出國報告（出國類別：洽公）

2019年中馬化驗比對測試及技術研討

服務機關：台灣中油公司天然氣事業部
永安液化天然氣廠
姓名職稱：解順傑化學師、呂承勳化學師
派赴國家：馬來西亞
出國期間： 108 年 11 月 18 日至 11 月 21 日
報告日期：108 年 12 月 16 日

摘要

台灣中油公司與馬來西亞石油石油公司(PETRONAS)雙方簽訂天然氣採購契約並自1995年開始執行，另簽有新約於2014年啟用，目前雙方合約存續中，為國內LNG主要供應國之一。由於中馬合約為DES合約，分析計價係以買方實驗室分析結果作為計價依據，買賣雙方天然氣交易金額龐大，為達到雙方互信和加強雙邊交流，依據合約之要求，雙方實驗室須定期進行化驗比對測試，故本次出國主要任務為至馬來PETRONAS公司的民都魯天然氣液化廠實驗室執行化驗比對，藉由雙方實驗室取樣分析，化驗比對測試，以檢核雙方實驗室儀器及人員操作之精準度，了解雙方實驗室間的差異性，並進一步探討分析技術及意見交流，目的為加強買賣雙方之相互信賴與了解，並確保雙方實驗室間，儀器及操作分析技術維持一定水準；促進買賣雙方之互信，以利後續LNG交易順利進行。

目次

一、目的

依台灣中油公司與馬來西亞石油公司(PETRONAS) 雙方執行合約之協定，本次出國主要是前往馬來西亞PETRONAS 公司的BINTULU天然氣液化廠執行雙方實驗室間的化驗分析比對任務，透過取得未知成份的樣品，進行雙方實驗室間化驗比對，以查核雙方檢測儀器(氣相層析儀(GC))及人員操作之精準度，並比對實驗室間分析結果的差異性，以確保執行天然氣合約交易買賣之公信力。

二、過程

比對測試(Correlation Test, CT)

比對測試(Correlation Test)是種衡量確認分析方法、人員操作與儀器誤差可信範圍，整體比對測試流程如下：

(一)比對測試流程

1. 化驗比對程序

本次化驗比對是本公司與馬來西亞石油公司(PETRONAS)執行中馬實驗室間化驗比對，比對流程比照往年，由PETRONAS公司及本公司永安液化天然氣廠(簡稱永安廠)進行雙方實驗室間化驗比對，以降低LNG在卸收時，天然氣品質與熱值上分析差異之爭議，增加買賣雙方在交易上的公平性。

此次化驗比對時程，已於今年10月初與PETRONAS LNG Ltd的Ms. Maisarah Sharifuddin確認本年度先由PETRONAS公司Ms. Maisarah Sharifuddin等4位代表賣方

於2019年10月29日至10月30日至永安廠進行化驗比對測試Part A，10月29日至10月30日再由永安廠技術組化學師呂承勳與職奉派代表買方於2019年11月18日至21日赴馬來西亞執行本年度中馬化驗比對測試Part B及技術交流，完成本年度中馬實驗室間化驗比對，確認雙方實驗室參加比對之所有氣相層析儀分析結果之重複性及再現性皆符合買賣實行細則協定之允收標準，才視為買賣雙方認可彼此實驗室之氣相層析儀及測試程序。

2. 化驗比對儀器

化驗比對儀器依據買賣合約實施細則內容協定，買賣雙方同意使用氣相層析儀(GC)來分析LNG成分。本年度買賣雙方實驗室化驗比對之儀器共計4台(如表 一)，其中馬來西亞實驗室2台，永安廠實驗室2台。

表 一 永安廠與馬來西亞執行本年度化驗比對之儀器

	廠牌	型號	編號	序號
永安廠	Agilent	6890N	GC-G	US 10511027
	Agilent	6890N	GC-H	CN10703064
馬來西亞	Agilent	7890B	LAB 6	CN16203084
	Agilent	7890B	LAB 9	CN15203052

3. 比對樣品準備

比對樣品製備共七只(詳表二)，本次比對用樣品由永安液化天然氣廠負責製備，於108年10月15日以七支鋼瓶串聯連續取樣完成，最前一只及最後一只當查核樣品，以查證本批樣品是否分佈均勻，取樣具代表性，詳如附件一(製備比對樣品分析報告)，另外買賣方各分配兩只，其中第二支、第六支(鋼瓶編號CTM191015-2、CTM191015-6)比對測試用樣品於2019年10月18日隨船送往馬來西亞實驗室；第三支和第四支(鋼瓶編號CTM191015-3、CTM191015-4)供永安廠比對測試用，鋼瓶編號CTM191015-5為保留樣品。

表二 **2019** 年中卡比對樣品資訊

LAB	CYLINDER #	Remark
Yung-An/CPC LAB	Cylinder 1 (CTM191015-1)	Verification sample
BTU LAB	Cylinder 2 (CTM191015-2)	Analysis CT sample
Yung-An/CPC LAB	Cylinder 3 (CTM191015-3)	Analysis CT sample
Yung-An/CPC LAB	Cylinder 4 (CTM191015-4)	Back-up CT sample
Yung-An/CPC LAB	Cylinder 5 (CTM191015-5)	Back-up CT sample
BTU LAB	Cylinder 6 (CTM191015-6)	Back-up CT sample
Yung-An/CPC LAB	Cylinder 7 (CTM191015-7)	Verification sample

4. 第一部份(Part A)由永安廠實驗室分析化驗比對樣品，於108年10月29~30日完成。

5. 第二部份(Part B)由馬來西亞實驗室分析化驗比對樣品，108年11月18日至108年11月21日完成。

(二)第一部份比對測試 (Part A CT)

1. 於108年10月29~30日在永安廠實驗室比對測試，內容流程如下：

2. 比對儀器: GC-G、GC-H共2台。

3. 參加人員：

(1)買方代表

台灣中油公司永安液化天然氣廠：林俊豪(經理)、解順傑(化學師)。

(2)賣方代表

MLNG representatives

Ms. Evelyn Enjop : Chemist(Analytical Technology&Services)

Mr. Wong Aik Ching : Manager(Cargo Documentation)

PLL representatives

Ms. Kuan Kim Chiew : Manager(Global Marketing Operation)

Ms. Maisarah Sharifuddin : Executive (Global Marketing Operation)

(3)公證方代表

Mr. Jimmy Chung : Operation (BV-Taiwan)

Mr. Tommy Tsai : Surveyor (BV-Taiwan)

4. 測試步驟如下:

(1)測試前會議(Open Meeting)，確認及說明作業流程。

(2)分析參考標準氣體。

(3)由賣方選定比對測試用鋼瓶瓶號：Cylinder 4 (CTM191015-4)。樣品經測漏，無洩漏。

(4)分析CT樣品氣體。

(5)測試後會議(Close Meeting)，買賣雙方確認分析數據結果並檢討，**詳如附件二**。

(三) 第二部份比對測試 (Part B CT)

1. 於108年11月18日~108年11月21日在馬來西亞Bintulu實驗室比對測試，內容流程如下：

2. 比對儀器： LAB 6、LAB 9

3. 參加人員:

(1)賣方代表

Mr. Francis Gobel : Manager, Analytical Technology & Services

Ms. Maisarah Sharifuddin : Executive (Global Marketing Operation)

(2)買方代表

台灣中油公司永安液化天然氣廠：解順傑(化學師)、呂承勳(化學師)。

4. 測試步驟如下:

(1)測試前會議(Open Meeting)，確認及說明作業流程。

(2)分析參考標準氣體(原廠分析證明書如附件三)。

(3)由我方代表選定比對測試用鋼瓶瓶號：Cylinder 2 (CTM191015-2)， 如圖一。

(4)分析CT樣品氣體，分析儀器樣式，如圖二~三。

(5)測試後會議(Close Meeting)，由雙方確認分析結果及檢討，**詳如附件三** 。

三、具體成效

這次2019 CPC與PETRONAS買賣雙方LNG化驗比對測試，共有4台氣相層析儀參與測試，藉由此次雙方LNG化驗比對測試結果，顯示本公司之氣相層析儀分析結果之高度有效性及人為操作之可靠程度。

此次重點在比對測試(CT) 之比對樣品，針對10種成份分析，分別為C1~C3、n- C4、n- C5、N2、i- C4、i- C5、O2、CO2，測試結果本廠2台(GC-H、GC-G)、及馬來西亞Bintulu (LAB 6、LAB 9)2台氣相層析儀重複性和再現性皆符合GPA2261規範要求範圍內，詳細結果報告如附件二，經雙方化驗比對結果，各種成分濃度分析結果幾乎沒有差異，僅甲烷、乙烷、丙烷及N2濃度分別差異0.03 mol%、0.03 mol%、0.03mol%、0.01 mol%，其他6個成分濃度幾乎相同，顯示雙方氣相層析儀之操作人員之操作手法細膩及對於分析程序之嫻熟，且於機台之維護保養良好。

四、心得及建議

這次前往馬來西亞Bintulu之目的除了依據合約之要求，定期執行中馬雙方實驗室間氣相分析儀之化驗比對測試外，透過比對測試，可以檢視並確保雙方實驗室設施及人員分析實驗能力與品質，另經由此次雙方面對面技術交流，討論分析時的固定條件因素，這次至馬來西亞參加中馬雙方LNG化驗比對測試及技術研討，過程中，馬來西亞代表多方的協助及友善熱情的接待，在此特別感謝馬來西亞石油公司 (PETRONAS LNG)Ms. Maisarah Sharifuddin及MLNG公司實驗室人員的各種妥善的安排，俾使會議過程順利進行。

圖一 實驗室的CT樣品鋼瓶編號確認

圖二 實驗室分析機台 Agilent 7890B LAB 6

圖三實驗室分析機台 Agilent 7890B LAB 9

五、附件

1. 附件一：製備比對樣品分析報告
2. 附件二：YUNG-AN TERMINAL ANALYSIS RESULT OF CORRELATION TEST。
3. 附件三：RESEULT OF CORRELATION TEST BETWEEN MLNG & YUNG AN。

附件1

10/15/2019	(2019)馬來 比對樣品製備-CTM-191015-GCH			
STD :	10:05	MESA :CC720025		
成份	ONLINE-GC	191015-01	191015-7	偏差
CO2	0.0000	0.00	0.00	0.00
C2H6	7.4193	7.42	7.42	0.00
O2	0.0021	0.00	0.00	0.00
N2	0.1520	0.15	0.14	0.01
C3H8	1.5655	1.57	1.57	0.00
CH4	90.2031	90.20	90.21	0.01
i-C4H10	0.2952	0.30	0.30	0.00
n-C4H10	0.3214	0.32	0.32	0.00
i-C5H12	0.0305	0.03	0.03	0.00
n-C5H12	0.0109	0.01	0.01	0.00
HV				
	9874	9876	9877	1

10/30/2019	(2019)馬來西亞比對-CTM-191015-04			
STD :	MESA :CC720025			
成份	ONLINE-GC	GC-H	GC-G	偏差
CO2	0.0000	0.00	0.00	0.00
C2H6	7.4193	7.42	7.42	0.00
O2	0.0021	0.00	0.00	0.00
N2	0.1520	0.15	0.15	0.00
C3H8	1.5655	1.57	1.57	0.00
CH4	90.2031	90.20	90.20	0.00
i-C4H10	0.2952	0.30	0.30	0.00
n-C4H10	0.3214	0.32	0.32	0.00
i-C5H12	0.0305	0.03	0.03	0.00
n-C5H12	0.0109	0.01	0.01	0.00
HV		1103.7	1103.7	0.0
	9874	9876	9876	0

附件2

YUNG-AN TERMINAL ANALYSIS RESULT OF CORRELATION TEST

MALAYSIA LNG SDN. BHD.

TAIWAN- MLNG PROJECTS

NOVEMBER 2019

MLNG / CPC YUNG-AN - Correlation Test

General Review & Conclusion

This Correlation test is to enhance mutual confidence and understanding of Buyer and Seller concerning each other's analysis techniques as well as to satisfy the quality requirement of the contracts.

Participants:

Ms. Evelyn Enjop	Chemist	MLNG (Analytical Technology&Services)
Mr. Wong Aik Ching	Manager	MLNG (Cargo Documentation)
Ms. Kuan Kim Chiew	Manager	PLL (Global Marketing Operation)
Ms. Maisarah Sharifuddin	Executive	PLL (Global Marketing Operation)
Mr.Chun Hao Lin	Manager	Technical Department Yung-An Terminal, CPC Corp., Taiwan
Mr.Shun-Chieh Hsieh	Chemist	Technical Department Yung-An Terminal, CPC Corp., Taiwan
Mr. Jimmy Chung	Operation	BV-Taiwan
Mr. Tommy Tsai	Surveyor	BV-Taiwan

Measurement date : October 30th, 2019
Cylinder No. CTM191015-4

Two Gas Chromatographs were used, 6890N GC-H and Agilent 6890N GC-G, and the calibration gas mixtures and the correlation sample were analyzed in two GCs on October 30th, 2019, respectively. The dedailed of the GCs As Below:

Agilent 6890N GC–H	Serial No.: CN 10703064
Agilent 6890N GC–G	Serial No.: US 10511027

The comparison Results between both GCs in Yung-An Terminal were within the Correlation test limits according to Procedure NGPA 2261.
All related documents are attached.

