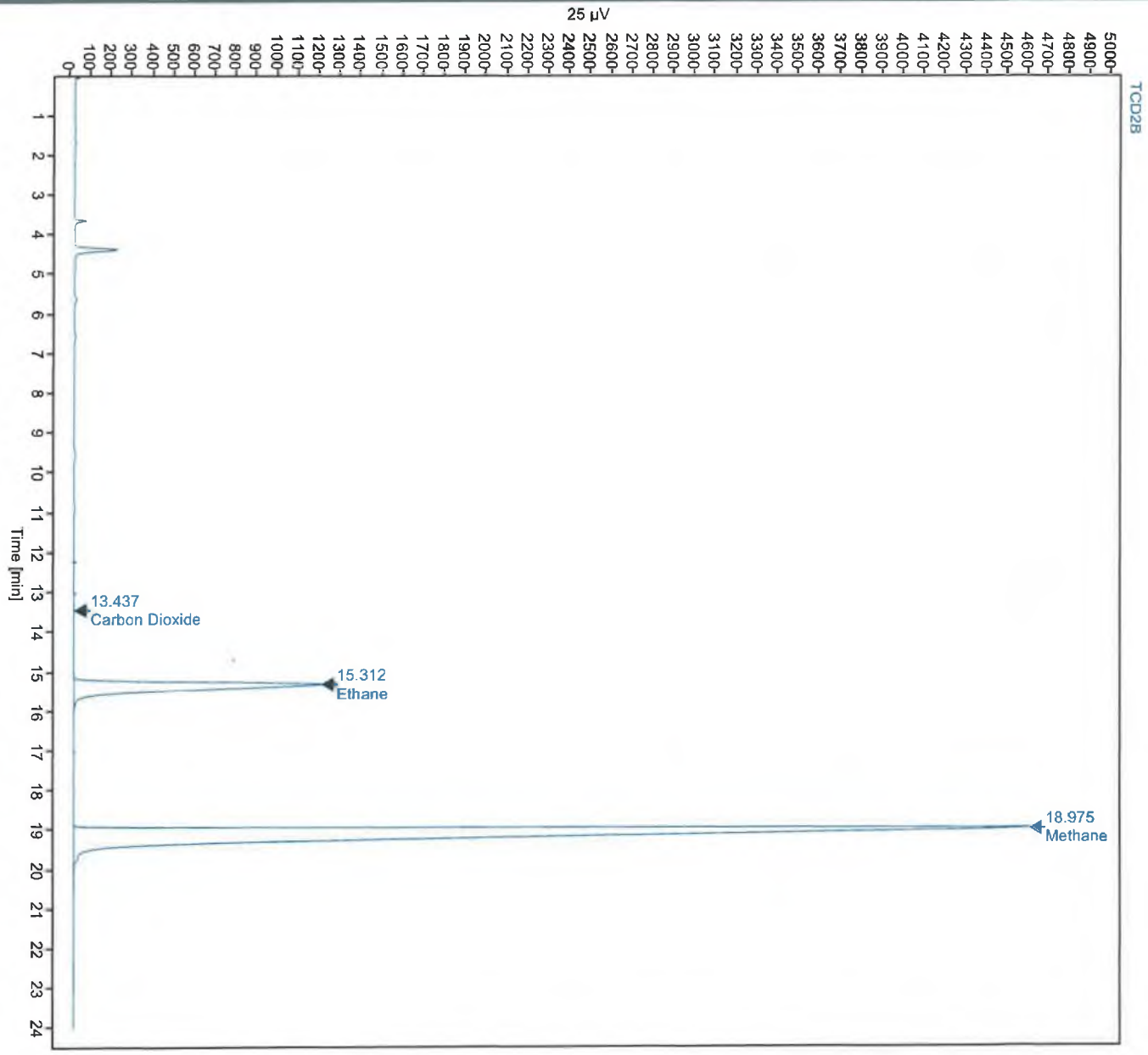
Single Injection Report

Agilent



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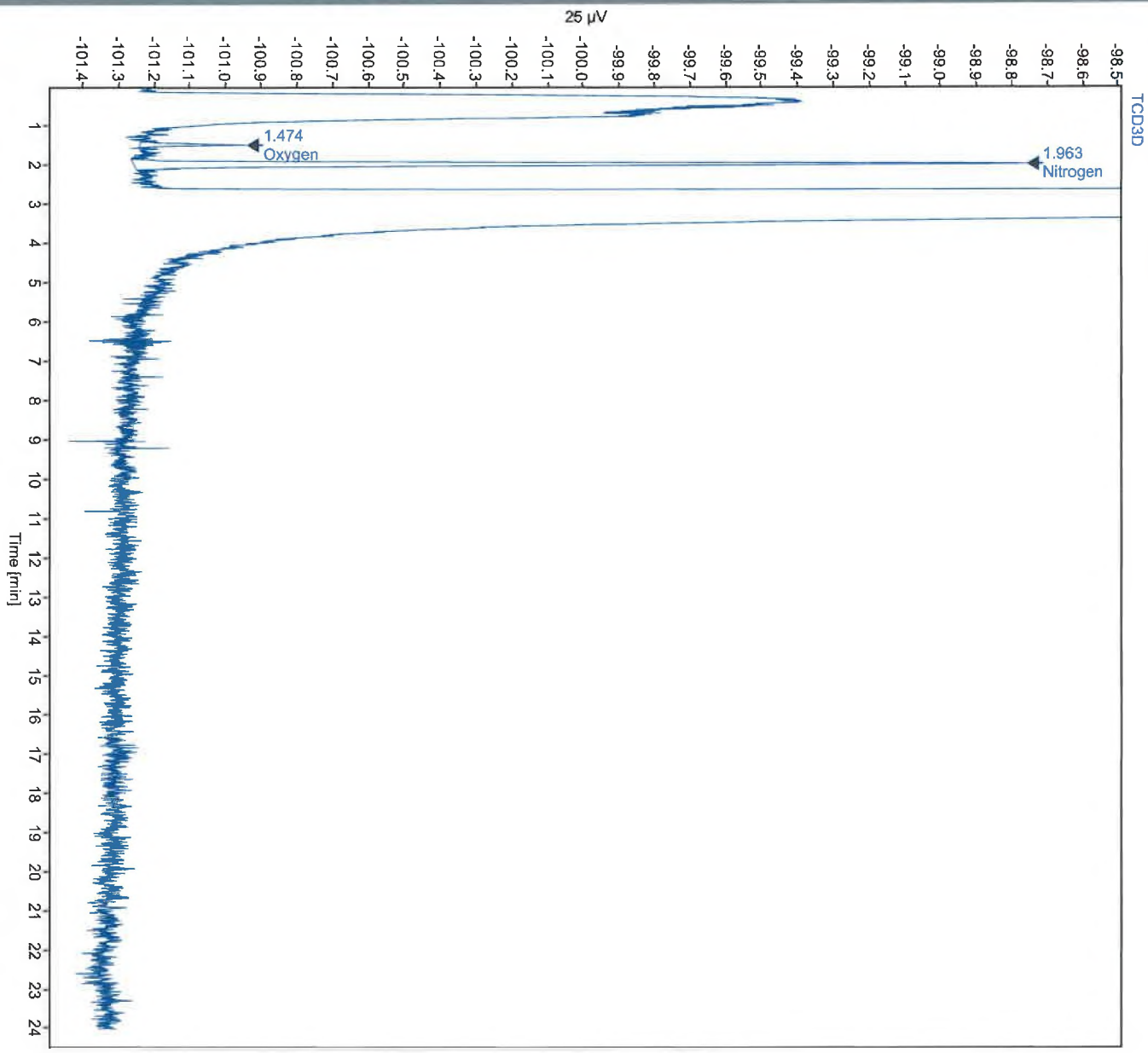
Single Injection Report

Agilent



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Single Injection Report

Agilent

Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]	mol% (2dp)
Oxygen	TCD3	1.474	0.008308600	1.00462	0.008347	0.008407	0.01
C6+	FID1	1.670	0.000004992	2021.46917	0.010091	0.010164	0.01
Nitrogen	TCD3	1.963	0.014416381	13.91044	0.200538	0.201981	0.20
Propane	FID1	4.359	0.000010190	78935.65779	0.804354	0.810142	0.81
i-Butane	FID1	5.607	0.000007631	6585.27710	0.050252	0.050614	0.05
n-Butane	FID1	6.539	0.000007487	4009.97399	0.030023	0.030239	0.03
i-Pentane	FID1	9.531	0.000006069	8238.68462	0.050001	0.050360	0.05
n-Pentane	FID1	10.863	0.000006120	4937.30191	0.030216	0.030434	0.03
Carbon Dioxide	TCD2	13.437	0.000895780	11.25981	0.010086	0.010159	0.01
Ethane	TCD2	15.312	0.000830562	15538.02758	12.905295	12.998146	13.00
Methane	TCD2	18.975	0.001256901	67774.99395	85.186458	85.799355	85.80
				Total mol%	99.285662	100.000000	100.00

99.29

CW
25 MAR 2025

SO
25/3/25

25/3/25

Single Injection Report

Agilent

Sample name:	20250325 LNG QC Run 3		
Data file:	L2501418001.3.dx	**Operator:**	ilnglab
Instrument:	GC09	**Injection date:**	2025-03-25 07:29:50+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC09_AQUISITION_NAT_GAS_20241111.amx		
Injection Acq Method Modified Date	2024-11-11 10:14:35+09:30		
Processing method:	GC-09_ NATURAL_GAS_PROCESSING_20250225.pmx		
Injection DA Method Latest File Change	2025-02-25 15:59:47+09:30		

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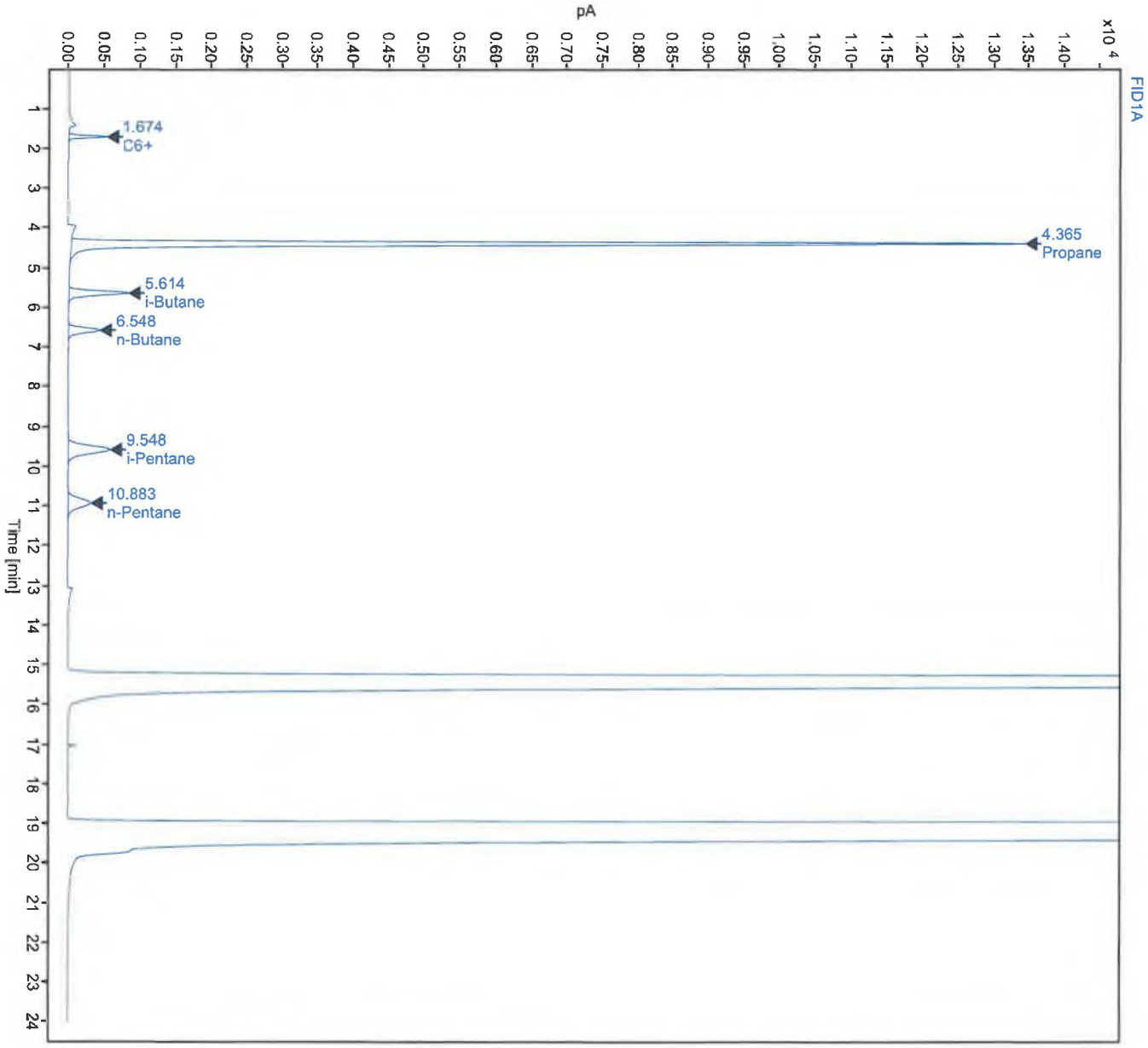
Single Injection Report