MLNG

Ms. Evelyn Enjop

PETRONAS

Ms. Kuan Kim Chiew

Yung-An Terminal

S.C. HSIEH

Mr.Shun-Chieh Hsieh

Independent Surveyor

Mr. Jimmy Chung BV/Taiwan

CPC Corporation,Tawian

CHROMATOGRAPH REPORT

LOG SHEET FOR CORRELATION SAMPLE

SAMPLE	REFERENCE STANDARD GAS						Correlation Test Sample					
CYLINDER NO.	CC720025						CTM191015-4					
LOCATION	YUNG AN						YUNG AN					
INSTRUMENT	GC H						GC H					
SAMPLED BY							CPC					
ANALYSIS DATE	30-Oct-19						30-Oct-19					
ANALYST												
ANALYSIS METHOD	GPA2261						GPA2261					
COMPONENT	CERTIFICATE MOL% A	COUNT1 PEAK AREA B	COUNT2 PEAK AREA C	AVERAGE D	DIFF. (B-C)*100/D	RESPONSE FACTOR E=A/D	COUNT1 PEAK AREA F	COUNT2 PEAK AREA G	AVERAGE H	DIFF. (F-G)*100/H	TEST RESULT(MOL%) UNNORMALISED E×H	TEST RESULT(MOL%) REPORTED VALUE
CH_4	92.0237	105487	105495	105491.0	0.01	8.7234E-04	103084	103240	103162.0	0.15	89.992	90.20
C_2H_6	4.2500	7316	7320	7318.0	0.05	5.8076E-04	12725	12747	12736.0	0.17	7.397	7.42
C_3H_8	2.3670	4942	4946	4944.0	0.08	4.7876E-04	3274	3276	3275.0	0.06	1.568	1.57
$i\text{-}C_4H_{10}$	0.5391	1294	1295	1294.5	0.08	4.1645E-04	709	709	709.0	0.00	0.295	0.30
$n\text{-}C_4H_{10}$	0.5393	1329	1331	1330.0	0.15	4.0549E-04	779	779	779.0	0.00	0.316	0.32
$i\text{-}C_5H_{12}$	0.0301	82	82	82.0	0.00	3.6707E-04	83	83	83.0	0.00	0.030	0.03
$n\text{-}C_5H_{12}$	0.0201	55	55	55.0	0.00	3.6545E-04	30	30	30.0	0.00	0.011	0.01
N_2	0.1901	271	270	270.5	0.37	7.0277E-04	207	208	207.5	0.48	0.146	0.15
O_2	0.0205	25	25	25.0	0.00	8.2000E-04	0	0	0.0	0.00	0.000	0.00
CO_2	0.0201	18	19	18.5	5.41	1.0865E-03	0	0	0.0	0.00	0.000	0.00
TOTAL	100.0000										99.755	100.00
Hv(BTU/SCF)												1104.0

ANALYST: Tony Hsu CHIEF: S.C. HSIEH SELLER : SURVEYOR:

CPC Corporation,Tawian

CHROMATOGRAPH REPORT

LOG SHEET FOR CORRELATION SAMPLE

SAMPLE	REFERENCE STANDARD GAS						Correlation Test Sample					
CYLINDER NO.	CC720025						CTM191015-4					
LOCATION	YUNG AN						YUNG AN					
INSTRUMENT	GC G						GC G					
SAMPLED BY							CPC					
ANALYSIS DATE	30-Oct-19						30-Oct-19					
ANALYST												
ANALYSIS METHOD	GPA2261						GPA2261					
COMPONENT	CERTIFICATE MOL% A	COUNT1 PEAK AREA B	COUNT2 PEAK AREA C	AVERAGE D	DIFF. (B-C)*100/D	RESPONSE FACTOR E=A/D	COUNT1 PEAK AREA F	COUNT2 PEAK AREA G	AVERAGE H	DIFF. (F-G)*100/H	TEST RESULT(MOL%) UNNORMALISED E×H	TEST RESULT(MOL%) REPORTED VALUE
CH_4	92.0237	84097.00	84046.00	84071.5	0.06	1.0946E-03	82408.00	82313.00	82360.5	0.12	90.151	90.20
C_2H_6	4.2500	5656.00	5650.00	5653.0	0.11	7.5181E-04	9877.00	9865.00	9871.0	0.12	7.421	7.42
C_3H_8	2.3670	3953.00	3956.00	3954.5	0.08	5.9856E-04	2620.00	2619.00	2619.5	0.04	1.568	1.57
$i\text{-}C_4H_{10}$	0.5391	1026.00	1026.00	1026.0	0.00	5.2544E-04	563.00	562.00	562.5	0.18	0.296	0.30
$n\text{-}C_4H_{10}$	0.5393	1061.00	1060.00	1060.5	0.09	5.0853E-04	629.00	630.00	629.5	0.16	0.320	0.32
$i\text{-}C_5H_{12}$	0.0301	65.00	65.00	65.0	0.00	4.6308E-04	67.00	67.00	67.0	0.00	0.031	0.03
$n\text{-}C_5H_{12}$	0.0201	44.00	44.00	44.0	0.00	4.5682E-04	24.00	23.00	23.5	4.26	0.011	0.01
N_2	0.1901	234.00	234.00	234.0	0.00	8.1239E-04	183.00	187.00	185.0	2.16	0.150	0.15
O_2	0.0205	23.00	24.00	23.5	4.26	8.7234E-04	0.00	0.00	0.0	0.00	0.000	0.00
CO_2	0.0201	25.00	25.00	25.0	0.00	8.0400E-04	0.00	0.00	0.0	0.00	0.000	0.00
TOTAL	100.0000										99.948	100.00
Hv(BTU/SCF)												1104.0

ANALYST: Tony H/Su CHIEF: S.C. HSIEH SELLER: SURVEYOR:

YUNG AN LNG Receiving Terminal Laboratory

RESULTS OF CORRELATION TEST BETWEEN GC-G& GC-H OF YUNG-AN TERMINAL

SAMPLE			Correlation Test Sample			
CYLINDER NO.			CTM191015-4			
LOCATION			YUNG-AN			
ANALYSIS DATE			30-Oct-19			
ANALYST			Tony Hsu			
ANALYSIS METHOD			GPA2261			
COMPONENT	UNIT	On line GC	YA _GC-I (A)	YA _GC-H (B)	DIFFERENCE (A)-(B)	CORRELATION LIMITS *
CH_4	% MOL	90.20	90.20	90.20	0.00	0.30
C_2H_6	% MOL	7.42	7.42	7.42	0.00	0.10
C_3H_8	% MOL	1.57	1.57	1.57	0.00	0.05
I-C_4H_{10}	% MOL	0.30	0.30	0.30	0.00	0.03
N-C_4H_{10}	% MOL	0.32	0.32	0.32	0.00	0.03
I-C_5H_{12}	% MOL	0.03	0.03	0.03	0.00	0.03
N-C_5H_{12}	% MOL	0.01	0.01	0.01	0.00	0.03
N_2	% MOL	0.15	0.15	0.15	0.00	0.03
O_2	% MOL	0.00	0.00	0.00	0.00	0.03
CO_2	% MOL	0.00	0.00	0	0	0.03
TOTAL	% MOL	100.00	100.00	100.00		
Heating value	BTU/SCF	1104.0	1104.0	1104.0	0.00	

S.C. HSIEH

CHROMATOGRAPH REPORT

LOG SHEET FOR CORRELATION TEST

TWOKHJ19000328

SAMPLE	STANDARD GAS						QC SAMPLE					
CYLINGER NO.	CC720025						CTM19015-4					
LOCATION	YUNG AN						YUNG AN					
SAMPLING DATE	Nov.14,2018						Oct 15, 2019					
ANALYSIS DATE	Oct 30, 2019						Oct 30, 2019					
INSTRUMENT METHOD	GC-H/GPA2261						GC-H/GPA2261					
Component	mol % A	COUNT 1 PEAK AREA B	COUNT 2 PEAK AREA C	AVERAGE PEAK AREA D=(B+C)/2	DIFF. 100(B-C) D	RESPONSE FACTOR E=A/D	COUNT 1 PEAK AREA F	COUNT 2 PEAK AREA G	AVERAGE PEAK AREA H=(F+G)/2	DIFF. 100(F-G) H	B.N.mol% AVERAGE E*H	REPORTED VALUE
CH4	92.0237	105487	105495	105491.0	0.01	8.7234E-04	103084	103240	103162.0	0.15	89.992	90.20
C2H6	4.2500	7316	7320	7318.0	0.05	5.8076E-04	12725	12747	12736.0	0.17	7.397	7.42
C3H8	2.3670	4942	4946	4944.0	0.08	4.7876E-04	3274	3276	3275.0	0.06	1.568	1.57
i-C4H10	0.5391	1294	1295	1294.5	0.08	4.1645E-04	709	709	709.0	0.00	0.295	0.30
n-C4H10	0.5393	1329	1331	1330.0	0.15	4.0549E-04	779	779	779.0	0.00	0.316	0.32
i-C5H12	0.0301	82	82	82.0	0.00	3.6707E-04	83	83	83.0	0.00	0.030	0.03
n-C5H12	0.0201	55	55	55.0	0.00	3.6545E-04	30	30	30.0	0.00	0.011	0.01
N2	0.1901	271	270	270.5	0.37	7.0277E-04	207	208	207.5	0.48	0.146	0.15
O2	0.0205	25	25	25.0	0.00	8.2000E-04	0	0	0.0	0.00	0.000	0.00
CO2	0.0201	18	19	18.5	5.41	1.0865E-03	0	0	0.0	0.00	0.000	0.00
LABORATORY TEMP. : 22.5-23.5 °C									Total mol %		99.755	100.00

CHROMATOGRAPH REPORT

LOG SHEET FOR CORRELATION TEST

BUREAU VERITAS
TWOKHJ19000328

SAMPLE	STANDRD GAS						QC SAMPLE					
CYLINGER NO.	CC720025						CTM19015-4					
LOCATION	YUNG AN						YUNG AN					
SAMPLING DATE	Nov.14,2018						Oct 15, 2019					
ANALYSIS DATE	Oct 30, 2019						Oct 30, 2019					
INSTRUMENT METHOD	GC-G/GPA2261						GC-G/GPA2261					
Component	mol % A	COUNT 1 PEAK AREA B	COUNT 2 PEAK AREA C	AVERAGE PEAK AREA D=(B+C)/2	DIFF. 100(B-C) D	RESPONSE FACTOR E=A/D	COUNT 1 PEAK AREA F	COUNT 2 PEAK AREA G	AVERAGE PEAK AREA H=(F+G)/2	DIFF. 100(F-G) H	B.N.mol% AVERAGE E*H	REPORTED VALUE
CH4	92.0237	84097	84046	84071.5	0.06	1.0946E-03	82408	82313	82360.5	0.12	90.151	90.20
C2H6	4.2500	5656	5650	5653.0	0.11	7.5181E-04	9877	9865	9871.0	0.12	7.421	7.42
C3H8	2.3670	3953	3956	3954.5	0.08	5.9856E-04	2620	2619	2619.5	0.04	1.568	1.57
i-C4H10	0.5391	1026	1026	1026.0	0.00	5.2544E-04	563	562	562.5	0.18	0.296	0.30
n-C4H10	0.5393	1061	1060	1060.5	0.09	5.0853E-04	629	630	629.5	0.16	0.320	0.32
i-C5H12	0.0301	65	65	65.0	0.00	4.6308E-04	67	67	67.0	0.00	0.031	0.03
n-C5H12	0.0201	44	44	44.0	0.00	4.5682E-04	24	23	23.5	4.26	0.011	0.01
N2	0.1901	234	234	234.0	0.00	8.1239E-04	183	187	185.0	2.16	0.150	0.15
O2	0.0205	23	24	23.5	4.26	8.7234E-04	0	0	0.0	0.00	0.000	0.00
CO2	0.0201	25	25	25.0	0.00	8.0400E-04	0	0	0.0	0.00	0.000	0.00
LABORATORY TEMP. : 22.5-23.5 °C									Total mol %		99.948	100.00

BUREAU VERITAS TAIWAN 126 CTD

BUREAU VERITAS

TWOKHJ19000328

RESULTS OF CORRELATION TEST

SAMPLE	Standard gas
CYLINGER NO.	CC720025/CTM19015-4
LOCATION	YUNG AN
SAMPLING DATE	Oct.15,2019
ANALYST DATE	Oct 30, 2019
ANALYSIS METHOD	GC-H/G / GPA2261