Agilent



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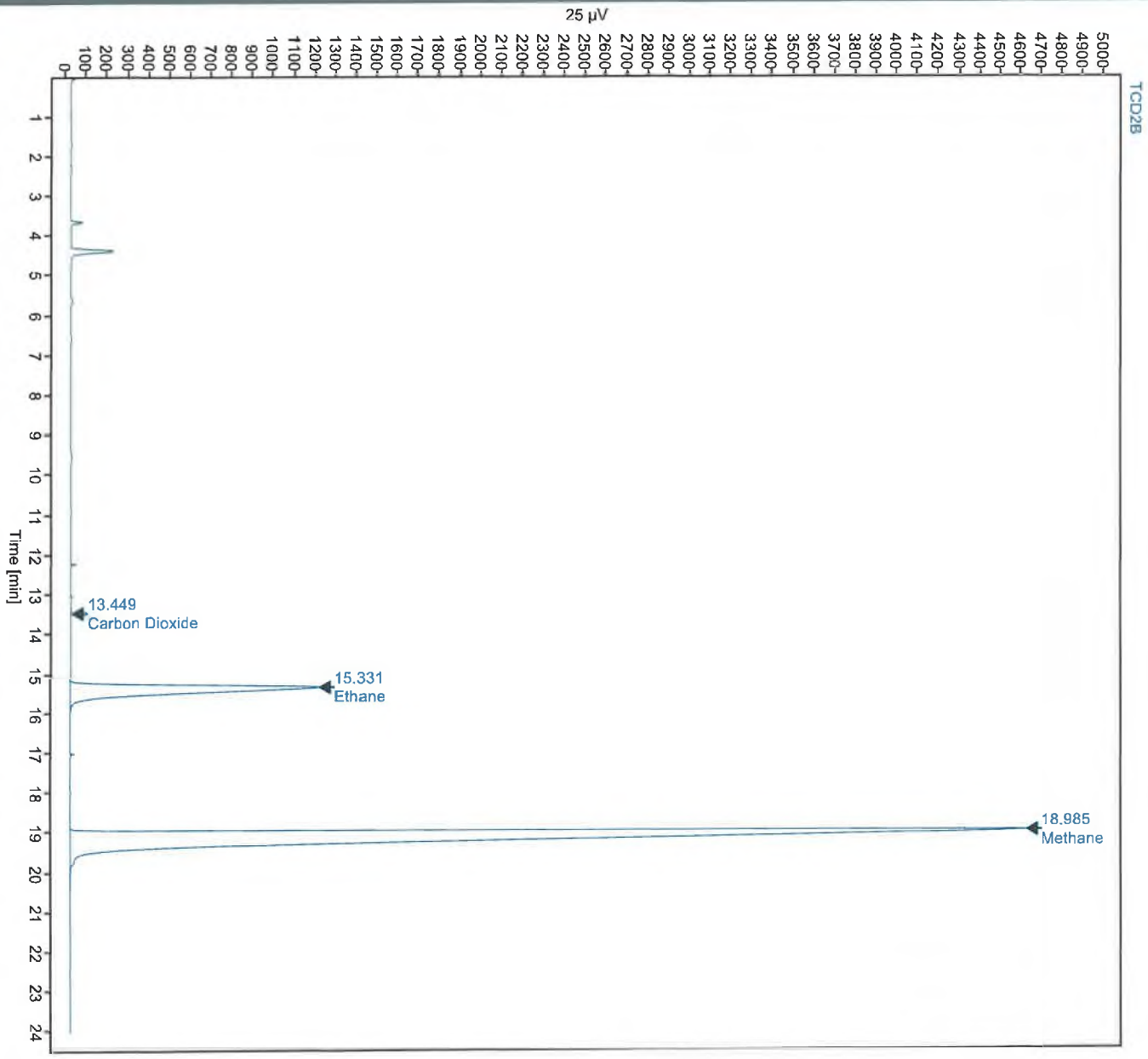
Single Injection Report

Agilent



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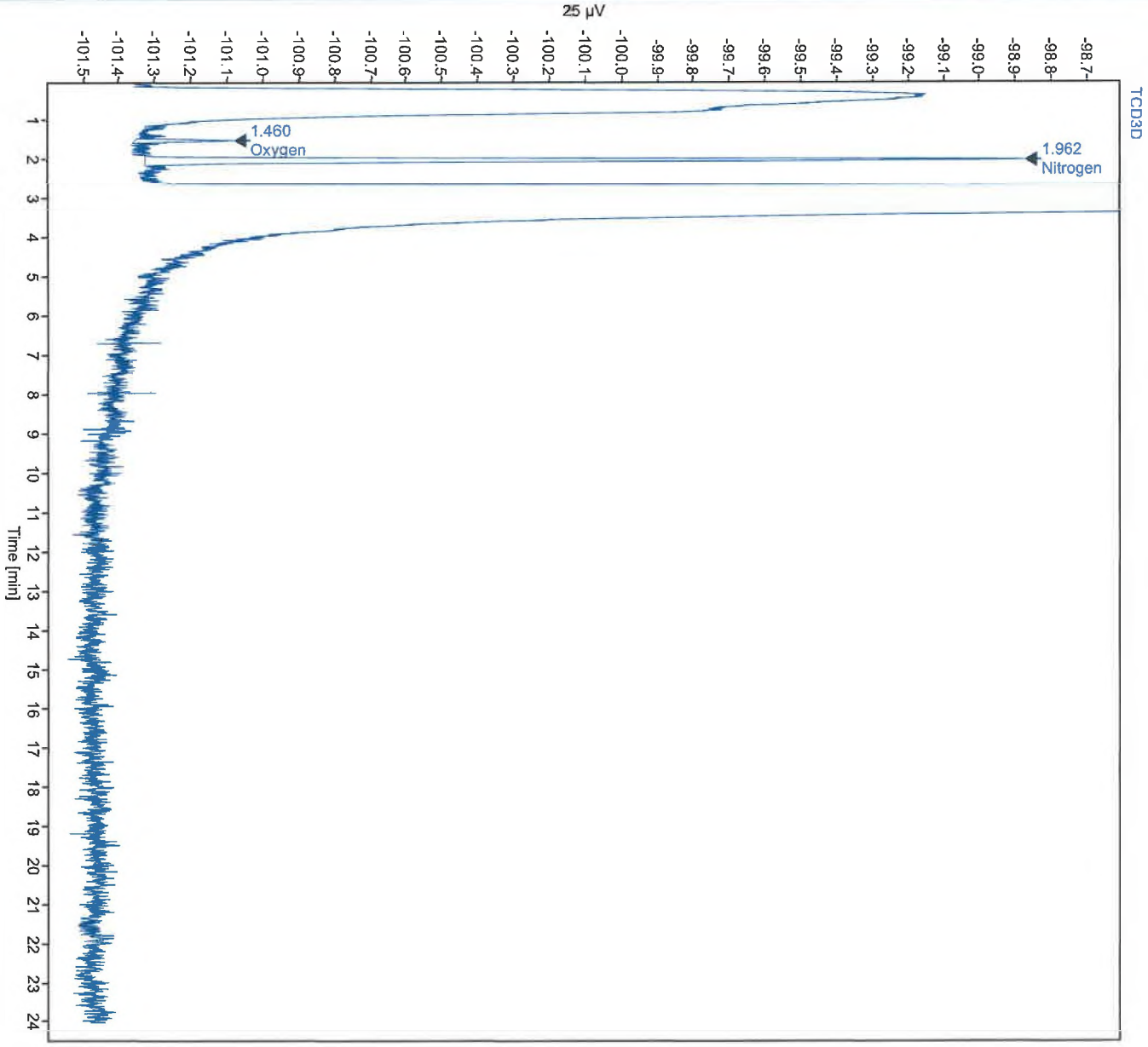
Single Injection Report

Agilent



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25 MAR 2025

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25/3/25

Single Injection Report

Agilent

Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]	mol% (2dp)
Oxygen	TCD3	1.460	0.008308600	0.98415	0.008177	0.008196	0.01
C6+	FID1	1.674	0.000004992	2004.62197	0.010007	0.010030	0.01
Nitrogen	TCD3	1.962	0.014416381	13.49679	0.194575	0.195025	0.20
Propane	FID1	4.365	0.000010190	78985.00258	0.804857	0.806718	0.81
i-Butane	FID1	5.614	0.000007631	6587.02590	0.050266	0.050382	0.05
n-Butane	FID1	6.548	0.000007487	4007.03718	0.030001	0.030070	0.03
i-Pentane	FID1	9.548	0.000006069	8226.94211	0.049929	0.050045	0.05
n-Pentane	FID1	10.883	0.000006120	4923.13539	0.030130	0.030199	0.03
Carbon Dioxide	TCD2	13.449	0.000895780	11.32568	0.010145	0.010169	0.01
Ethane	TCD2	15.331	0.000830562	15629.55897	12.981318	13.011332	13.01
Methane	TCD2	18.985	0.001256901	68103.94469	85.599916	85.797834	85.80 *
				Total mol%	99.769321	100.000000	100.01
					99.77		

* Re normalised Methane = 85.80 − 0.01

= 85.79 mol%

— CW 25/03/25

CW
25 MAR 2025

SO
25/3/25

CERTIFIED REFERENCE MATERIAL

Approved signatory
Name: **Gautami Snewin**
Signature

Issued by **EffecTech**
Date of issue **12 April 2023** Certificate number **23/0472/01**

EffecTech
Global Leaders in Gas Measurement
Dove House
Dove Fields
Uttoxeter
Staffordshire ST14 8HU
United Kingdom www.effectech.co.uk

ilac-MRA UKAS REFERENCE MATERIALS 5710

Customer	: CAC Gas & Instrumentation Pty. Limited Unit 3 / 36 Holbeche Rd., Arndell Park, NSW 2148, Australia.
Customer reference	: PO No.PO6534 (Part Code: 10AL-INPX-SPC6O2PT)
Product description	: Certified Reference Material (CRM) for use in natural gas analysis Multi-component natural gas mixture
Preparation method	: Mixture prepared by ISO 6142-1:2015 - *Gas Analysis - Preparation of calibration gas mixtures - Part 1 - Gravimetric method for Class I mixtures*
Value assignment	: Values assigned by ISO 6143:2001 - *Gas Analysis - Comparison methods for determining and checking the composition of calibration gas mixtures* using high precision gas chromatography
Metrological traceability	: Mixture classified as a Certified Reference Material (CRM) on which the values are assigned through an unbroken chain of analytical comparisons to a Primary Reference Gas Mixture
Stability	: EffecTech stability studies of similar gas mixtures in this type of cylinder/valve combination have demonstrated a shelf-life of 5 years providing the contents pressure and usage/storage temperature remain within the limits stated in the table below.
Handling and Use	: Supplementary advice is annexed to this certificate on the handling, storage and use of this certified reference material. General instructions for the proper use of gas mixtures can be found in ISO 16664: *Gas Analysis - Handling of calibration gases and gas mixtures*

Date of production	: 27 March 2023	Cylinder number	: D172603
Expiry date	: 27 March 2028	Contents pressure	: 84 bar
Minimum usage pressure	: 3 bar	Cylinder size	: 10 litres
Usage temperature range	: 0 to 50 °C	Cylinder material	: aluminium
Storage temperature range	: -40 to 50 °C	Valve outlet connection	: BS 341 - No.4

Composition

component	**amount fraction (%mol/mol)**
oxygen	0.00995 ± 0.00017
nitrogen	0.3781 ± 0.0079
carbon dioxide⋆	0.00993 ± 0.00020
methane	84.756 ± 0.025
ethane	13.713 ± 0.034
propane	0.9921 ± 0.0034
iso-butane	0.04939 ± 0.00045
n-butane	0.01987 ± 0.00045
iso-pentane	0.05067 ± 0.00036
n-pentane	0.02026 ± 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 contents of this certificate comply with the mandatory requirements of ISO Guide 31:2015 - *Reference materials — Contents of certificates, labels and accompanying documentation* and ISO 6141:2015 - *Gas Analysis - Contents of certificates for calibration gas mixtures*

To re-order this gas mixture contact CAC Gas & Instrumentation quoting certificate number 23/0472/01.
tel: 1300 CAC GAS (+61 2 8676 6500) email: cac@cacgas.com.au

CERTIFIED REFERENCE MATERIAL

UKAS accredited reference material producer no.5710

Certificate number

23/0472/01

Physical Properties

Reference conditions	**primary** combustion 15 °C metering 15 °C		**secondary** combustion 0 °C metering 0 °C	
mean molar mass	18.363 ± 0.018	$kg \cdot kmol^{-1}$	18.363 ± 0.018	$kg \cdot kmol^{-1}$
compression factor	0.9973 ± 0.0010		0.9967 ± 0.0010	
Real gas properties				
superior calorific value	42.256 ± 0.042	$MJ \cdot m^{-3}$	44.668 ± 0.045	$MJ \cdot m^{-3}$
	996.4 ± 1.0	$kJ \cdot mol^{-1}$	997.9 ± 1.0	$kJ \cdot mol^{-1}$
	54.260 ± 0.054	$MJ \cdot kg^{-1}$	54.344 ± 0.054	$MJ \cdot kg^{-1}$
inferior calorific value	38.197 ± 0.038	$MJ \cdot m^{-3}$	40.323 ± 0.040	$MJ \cdot m^{-3}$
	900.70 ± 0.90	$kJ \cdot mol^{-1}$	900.85 ± 0.90	$kJ \cdot mol^{-1}$
	49.048 ± 0.049	$MJ \cdot kg^{-1}$	49.057 ± 0.049	$MJ \cdot kg^{-1}$
relative density	0.63551 ± 0.00064		0.63574 ± 0.00064	
density	0.77876 ± 0.00078	$kg \cdot m^{-3}$	0.82196 ± 0.00082	$kg \cdot m^{-3}$
superior Wobbe index	53.006 ± 0.053	$MJ \cdot m^{-3}$	56.022 ± 0.056	$MJ \cdot m^{-3}$
Ideal gas properties				
superior calorific value	42.140 ± 0.042	$MJ \cdot m^{-3}$	44.523 ± 0.045	$MJ \cdot m^{-3}$
	996.4 ± 1.0	$kJ \cdot mol^{-1}$	997.9 ± 1.0	$kJ \cdot mol^{-1}$
	54.260 ± 0.054	$MJ \cdot kg^{-1}$	54.344 ± 0.054	$MJ \cdot kg^{-1}$
inferior calorific value	38.093 ± 0.038	$MJ \cdot m^{-3}$	40.191 ± 0.040	$MJ \cdot m^{-3}$
	900.70 ± 0.90	$kJ \cdot mol^{-1}$	900.85 ± 0.90	$kJ \cdot mol^{-1}$
	49.048 ± 0.049	$MJ \cdot kg^{-1}$	49.057 ± 0.049	$MJ \cdot kg^{-1}$
relative density	0.63404 ± 0.00063		0.63404 ± 0.00063	
density	0.77663 ± 0.00078	$kg \cdot m^{-3}$	0.81928 ± 0.00082	$kg \cdot m^{-3}$
superior Wobbe index	52.922 ± 0.053	$MJ \cdot m^{-3}$	55.914 ± 0.056	$MJ \cdot m^{-3}$

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).

For the purpose of these calculations, and in accordance with the recommendations of the international standard, the gas mixture is assumed dry (free from moisture).

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).

ADVICE on the storage and use of your calibration gas mixture

The calibration gas mixture supplied to you contains components which are condensable under certain conditions of temperature. It is important that these conditions are avoided where possible during storage and usage of the mixture.

Please read this advice in conjunction with recommended storage/usage conditions given on the certificate of calibration.

Storage

*Has the ambient temperature during **storage** dropped below the hydrocarbon dew temperature at contents pressure?*

If so then there will be stratification of your mixture into two phases (vapour and liquid)

The withdrawal of any gas phase content from this two phase mixture will invalidate the certified reference values we have provided with your calibration gas.

Advice before use

There will be no record of the minimum temperature to which your gas mixture has been exposed in transport to you. Hence, there is no guarantee that the gas mixture has not been exposed to temperatures below the hydrocarbon dew temperature of your mixture at contents pressure. If you suspect the gas has been exposed to temperatures below this the contents must be allowed to equilibrate at a greater temperature for a minimum period of about 24 hours. Following this equilibration time your mixture should be entirely homogeneous and gaseous. Often, it is good practice to roll the cylinder, where possible, to encourage mixing during equilibration.