Component	UNIT	QC	GC H	GC-G	DIFFERNCE	CORRELATION LIMITS
		A	B	C	(B)-(C)	
Methane, CH4	MOL %	90.20	90.2	90.2	0.00	0.30
Ethane, C2H6	MOL %	7.42	7.42	7.42	0.00	0.10
Propane, C3H8	MOL %	1.57	1.57	1.57	0.00	0.05
i-Butane, i-C4H10	MOL %	0.30	0.3	0.3	0.00	0.03
n-Butane, n-C4H10	MOL %	0.32	0.32	0.32	0.00	0.03
i-Pentane, i-C5H12	MOL %	0.03	0.03	0.03	0.00	0.03
n-Pentane, n-C5H12	MOL %	0.01	0.01	0.01	0.00	0.03
Nitrogen, N2	MOL %	0.15	0.15	0.15	0.00	0.03
Oxygen, O2	MOL %	0.00	0	0	0.00	0.03
TOTAL	MOL %	100.000	100	100		

BUREAU VERITAS TAIWAN 126 CTD

method-GC-H(STD-M)

OVEN
Initial temp: 80 'C (On)
Initial time: 23.00 min
Maximum temp: 450 'C
Equilibration time: 2.00 min

FRONT DETECTOR (TCD)
Temperature: 150 'C (On)
Reference flow: 35.0 mL/min (On)
Mode: Constant makeup flow
Makeup flow: 3.0 mL/min (Off)

BACK DETECTOR (NO DET)

TIME TABLE

Time	Specifier	Parameter & Setpoint	
0.01		Valve 4:	On
0.03		Valve 3:	On
0.05		Valve 2:	On
1.02		Valve 2:	Off
2.10		Valve 3:	Off
3.28		Valve 3:	On
12.35		Valve 4:	Off
12.40		Valve 3:	Off
13.56		Valve 4:	On
15.90		Valve 4:	Off

Detector Default Integration Event Table "Event_TCD"

Event	Value	Time
Initial Slope Sensitivity	1.000	Initial
Initial Peak Width	0.150	Initial
Initial Area Reject	9.000	Initial
Initial Height Reject	0.400	Initial
Initial Shoulders	OFF	Initial
Integration	OFF	0.000
Integration	ON	1.600
Integration	OFF	2.000
Integration	ON	3.850
Baseline Now		6.900
Integration	OFF	12.200
Integration	ON	13.700
Baseline Now		14.100
Baseline Now		14.450
Integration	OFF	15.700
Integration	ON	16.300
Integration	OFF	22.500

Calibration Table

Calib. Data Modified : 10/30/2019 10:07:12 AM
Calculate : External Standard
Based on : Peak Area
Curve Type : Piecewise
Origin : Ignored
Signal 1: TCD1 A,

RetTime [min]	Sig	Lvl	Amount [Mol%]	Area	Amt/Area	Ref	Grp	Name
1.763	1	1	2.00000e-2	63.90000	3.12989e-4			C6+
4.087	1	1	2.36700	4943.89990	4.78772e-4			C3

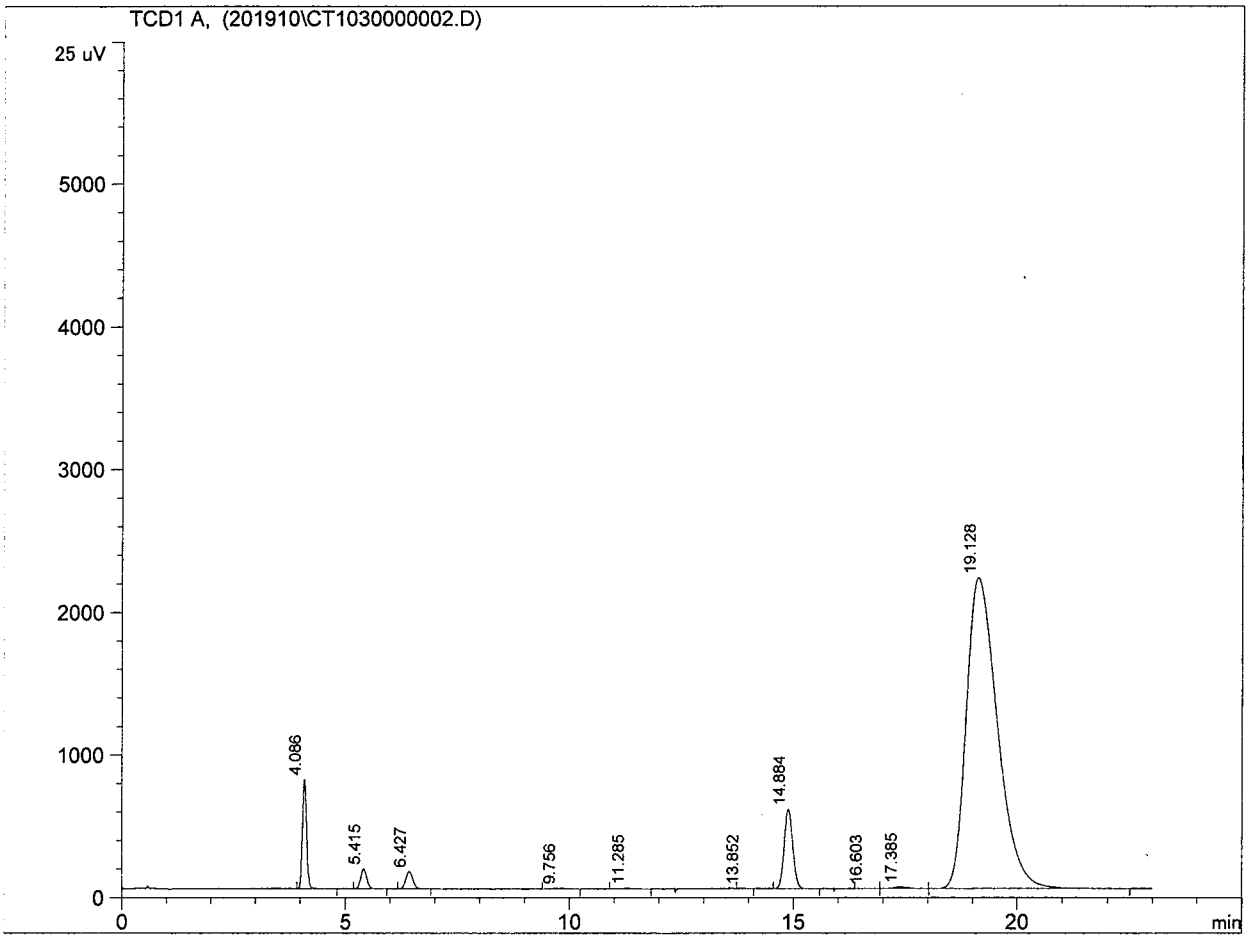
method-GC-H(STD-M)

5.415	1	1	5.39100e-1	1294.63696	4.16410e-4	I-C4
6.428	1	1	5.39300e-1	1329.68872	4.05584e-4	N-C4
9.756	1	1	3.01000e-2	81.95073	3.67294e-4	I-C5
11.285	1	1	2.01000e-2	55.21344	3.64042e-4	N-C5
13.852	1	1	2.01000e-2	18.27539	1.09984e-3	CO2
14.885	1	1	4.25000	7317.90137	5.80768e-4	C2
16.603	1	1	2.05000e-2	24.73767	8.28696e-4	O2
17.385	1	1	1.90100e-1	270.60667	7.02496e-4	N2
19.127	1	1	92.02370	1.05491e5	8.72336e-4	CH4

Data File Name :C:\CHEM32\GC-H\DATA\201910\CT1030000002.D
Acquired on :30-Oct-19, 09:18:18
Last Recalib On :30. Oct. 2019 10:07:09 AM
Sample Name :STD-CC720025
Instrument :GC-H
Instrument Method :C:\CHEM32\GC-H\METHODS\GC-H(STD-M).M
Analysis Mehtod :C:\CHEM32\GC-H\METHODS\GC-H(STD-M).M

Created On :30. Oct. 2019 10:07:20 am

Pressure	1atm
Temperature	22.5~23.5
Analyst	Tony Hsu

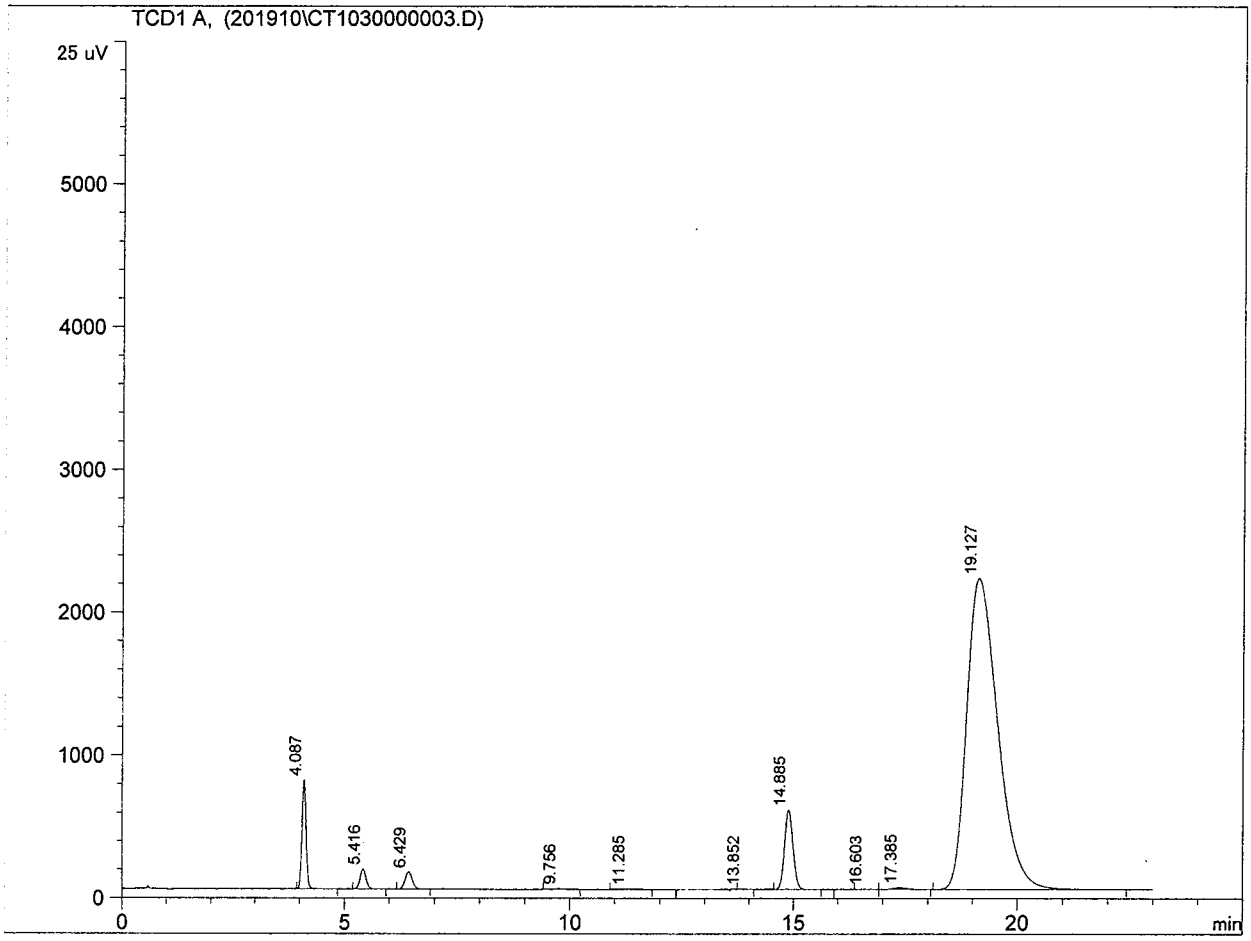


RT	Peak Area	Type	Width	[Mole%]	Name
0.00	0		0.000	0.00	C6+
4.09	4942	BB	0.099	2.37	C3
5.41	1294	BB	0.147	0.54	I-C4
6.43	1329	BBA	0.172	0.54	N-C4
9.76	82	BB	0.276	0.03	I-C5
11.28	55	BB	0.295	0.02	N-C5
13.85	18	BBA	0.150	0.02	CO2
14.88	7316	BB	0.205	4.25	C2
16.60	25	BV	0.190	0.02	O2
17.39	271	VV	0.350	0.19	N2
19.13	105487	VB	0.749	92.02	CH4
				99.99	