Use

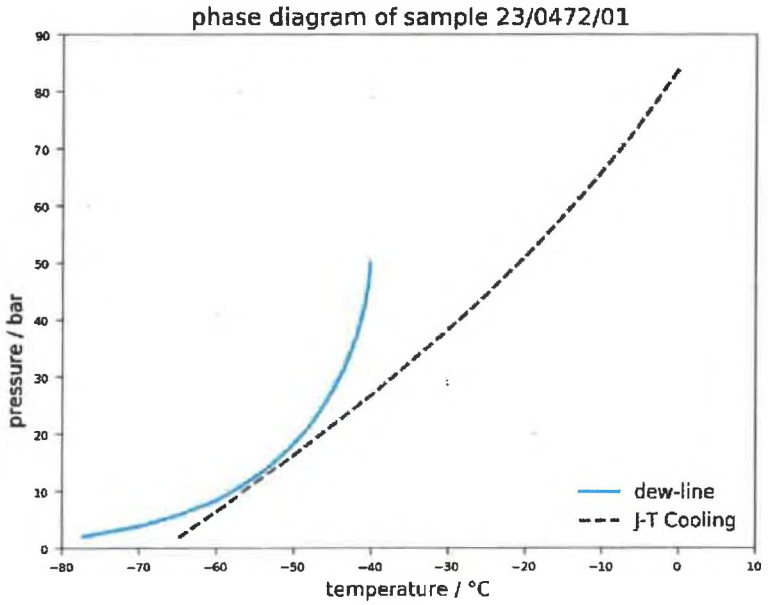
*When in **use** does condensation occur in your gas mixture following depressurisation as a result of cooling?*

Your gas mixture cools when it is depressurised through your pressure regulator. This is called Joule-Thomson (or Joule-Kelvin) cooling. If the gas cools to below the hydrocarbon dew temperature at its pressure then your mixture will stratify into two phases (vapour and liquid).

If this occurs the gas phase composition delivered to your application will not be representative of the certified reference values we have provided with your calibration gas.

Advice during use

The diagram below shows the pressure-temperature phase characteristics of your particular calibration mixture. Conditions shown to the left of the hydrocarbon dewline are in the two phase (liquid and vapour) region, whilst to the right your mixture remains as a single phase vapour. The cooling curve shown does not enter the two-phase region.



This demonstrates that during use your mixture remains entirely in the vapour phase should it be depressurised in a single stage from contents pressure and at a starting temperature of 0°C.

Technical information : The dewline and the cooling curve were calculated using GasVLE™ and constructed using the LRS equation of state (EOS) and the cooling curve generated from a simulated isenthalpic flash calculation assuming adiabatic conditions starting at contents pressure and the stated temperature.

Single Injection Report

Agilent

Sample name:	20250325 L-410-MISC (CPC Terminal Correlation Standard - D172603) Run 2		
Data file:	L2501423001.2.dx	**Operator:**	ilnglab
Instrument:	GC09	**Injection date:**	2025-03-25 13:41:33+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC09_AQUISITION_NAT_GAS_20241111.amx		
Injection Acq Method Modified Date	2024-11-11 10:14:35+09:30		
Processing method:	GC-09_ NATURAL_GAS_PROCESSING_20250225.pmx		
Injection DA Method Latest File Change	2025-02-25 15:59:47+09:30		

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25 MAR 2025

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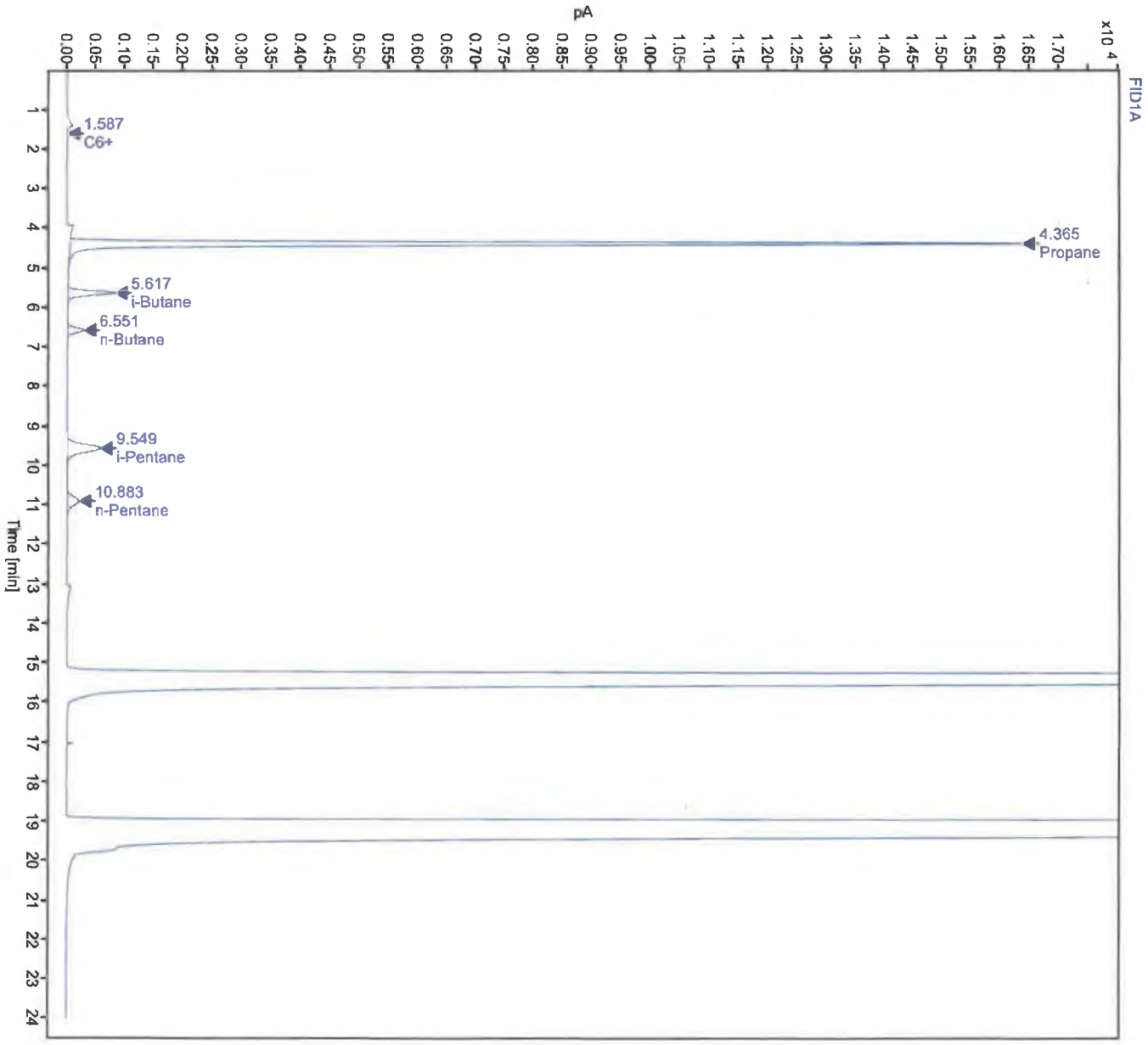
Single Injection Report