Data File Name :C:\CHEM32\GC-H\DATA\201910\CT1030000003.D
Acquired on :30-Oct-19, 09:42:13
Last Recalib On :30. Oct. 2019 10:07:09 AM
Sample Name :STD-CC720025
Instrument :GC-H
Instrument Method :C:\CHEM32\GC-H\METHODS\GC-H(STD-M).M
Analysis Mehtod :C:\CHEM32\GC-H\METHODS\GC-H(STD-M).M

Created On :30. Oct. 2019 10:07:16 am

Pressure	19tm
Temperature	22.5~23.5
Analyst	Tony Hsu

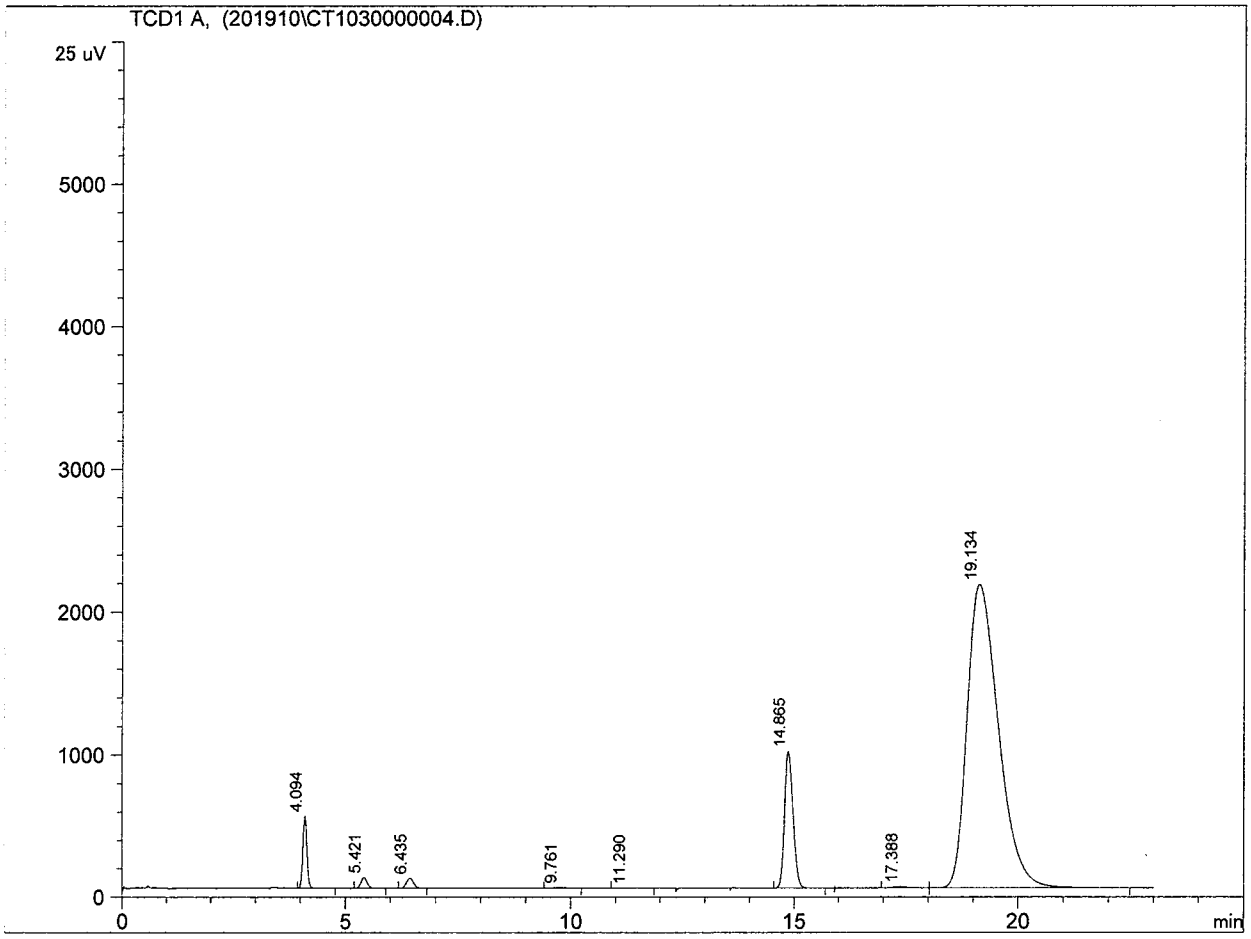


RT	Peak Area	Type	Width	[Mole%]	Name
0.00	0		0.000	0.00	C6+
4.09	4946	BB	0.102	2.37	C3
5.42	1295	BB	0.147	0.54	I-C4
6.43	1331	BBA	0.170	0.54	N-C4
9.76	82	BB	0.275	0.03	I-C5
11.29	55	BB	0.304	0.02	N-C5
13.85	19	BBA	0.151	0.02	CO2
14.88	7320	BB	0.205	4.25	C2
16.60	25	BV	0.189	0.02	O2
17.38	270	VB	0.346	0.19	N2
19.13	105495	BB	0.745	92.03	CH4
				100.01	

Data File Name :C:\CHEM32\GC-H\DATA\201910\CT1030000004.D
Acquired on :30-Oct-19, 10:18:45
Last Recalib On :30. Oct. 2019 11:30:53 AM
Sample Name :CTM191015-4
Instrument :GC-H
Instrument Method :C:\CHEM32\GC-H\METHODS\GC-H(STD-M).M
Analysis Mehtod :C:\CHEM32\GC-H\METHODS\GC-H(STD-M).M

ssure	latm
mperature	22.5_23.5
Analyst	Tony HS

Created On :30. Oct. 2019 11:33:42 am

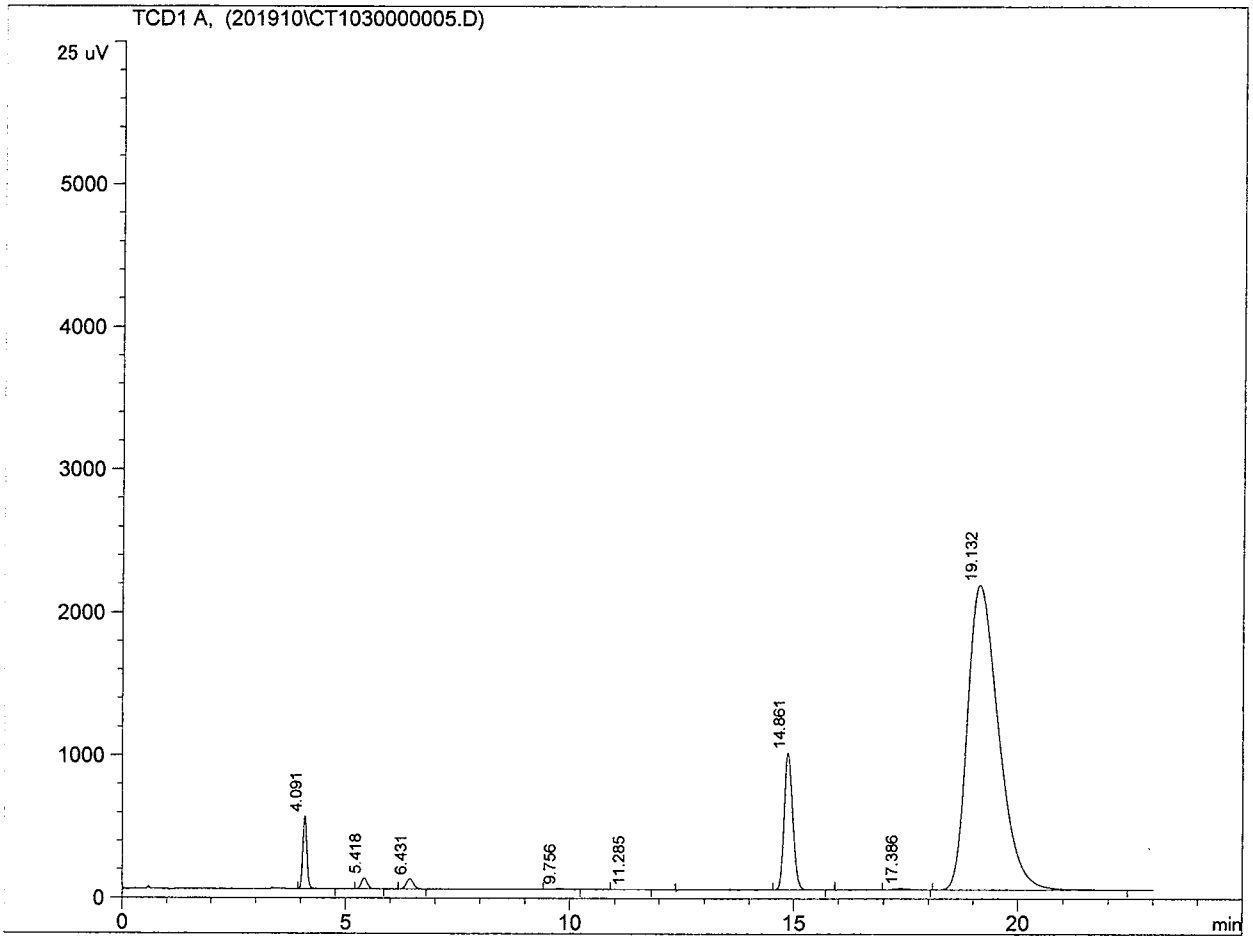


RT	Peak Area	Type	Width	[Mole%]	Name
0.00	0		0.000	0.00	C6+
4.09	3274	BB	0.101	1.57	C3
5.42	709	BB	0.145	0.30	I-C4
6.43	779	BV	0.172	0.32	N-C4
9.76	83	BB	0.275	0.03	I-C5
11.29	30	BB	0.318	0.01	N-C5
0.00	0		0.000	0.00	CO2
14.86	12725	BBA	0.207	7.39	C2
0.00	0		0.000	0.00	O2
17.39	207	BV	0.345	0.15	N2
19.13	103084	VB	0.745	89.92	CH4
				99.68	

Data File Name :C:\CHEM32\GC-H\DATA\201910\CT1030000005.D
Acquired on :30-Oct-19, 10:42:42
Last Recalib On :30. Oct. 2019 11:30:53 AM
Sample Name :CTM191015-4
Instrument :GC-H
Instrument Method :C:\CHEM32\GC-H\METHODS\GC-H(STD-M).M
Analysis Mehtod :C:\CHEM32\GC-H\METHODS\GC-H(STD-M).M

[illegible]	1atm
[illegible]perature	22.5-27.5
[illegible]alyst	Tony 4/5

Created On :30. Oct. 2019 11:33:46 am



RT	Peak Area	Type	Width	[Mole%]	Name
0.00	0		0.000	0.00	C6+
4.09	3276	BB	0.101	1.57	C3
5.42	709	BB	0.147	0.30	I-C4
6.43	779	BV	0.170	0.32	N-C4
9.76	83	BB	0.275	0.03	I-C5
11.28	30	BB	0.300	0.01	N-C5
0.00	0		0.000	0.00	CO2
14.86	12747	BBA	0.207	7.40	C2
0.00	0		0.000	0.00	O2
17.39	208	BB	0.345	0.15	N2
19.13	103240	BB	0.744	90.06	CH4
				99.83	

1037

Calibration Table

Calib. Data Modified : 10/30/2019 10:19:32 AM

Calculate : External Standard
Based on : Peak Area

Curve Type : Linear
Origin : Included
Weight : Equal

Signal 1: TCD1 B,

RetTime [min]	Sig	Lvl	Amount [Mole%]	Area	Amt/Area	Ref	Grp	Name
1.650	1	1	2.00000e-2	45.00000	4.44444e-4			C6+
4.546	1	1	2.36700	3954.69324	5.98529e-4			C3
6.315	1	1	5.39100e-1	1025.94159	5.25469e-4			I-C4
7.640	1	1	5.39300e-1	1060.67523	5.08450e-4			N-C4
11.871	1	1	3.01000e-2	64.82653	4.64316e-4			I-C5
13.747	1	1	2.01000e-2	44.05963	4.56200e-4			N-C5
17.527	1	1	2.01000e-2	25.10019	8.00791e-4			CO2
20.733	1	1	4.25000	5652.65234	7.51859e-4			C2
22.102	1	1	2.05000e-2	23.55554	8.70284e-4			O2
22.536	1	1	1.90100e-1	233.82836	8.12989e-4			N2
24.196	1	1	92.02370	8.40718e4	1.09458e-3			CH4

6890 GC METHOD

OVEN
- Initial temp: 90 'C (On)
- Initial time: 27.00 min
- Maximum temp: 200 'C
- Equilibration time: 3.00 min

FRONT DETECTOR (FID)
- Temperature: 66 'C (Off)
- Hydrogen flow: 40.0 mL/min (Off)
- Air flow: 450.0 mL/min (Off)
- Mode: Constant makeup flow
- Makeup flow: 45.0 mL/min (Off)
- Makeup Gas Type: Helium
- Flame: Off
- Electrometer: Off
- Lit offset: 2.0