Agilent



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Single Injection Report

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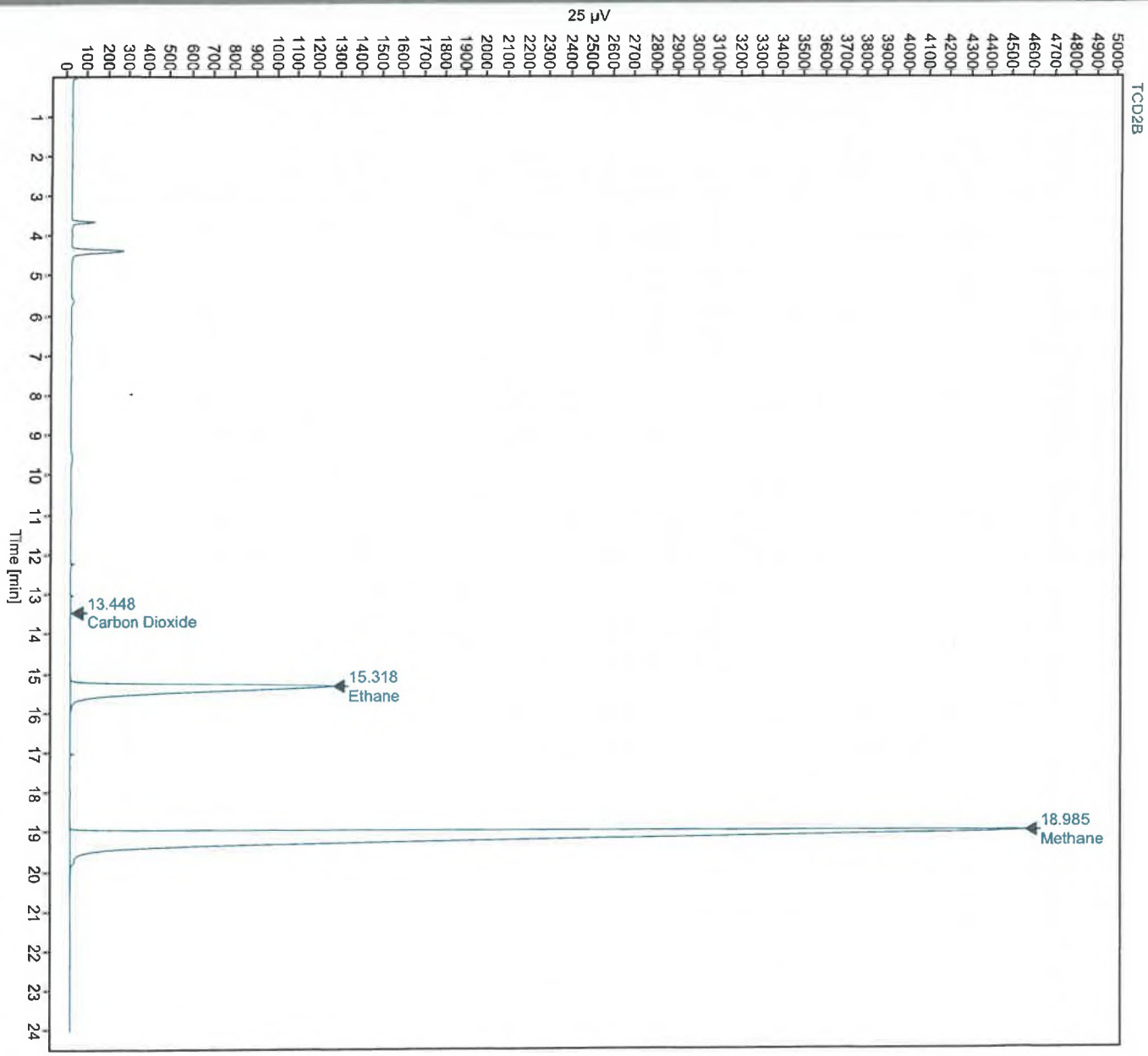

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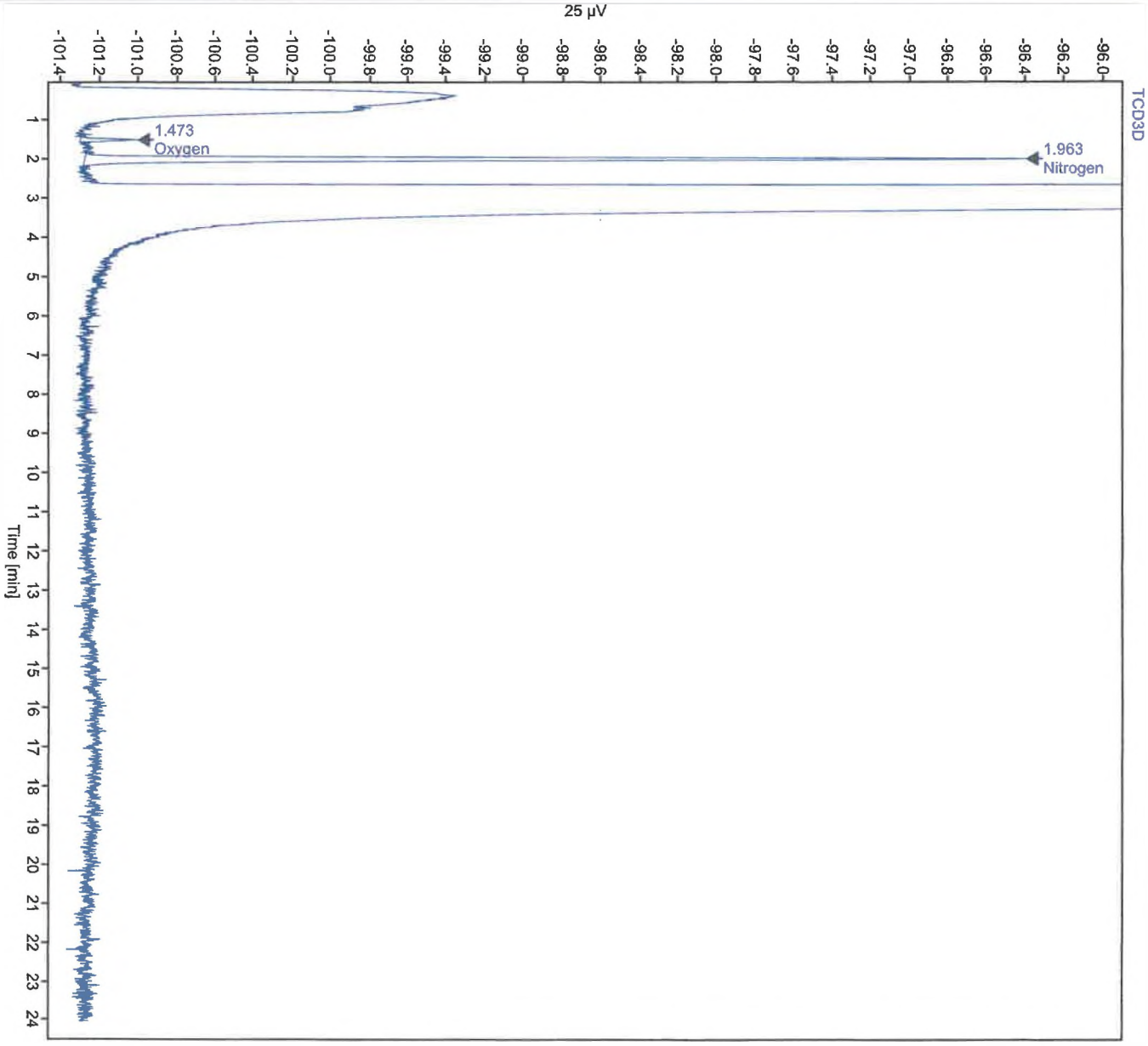
Single Injection Report