BACK DETECTOR (TCD)
- Temperature: 120 'C (On)
- Reference flow: 38.0 mL/min (On)
- Mode: Constant makeup flow
- Makeup flow: 3.0 mL/min (Off)
- Makeup Gas Type: Helium
- Filament: On
- Negative polarity: Off

AUX PRESSURE 3
- Description:
- Gas Type: Helium
- Initial pressure: 0.00 psi (Off)

AUX PRESSURE 4
- Description: Carrier gas
- Gas Type: Helium
- Driving Column 1
- Initial pressure: 82.00 psi (On)

TIME TABLE

Time	Specifier	Parameter & Setpoint
0.01	Valve 3:	On
0.03	Valve 2:	On
0.05	Valve 1:	On
0.90	Valve 1:	Off
1.88	Valve 2:	Off
3.44	Valve 2:	On
14.90	Valve 3:	Off
15.00	Valve 2:	Off
16.40	Valve 3:	On
21.70	Valve 3:	Off

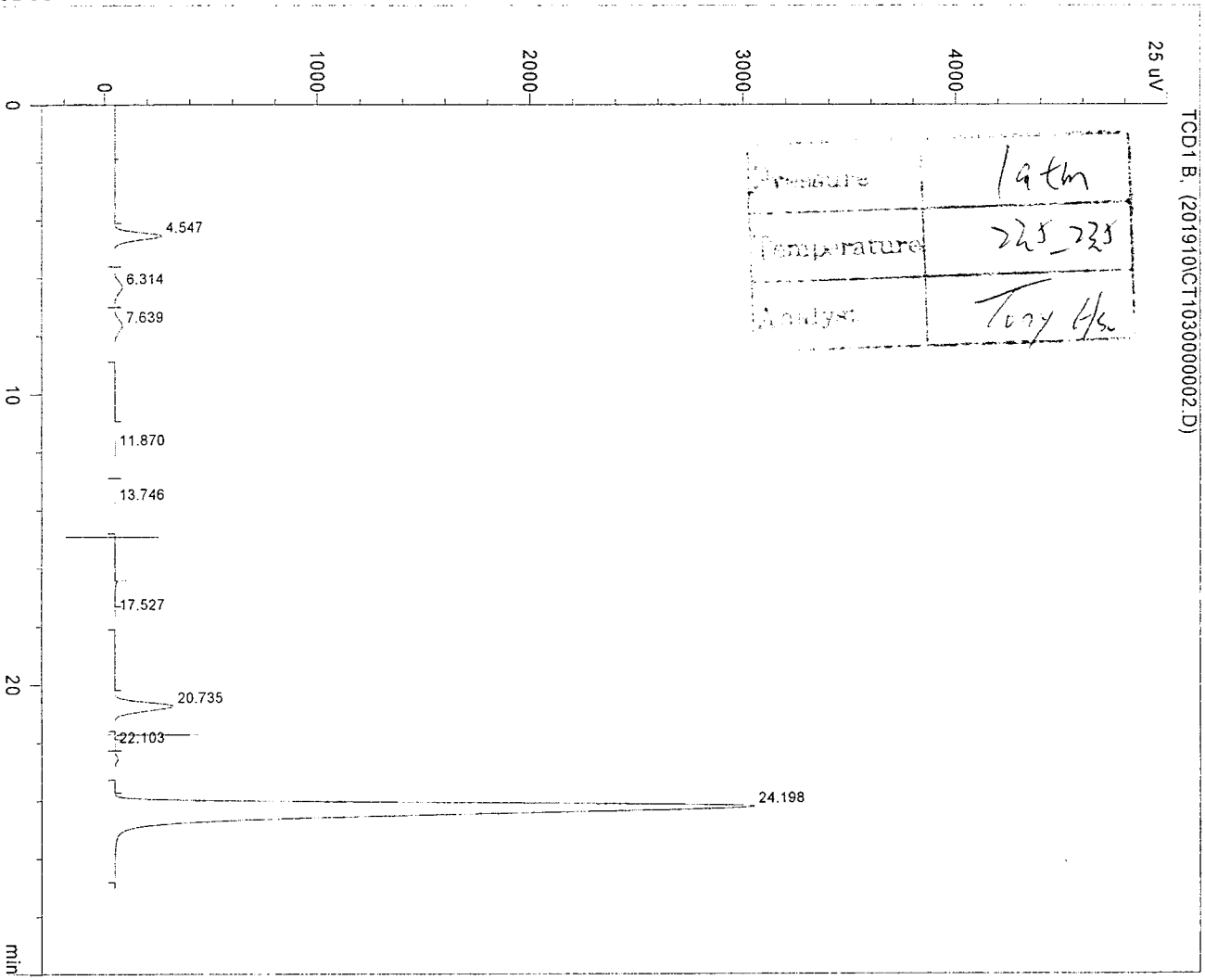
Detector Default Integration Event Table "Event_TCD"

Event	Value	Time
Initial Slope Sensitivity	0.200	Initial
Initial Peak Width	0.300	Initial
Initial Area Reject	12.000	Initial
Initial Height Reject	0.300	Initial
Initial Shoulders	OFF	Initial
Integration	OFF	0.000
Integration	ON	1.400
Integration	OFF	1.850
Integration	ON	3.850
Integration	OFF	14.800
Integration	ON	17.300
Baseline Now		19.200
Integration	OFF	21.600
Integration	ON	21.850
Area Reject	10.000	21.900
Baseline Now		23.420
Integration	OFF	26.800
Integration	ON	27.000
Integration	OFF	27.200

Apply Manual Integration Events: No

Data File Name :C:\HPCHEM\1\DATA\201910\CT1030000002.D
Acquired on :10/30/2019 9:21:45 AM 10/30/2019 9:21:45 AM
Last Recalib On :30. Oct. 2019 10:19:30 AM
Sample Name :STD-CC720025
Instrument :GC_G
Instrument Method :C:\HPCHEM\1\METHODS\CT-G.M
Analysis Mehtod :CT-G.M

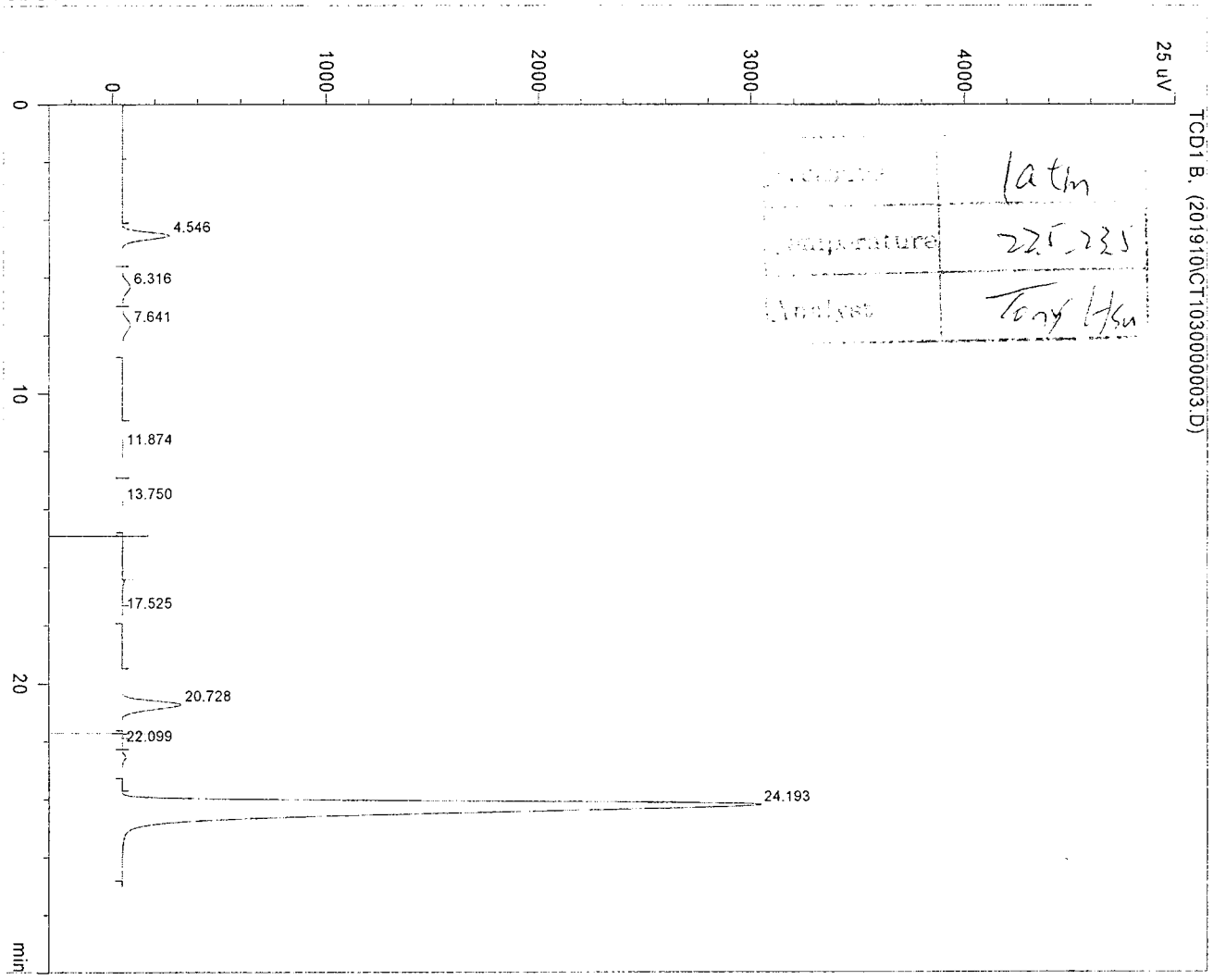
Created On :30. Oct. 2019 10:19:35 am



RT	Peak Area	Type	Width	[Mole%]	Name
0.00	0		0.000	0.00	C6+
4.55	3953	BV	0.282	2.37	C3
6.31	1026	VV	0.449	0.54	I-C4
7.64	1061	VB	0.473	0.54	N-C4
11.87	65	BV	0.719	0.03	I-C5
13.75	44	VBA	0.672	0.02	N-C5
17.53	25	BB	0.211	0.02	CO2
20.73	5656	BBA	0.320	4.25	C2
22.10	23	BV	0.179	0.02	O2
22.54	234	VBA	0.237	0.19	N2
24.20	84097	BBA	0.431	92.05	CH4
				100.03	

Data File Name :C:\HPCHEM\1\DATA\201910\CT1030000003.D
Acquired on :10/30/2019 9:49:48 AM 10/30/2019 9:49:48 AM
Last Recalib On :30. Oct. 2019 10:19:30 AM
Sample Name :STD-CC720025
Instrument :GC_G
Instrument Method :C:\HPCHEM\1\METHODS\CT-G.M
Analysis Mehtod :CT-G.M