Agilent



CW

25 MAR 2025

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Single Injection Report

Agilent

Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]	mol% (2 dp)
Oxygen	TCD3	1.473	0.008308600	1.08935	0.009051	0.009110	0.01 ✓
C6+	FID1	1.587	0.000004992	17.52164	0.000087	0.000088	0.00 ✓
Nitrogen	TCD3	1.963	0.014416381	26.90430	0.387863	0.390406	0.39 ✓
Propane	FID1	4.365	0.000010190	96482.40457	0.983156	0.989603	0.99 ✓
i-Butane	FID1	5.617	0.000007631	6491.19872	0.049534	0.049859	0.05 ✓
n-Butane	FID1	6.551	0.000007487	2577.00746	0.019294	0.019421	0.02 ✓
i-Pentane	FID1	9.549	0.000006069	8191.79360	0.049716	0.050042	0.05 ✓
n-Pentane	FID1	10.883	0.000006120	3219.13062	0.019701	0.019830	0.02 ✓
Carbon Dioxide	TCD2	13.448	0.000895780	10.93922	0.009799	0.009863	0.01 ✓
Ethane	TCD2	15.318	0.000830562	16403.91347	13.624467	13.713807	13.71 ✓
Methane	TCD2	18.985	0.001256901	66986.87654	84.195872	84.747971	84.75 ✓
				Total mol%	99.348541	100.000000	100.00
					99.35 ✓		

CW
25 MAR 2025

25/3/25

Single Injection Report

Agilent

Sample name:	20250325 L-410-MISC (CPC Terminal Correlation Standard - D172603) Run 3		
Data file:	L2501423001.3.dx	**Operator:**	ilnglab
Instrument:	GC09	**Injection date:**	2025-03-25 14:06:00+09:30
Type:	Sample	**Manually modified:**	Manual Integration
Acq. method:	GC09_AQUISITION_NAT_GAS_20241111.amx		
Injection Acq Method Modified Date	2024-11-11 10:14:35+09:30		
Processing method:	GC-09_ NATURAL_GAS_PROCESSING_20250225.pmx		
Injection DA Method Latest File Change	2025-02-25 15:59:47+09:30		

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25 MAR 2025

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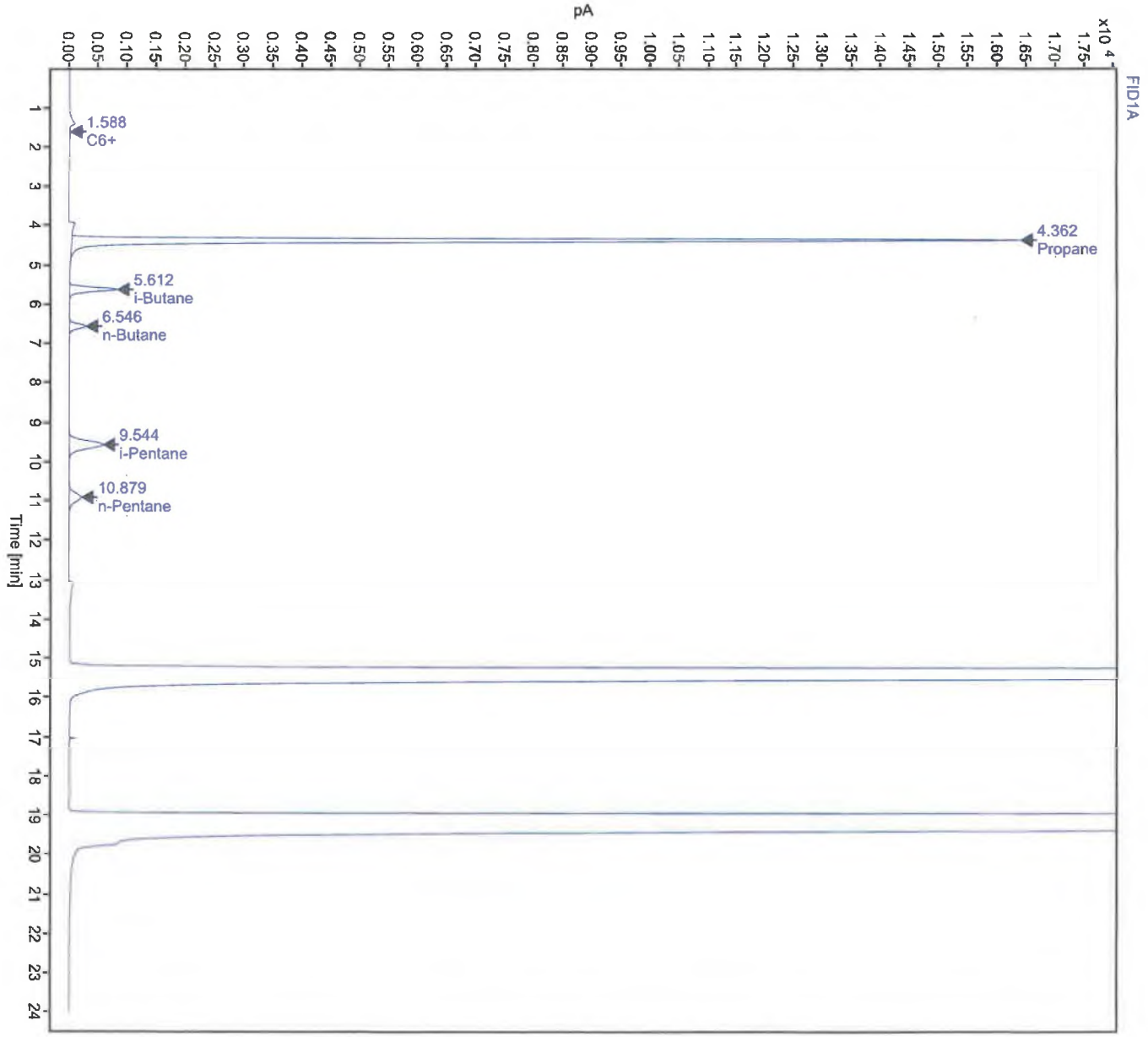
Single Injection Report