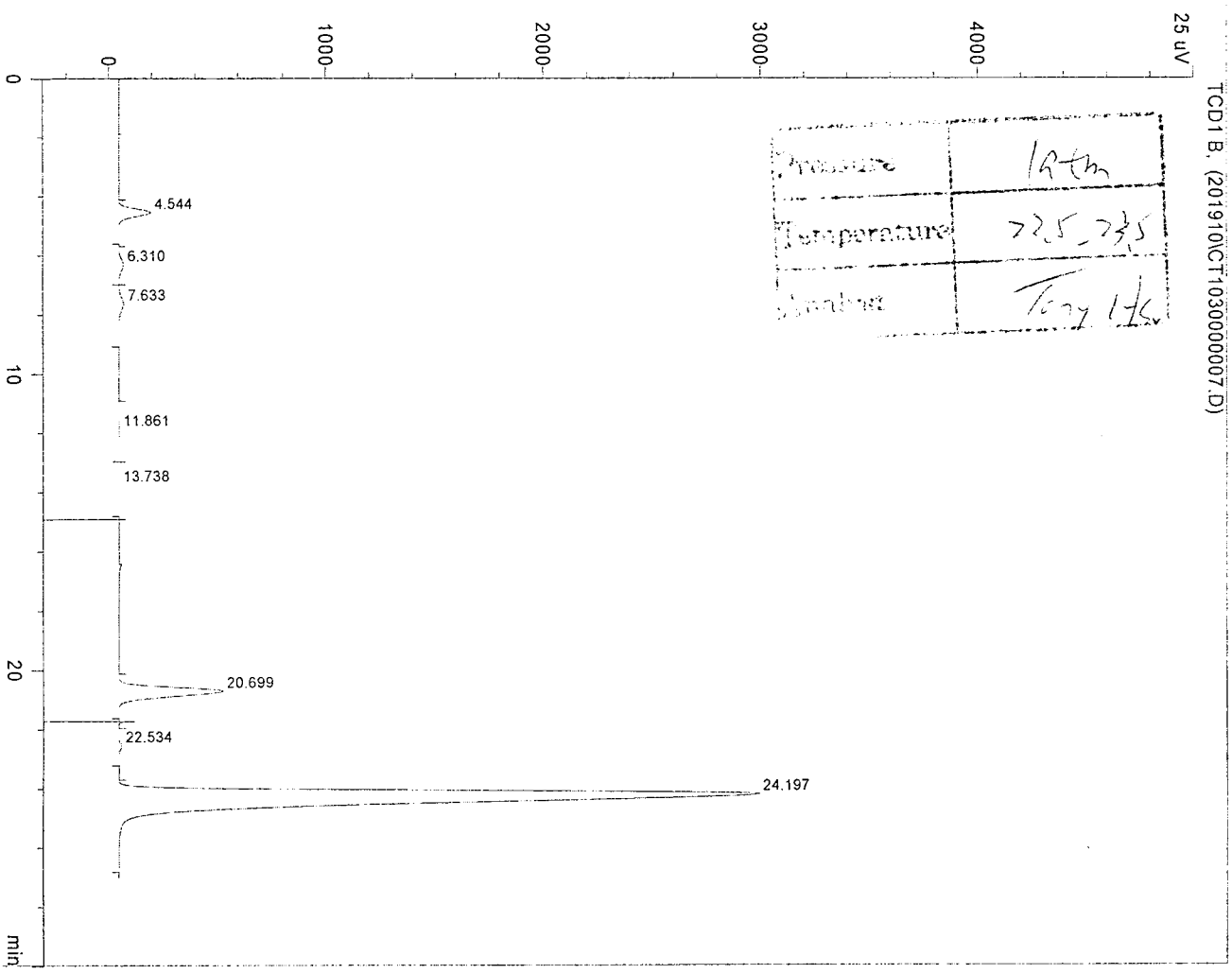
Created On :30. Oct. 2019 10:19:41 am



RT	Peak Area	Type	Width	[Mole%]	Name
0.00	0		0.000	0.00	C6+
4.55	3956	BV	0.282	2.37	C3
6.32	1026	VV	0.449	0.54	I-C4
7.64	1060	VB	0.473	0.54	N-C4
11.87	65	BV	0.749	0.03	I-C5
13.75	44	VBA	0.663	0.02	N-C5
17.52	25	BB	0.200	0.02	CO2
20.73	5650	BBA	0.328	4.25	C2
22.10	24	BV	0.171	0.02	O2
22.53	234	VBA	0.245	0.19	N2
24.19	84046	BBA	0.431	92.00	CH4
				99.97	

Data File Name :C:\HPCHEM\1\DATA\201910\CT1030000007.D
Acquired on :10/30/2019 12:52:36 PM 10/30/2019 12:52:36 PM
Last Recalib On :30. Oct. 2019 10:19:30 AM
Sample Name :CTM191015-4
Instrument :GC_G
Instrument Method :C:\HPCHEM\1\METHODS\CT-G.M
Analysis Mehtod :CT-G.M

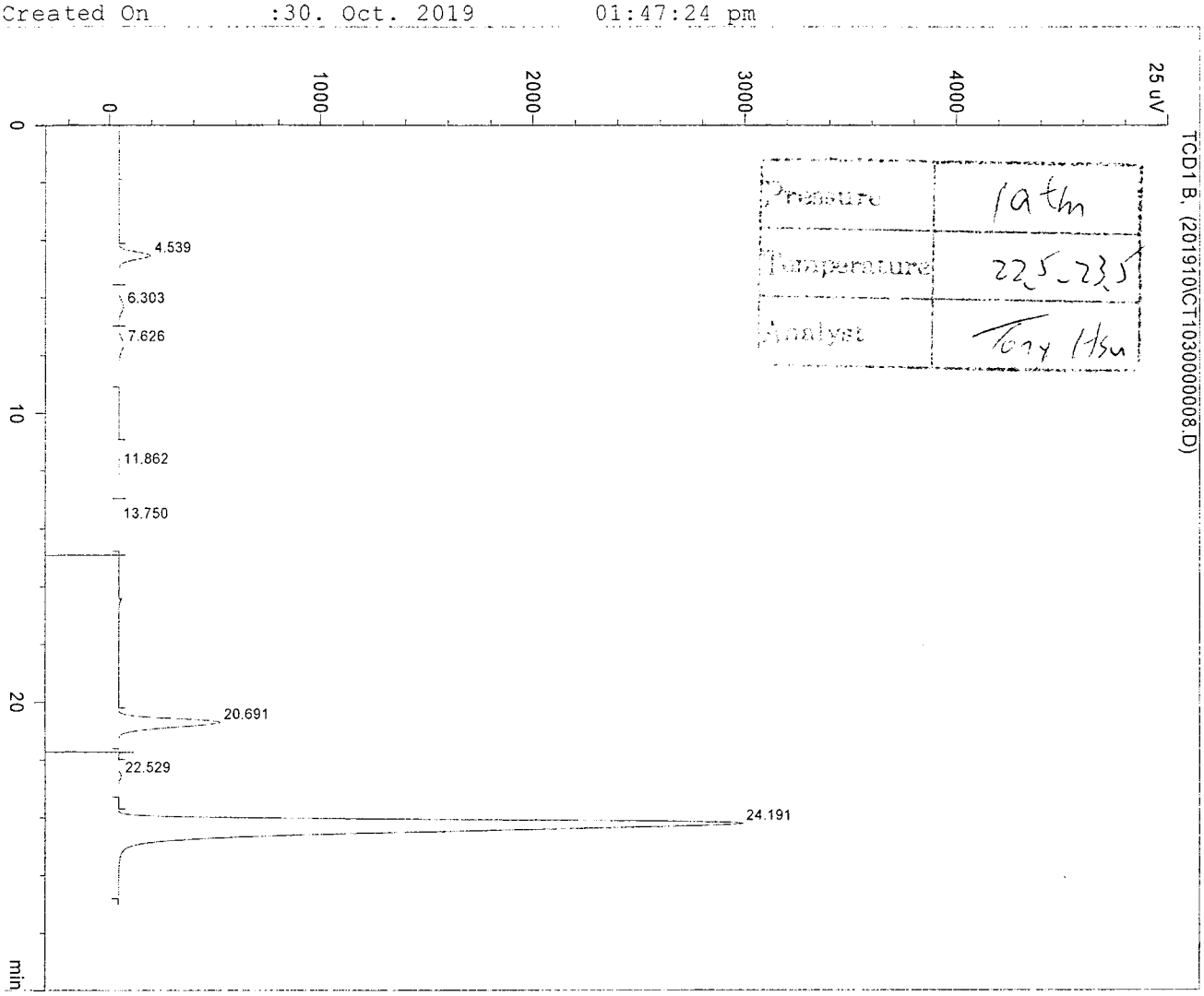
Created On :30. Oct. 2019 01:47:29 pm



RT	Peak Area	Type	Width	[Mole%]	Name
0.00	0		0.000	0.00	C6+
4.54	2620	BB	0.282	1.57	C3
6.31	563	BV	0.444	0.30	I-C4
7.63	629	VB	0.471	0.32	N-C4
11.86	67	BV	0.678	0.03	I-C5
13.74	24	VBA	0.594	0.01	N-C5
0.00	0		0.000	0.00	CO2
20.70	9877	BBA	0.328	7.43	C2
0.00	0		0.000	0.00	O2
22.53	183	BV	0.247	0.15	N2
24.20	82408	BBA	0.431	90.20	CH4
				100.00	

Data File Name :C:\HPCHEM\1\DATA\201910\CT1030000008.D
Acquired on :10/30/2019 1:20:02 PM 10/30/2019 1:20:02 PM
Last Recalib On :30. Oct. 2019 10:19:30 AM
Sample Name :CTM191015-4
Instrument :GC_G
Instrument Method :C:\HPCHEM\1\METHODS\CT-G.M
Analysis Mehtod :CT-G.M

Created On :30. Oct. 2019 01:47:24 pm



RT	Peak Area	Type	Width	[Mole%]	Name
0.00	0		0.000	0.00	C6+
4.54	2619	BV	0.282	1.57	C3
6.30	562	VV	0.448	0.30	I-C4
7.63	630	VB	0.475	0.32	N-C4
11.86	67	BV	0.719	0.03	I-C5
13.75	23	VBA	0.689	0.01	N-C5
0.00	0		0.000	0.00	CO2
20.69	9865	BBA	0.320	7.42	C2
0.00	0		0.000	0.00	O2
22.53	187	BBA	0.243	0.15	N2
24.19	82313	BBA	0.431	90.10	CH4
				99.89	

11031

THE LINDE GROUP

Linde

CERTIFICATE NUMBER : 90149409/D603343
REVISION NUMBER :
REVISION DATE :

CERTIFIED STANDARD

Certificate of Analysis

Material Number : S803700-AQ-D6 **Customer Tag :**

Customer	: LINDE MALAYSIA SDN. BHD [N481]	**PO Number**	: 496178
Job Card	: 90149409	**Order Date**	: 09-Jul-2018
Certification Date	: 07-Aug-2018	**SO Number**	: 124689369
		Vcode	: MGM1847/48A/S

INSTRUMENTATION
Method of Analysis
LS0304

REMARKS

Certified By

LINDE GAS SINGAPORE PTE. LTD.
07 AUG 2018
ANG ZE SIANG

.....

Checked By

LINDE GAS SINGAPORE
07 AUG 2018
BELLE LOH

.....

Product filled gravimetrically using high-load high-accuracy, weight traceable to National Metrology Centre (NMC) standards. Linde Gas Singapore has obtained a corporate License complying to ISO 9001 standard.

MLNG-CPC Gas Chromatography Analysis Correlation Test

SAMPLE		LNG CORRELATION GAS			
CYLINDER NO.		CTM191015-4		CTM191015-2	
LOCATION		YUNG AN LAB		MLNG LAB	
GC No.		YA_GC-G	YA_GC-H	7890B	7890B
				LAB 9	LAB 6
ANALYSIS DATE		30/10/2019		19/11/2019	
ANALYST		TONY HSU		LBM	
ANALYSIS METHOD		GPA 2261			
COMPONENT	UNIT	(A)	(B)	(C)	(D)
C1	% Mol	**90.20**	**90.20**	**90.23**	**90.20**
C2	% Mol	**7.42**	**7.42**	**7.39**	**7.40**
C3	% Mol	**1.57**	**1.57**	**1.58**	**1.60**
iC4	% Mol	**0.30**	**0.30**	**0.29**	**0.30**
nC4	% Mol	**0.32**	**0.32**	**0.32**	**0.32**
iC5	% Mol	**0.03**	**0.03**	**0.03**	**0.03**
nC5	% Mol	**0.01**	**0.01**	**0.01**	**0.01**
N2	% Mol	**0.15**	**0.15**	**0.15**	**0.14**
O2	% Mol	**0.00**	**0.00**	**0.00**	**0.00**
CO2	% Mol	**0.00**	**0.00**	**0.00**	**0.00**
GHV	Btu/SCF	1104.00	1104.00	1103.33	1104.03

DIFFERENCE						ERROR MAX	CORRELATION LIMIT
(A)-(B)	(A)-(C)	(A)-(D)	(B)-(C)	(B)-(D)	(C)-(D)		
0.00	0.03	0.00	0.03	0.00	0.03	0.03	0.30
0.00	0.03	0.02	0.03	0.02	0.01	0.03	0.05
0.00	0.01	0.03	0.01	0.03	0.02	0.03	0.05
0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.03
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.03
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03

On Behalf of Seller

(FRANCIS GOBEL)

19.11.2019.