Agilent



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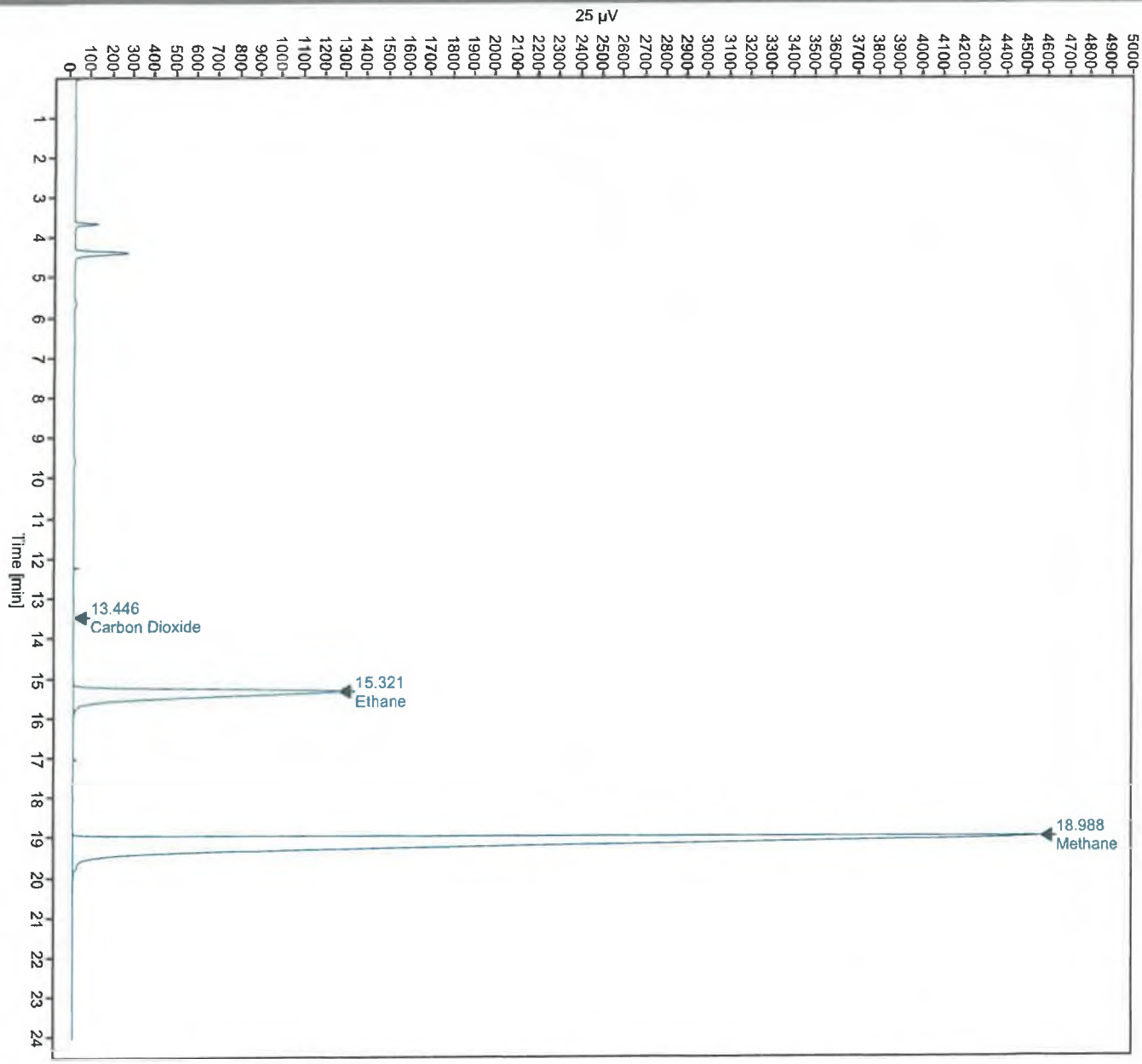
Single Injection Report

Agilent



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25 MAR 2025

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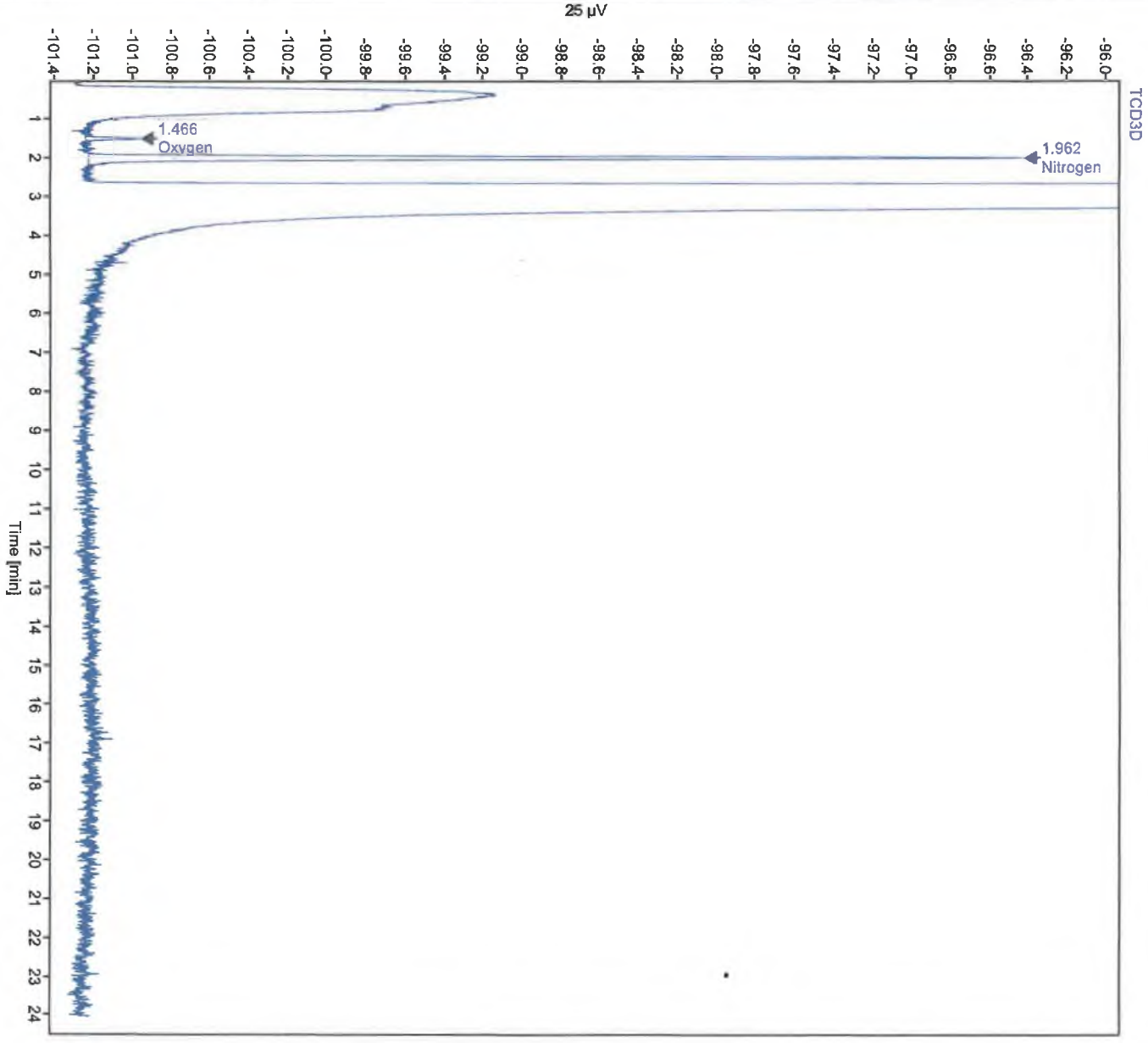
Single Injection Report

Agilent



CW

25 MAR 2025

25/3/25

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Name	Signal Type	RT [min]	RF	Area	Amount Un-norm [mol%]	Amount Norm [mol%]	mol% (2dp
Oxygen	TCD3	1.466	0.008308600	0.98191	0.008158	0.008218	0.01
C6+	FID1	1.588	0.000004992	17.52300	0.000087	0.000088	0.00
Nitrogen	TCD3	1.962	0.014416381	26.62382	0.383819	0.386616	0.39
Propane	FID1	4.362	0.000010190	96598.69428	0.984341	0.991513	0.99
i-Butane	FID1	5.612	0.000007631	6502.56668	0.049621	0.049983	0.05
n-Butane	FID1	6.546	0.000007487	2583.36120	0.019342	0.019483	0.02
i-Pentane	FID1	9.544	0.000006069	8221.66368	0.049897	0.050261	0.05
n-Pentane	FID1	10.879	0.000006120	3233.03877	0.019786	0.019930	0.02
Carbon Dioxide	TCD2	13.446	0.000895780	11.00179	0.009855	0.009927	0.01
Ethane	TCD2	15.321	0.000830562	16405.44231	13.625737	13.725016	13.73
Methane	TCD2	18.988	0.001256901	66931.29614	84.126013	84.738966	84.74*
				Total mol%	99.276657	100.000000	100.01

99.28

* Re-normalised Methane = 84.74 − 0.01

= 84.73 mol%

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