On Behalf of Buyer

S.C. HSIEH

2019.11.19

REPORT NO. : LNG CORRELATION	REVISION NO. : 0	PAGE OF

LOG SHEET FOR LNG ANALYSIS (PURGING METHOD)

SAMPLE	Standard Gas	LNG
CYLINDER NO.	D603343	CTM191015-2
CARGO NO.	N/A	N/A
LOCATION	MLNG Lab	MLNG LABORATORY
SAMPLING METHOD	Not applicable	N/A
SAMPLING DATE	Not applicable	15/10/2019
SAMPLING TIME	Not applicable	N/A
SAMPLED BY	Not applicable	N/A
ANALYSIS DATE	19/11/2019	19/11/2019
ANALYST	LBM,SM	LBM,SM
ANALYSIS METHOD	TES-LAB-BMS 81E	TES-LAB-BMS 81E

COMPONENT	CERTIFICATE MOL % A	COUNT 1 PEAK AREAS B	COUNT 2 PEAK AREAS C	AVERAGE PEAK AREAS D=(B+C)/2	DIFF. (B-C)x100/D	REPEAT RUN IN (Y/N)	RESPONSE FACTOR E=A/D	COUNT 1 PEAK AREAS F	COUNT 2 PEAK AREAS G	AVERAGE PEAK AREAS H=(F+G)/2	DIFF. (F-G)x100/H	REPEAT RUN IN (Y/N)	TEST RESULTS (MOL %) UNNORMALISED E x H	TEST RESULTS (MOL %) REPORTED VALU
CH4	90.7308	257783.31	257714.89	257749.100	0.03	Y	3.52012E-04	256913.02	256817.13	256865.075	0.04	Y	90.420	90.23
C2H6	4.5100	19567.76	19592.64	19580.200	-0.13	Y	2.30335E-04	32192.71	32132.44	32162.575	0.19	Y	7.408	7.39
C3H8	3.0100	16722.43	16706.50	16714.465	0.10	Y	1.80084E-04	8792.50	8792.87	8792.685	0.00	Y	1.583	1.58
i-C4H10	0.6490	4248.52	4245.36	4246.940	0.07	Y	1.52816E-04	1922.97	1924.56	1923.765	-0.08	N/A	0.294	0.29
n-C4H10	0.6500	4318.83	4316.34	4317.585	0.06	Y	1.50547E-04	2120.27	2122.29	2121.280	-0.10	N/A	0.319	0.32
i-C5H12	0.0495	337.70	337.94	337.820	-0.07	N/A	1.46528E-04	209.33	208.59	208.960	0.35	N/A	0.031	0.03
n-C5H12	0.0202	113.48	113.91	113.697	-0.37	N/A	1.77665E-04	56.66	58.26	57.460	-2.78	N/A	0.010	0.01
N2	0.3000	1244.86	1244.06	1244.460	0.07	N/A	2.41068E-04	633.88	634.25	634.065	-0.06	N/A	0.153	0.15
O2	0.0202	82.97	81.98	82.475	1.20	N/A	2.44923E-04	0.00	0.00	0.000	0.00	N/A	0.000	0.00
CO2	0.0603	264.24	264.15	264.195	0.03	N/A	2.28241E-04	0.00	0.00	0.000	0.00	N/A	0.000	0.00
											Total		100.218	100.00
											Heating Value (Btu/SCF)			1103.33

S.C. HSZBH
2019.11.19

19/11/2019.

Data file : C:\Chem32\2\Data\LNG\19114.D
Sample Name : LNG CAL GAS
Report No. : N/A Rev. No. : 0 Pg of
Location : MLNG LAB
Cylinder No. : D603343
Sampling Date : N/A
Sampling Time : N/A
Sampling Method : N/A
Sampled By : N/A
Analysis Method : TES-LAB-BMS 81E
Analysis Date : 19/11/2019
Analyst : GS
GC Used : AGILENT 7890B, LAB 9

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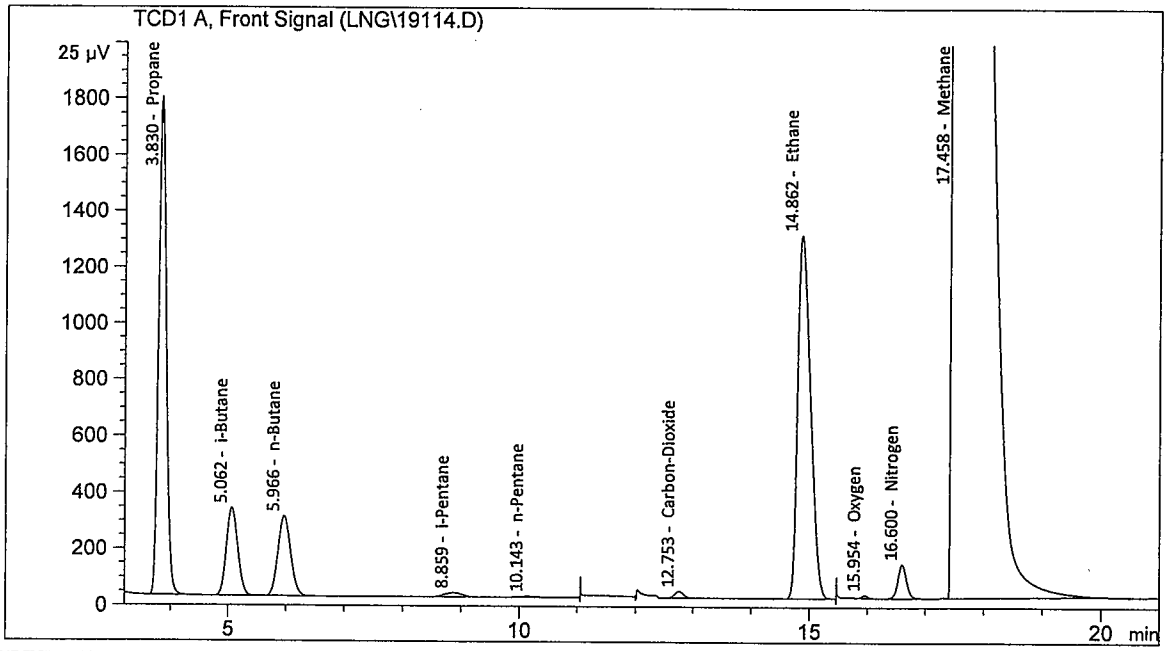
Injection Date : 19/11/2019 Injection Time : 02:27:24
Acq Operator : SYSTEM
Acq. Method : C:\CHEM32\2\METHODS\L791419.M
Last Changed : Tue, 12. Nov. 2019, 05:00:48 pm



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Customized Report: BMS81E

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RT [min]	Type	Area	Amt/Area	Amount (% mol)	Name
3.830	BB	16706.50	1.81375e-4	3.0301	Propane
5.062	BB	4245.36	1.53867e-4	0.6532	i-Butane
5.966	BB	4316.34	1.51501e-4	0.6539	n-Butane
8.859	BBA	337.94	1.45541e-4	0.0492	i-Pentane
10.143	BBA	113.91	1.82558e-4	0.0208	n-Pentane
12.753	BB	264.15	2.29251e-4	0.0606	Carbon-Dioxide
14.862	BBA	19592.64	2.28938e-4	4.4855	Ethane
15.954	VB	81.98	2.64294e-4	0.0217	Oxygen
16.600	BB	1244.06	2.37547e-4	0.2955	Nitrogen
17.458	VB	257714.89	3.53934e-4	91.2140	Methane
Totals:				100.4845	

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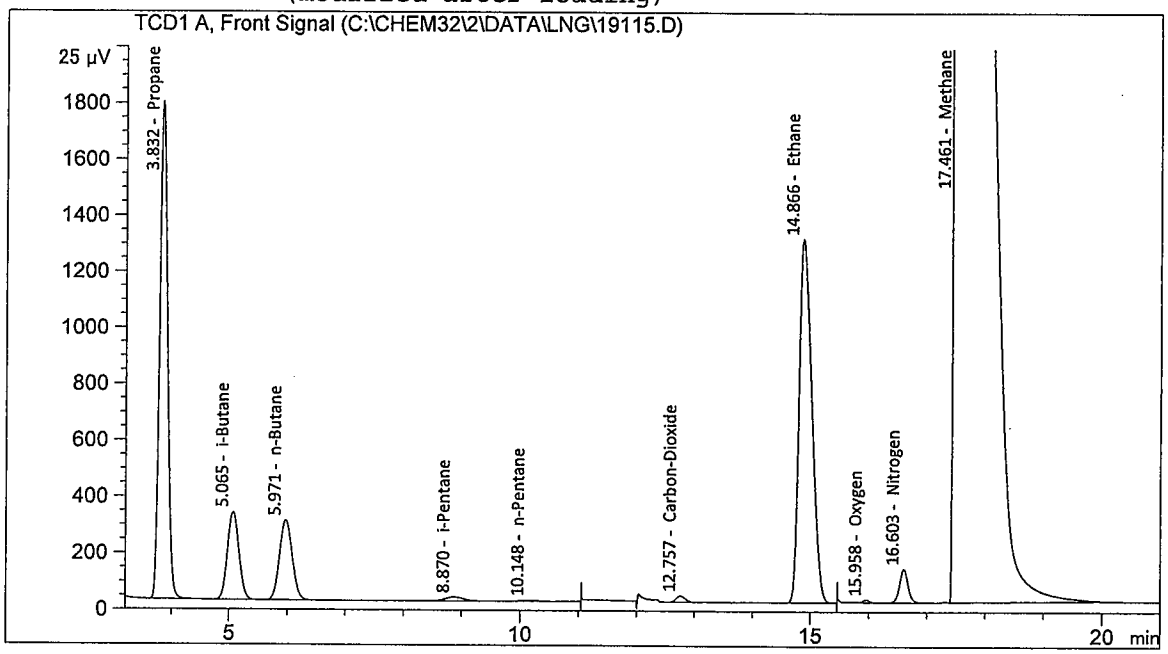
*** End of Report ***

Data file : C:\CHEM32\2\DATA\LNG\19115.D
Sample Name : LNG CAL GAS
Report No. : N/A Rev. No. : 0 Pg of
Location : MLNG LAB
Cylinder No. : D603343
Sampling Date : N/A
Sampling Time : N/A
Sampling Method : N/A
Sampled By : N/A
Analysis Method : TES-LAB-BMS 81E
Analysis Date : 19/11/2019
Analyst : GS
GC Used : AGILENT 7890B, LAB 9

Injection Date : 19/11/2019 Injection Time : 02:48:42
Acq Operator : SYSTEM
Acq. Method : C:\CHEM32\2\METHODS\L791419.M
Last Changed : Mon, 18. Nov. 2019, 07:28:11 pm
(modified after loading)



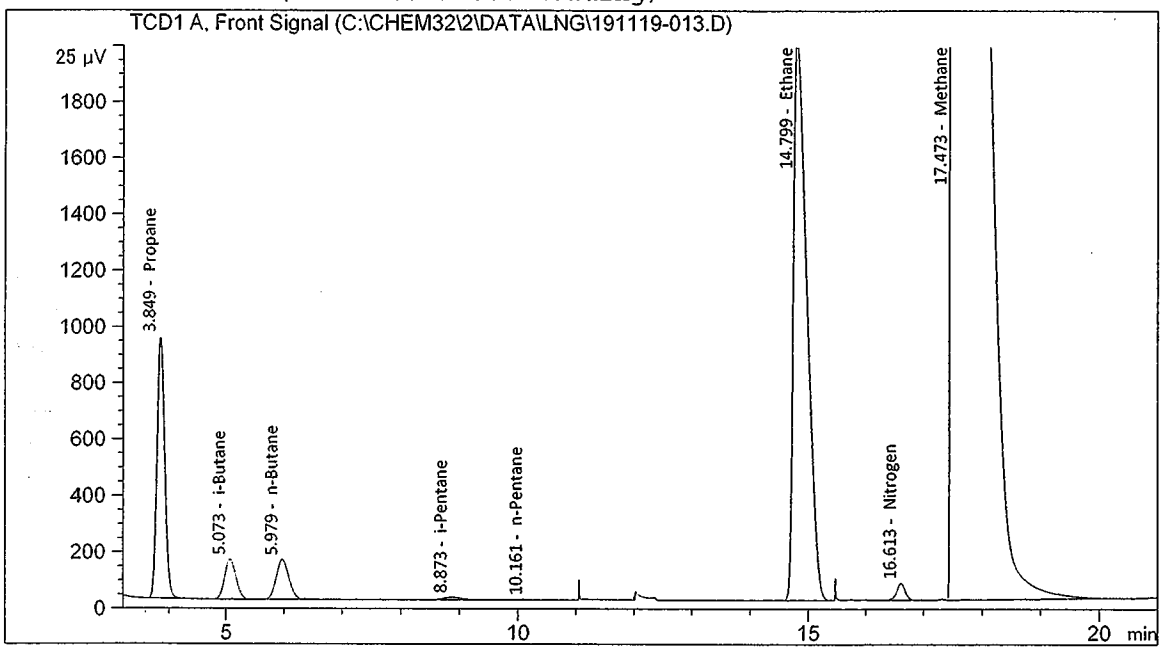
Customized Report: BMS81E

RT [min]	Type	Area	Amt/Area	Amount (% mol)	Name
3.832	BB	16722.43	1.80591e-4	3.0199	Propane
5.065	BB	4248.52	1.53248e-4	0.6511	i-Butane
5.971	BB	4318.83	1.50951e-4	0.6519	n-Butane
8.870	BBA	337.70	1.46811e-4	0.0496	i-Pentane
10.148	BBA	113.48	1.77889e-4	0.0202	n-Pentane
12.757	BB	264.24	2.29070e-4	0.0605	Carbon-Dioxide
14.866	BBA	19567.76	2.30734e-4	4.5150	Ethane
15.958	VB	82.97	2.34993e-4	0.0195	Oxygen
16.603	BB	1244.86	2.40402e-4	0.2993	Nitrogen
17.461	VB	257783.31	3.53095e-4	91.0219	Methane
Totals:				100.3089	

*** End of Report ***

Data file : C:\CHEM32\2\DATA\LNG\191119-013.D
Sample Name : LNG
Report No. : LNG CORRELATION Rev. No. : 0 Pg of
Cargo No : N/A
Location : MLNG LABORATORY
Cylinder No. : CTM191015-2
Sampling Method : N/A
Sampling Date : 15/10/2019
Sampling Time : N/A
Sampled By : N/A
Analysis Method : TES-LAB-BMS 81E
Analysis Date : 19/11/2019
Analyst : SM,LBM
GC Used : AGILENT 7890B, LAB 9

Injection Date : 19/11/2019 Injection Time : 10:34:36
Acq Operator : SYSTEM
Acq. Method : C:\CHEM32\2\METHODS\L791419.M
Last Changed : Tue, 19. Nov. 2019, 06:33:54 am
(modified after loading)



Customized Report: BMS81E

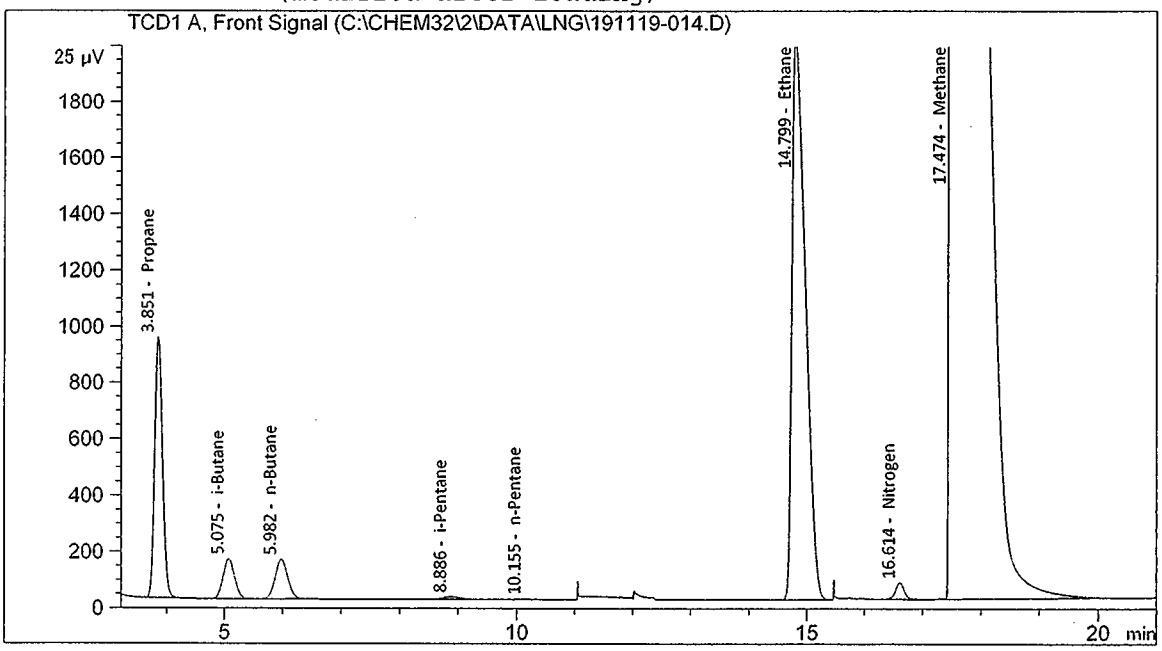
RT [min]	Type	Area	Amt/Area	Amount (% mol)	Name
3.849	BB	8792.50	1.80084e-4	1.5834	Propane
5.073	BB	1922.97	1.52816e-4	0.2939	i-Butane
5.979	BB	2120.27	1.50547e-4	0.3192	n-Butane
8.873	BBA	209.33	1.46527e-4	0.0307	i-Pentane
10.161	BB	56.66	1.77665e-4	0.0101	n-Pentane
0.000		0.00	0.00000	0.0000	Carbon-Dioxide
14.799	BBA	32192.71	2.30335e-4	7.4151	Ethane
0.000		0.00	0.00000	0.0000	Oxygen
16.613	BB	633.88	2.41068e-4	0.1528	Nitrogen
17.473	VB	256913.02	3.52012e-4	90.4365	Methane

Totals: 100.2416

*** End of Report ***

Data file : C:\CHEM32\2\DATA\LNG\191119-014.D
Sample Name : LNG
Report No. : LNG CORRELATION Rev. No. : 0 Pg of
Cargo No : N/A
Location : MLNG LABORATORY
Cylinder No. : CTM191015-2
Sampling Method : N/A
Sampling Date : 15/10/2019
Sampling Time : N/A
Sampled By : N/A
Analysis Method : TES-LAB-BMS 81E
Analysis Date : 19/11/2019
Analyst : SM,LBM
GC Used : AGILENT 7890B, LAB 9

Injection Date : 19/11/2019 Injection Time : 10:55:53
Acq Operator : SYSTEM
Acq. Method : C:\CHEM32\2\METHODS\L791419.M
Last Changed : Tue, 19. Nov. 2019, 06:33:54 am
(modified after loading)



Customized Report: BMS81E

RT [min]	Type	Area	Amt/Area	Amount (% mol)	Name
3.851	BB	8792.87	1.80084e-4	1.5835	Propane
5.075	BB	1924.56	1.52816e-4	0.2941	i-Butane
5.982	BB	2122.29	1.50547e-4	0.3195	n-Butane
8.886	BBA	208.59	1.46527e-4	0.0306	i-Pentane
10.155	BB	58.26	1.77665e-4	0.0104	n-Pentane
0.000		0.00	0.00000	0.0000	Carbon-Dioxide
14.799	BBA	32132.44	2.30335e-4	7.4012	Ethane
0.000		0.00	0.00000	0.0000	Oxygen
16.614	BB	634.25	2.41068e-4	0.1529	Nitrogen
17.474	VB	256817.13	3.52012e-4	90.4027	Methane
Totals:				100.1948	

*** End of Report ***

Method C:\CHEM32\2\METHODS\L791419.M

Calibration Table

General Calibration Setting

Calib. Data Modified : 19 November, 2019 06:33:52
Signals calculated separately : No

Rel. Reference Window : 5.000 %
Abs. Reference Window : 0.020 min
Rel. Non-ref. Window : 5.000 %
Abs. Non-ref. Window : 0.020 min
Uncalibrated Peaks : not reported
Partial Calibration : Yes, identified peaks are recalibrated
Correct All Ret. Times: No, only for identified peaks

Curve Type : Linear
Origin : Included
Weight : Equal

Recalibration Settings:
Average Response : Average all calibrations
Average Retention Time: Floating Average New 75%

Calibration Report Options :
Printout of recalibrations within a sequence:
Calibration Table after Recalibration
Normal Report after Recalibration
If the sequence is done with bracketing:
Results of first cycle (ending previous bracket)

Signal Details

Signal 1: TCD1 A, Front Signal

Overview Table

RT	Sig	Lvl	Amount [% mol]	Area	Rsp.Factor	Ref	ISTD	#	Compound
3.831	1	1	3.01000	1.67145e4	1.80084e-4	Yes	No		Propane
5.064	1	1	6.49000e-1	4246.93970	1.52816e-4	No	No		i-Butane
5.970	1	1	6.50000e-1	4317.58521	1.50547e-4	No	No		n-Butane
8.868	1	1	4.95000e-2	337.82170	1.46527e-4	No	No		i-Pentane
10.146	1	1	2.02000e-2	113.69683	1.77665e-4	No	No		n-Pentane
12.756	1	1	6.03000e-2	264.19672	2.28239e-4	No	No		Carbon-Dioxide
14.865	1	1	4.51000	1.95802e4	2.30335e-4	No	No		Ethane
15.957	1	1	2.02000e-2	82.47437	2.44925e-4	No	No		Oxygen
16.602	1	1	2.00000e-1	1244.45859	2.41068e-4	No	No		Nitrogen

Method C:\CHEM32\2\METHODS\L791419.M

RT	Sig	Lvl	Amount [% mol]	Area	Rsp.Factor	Ref	ISTD	#	Compound
17.460	1	1	90.73080	2.57749e5	3.52012e-4	No	No		Methane

Peak Sum Table

No Entries in table

2 Warnings or Errors :

Warning : Overlapping peak time windows at 15.957 min, signal 1
Warning : Overlapping peak time windows at 16.602 min, signal 1

REPORT NO. : LNG CORRELATION	REVISION NO. : 0	PAGE OF

LOG SHEET FOR LNG ANALYSIS (PURGING METHOD)

SAMPLE	Standard Gas	LNG
CYLINDER NO.	D603343	CTM191015-2
CARGO NO.	N/A	N/A
LOCATION	MLNG Lab	MLNG LABORATORY
SAMPLING METHOD	Not applicable	N/A
SAMPLING DATE	Not applicable	15/10/2019
SAMPLING TIME	Not applicable	N/A
SAMPLED BY	Not applicable	N/A
ANALYSIS DATE	19/11/2019	19/11/2019
ANALYST	LBM,SM	LBM,SM
ANALYSIS METHOD	TES-LAB-BMS 81E	TES-LAB-BMS 81E

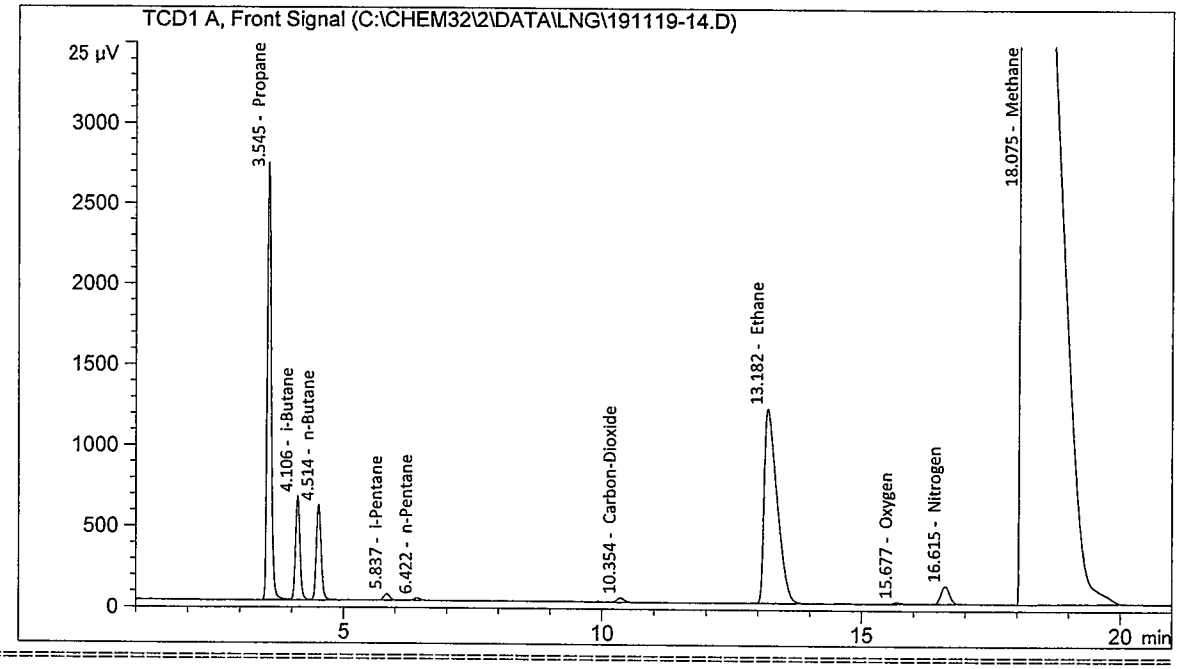
COMPONENT	CERTIFICATE MOL % A	COUNT 1 PEAK AREAS B	COUNT 2 PEAK AREAS C	AVERAGE PEAK AREAS D=(B+C)/2	DIFF. (B-C)x100/D	REPEAT RUN IN (Y/N)	RESPONSE FACTOR E=A/D	COUNT 1 PEAK AREAS F	COUNT 2 PEAK AREAS G	AVERAGE PEAK AREAS H=(F+G)/2	DIFF. (F-G)x100/H	REPEAT RUN IN (Y/N)	TEST RESULTS (MOL %) UNNORMALISED E x H	TEST RESULTS (MOL %) REPORTED VAI
CH4	90.7308	293407.41	293416.47	293411.940	0.00	Y	3.09227E-04	293838.00	293976.94	293907.470	-0.05	Y	90.884	90.20
C2H6	4.5100	20677.84	20680.99	20679.415	-0.02	Y	2.18091E-04	34189.77	34207.03	34198.400	-0.05	Y	7.458	7.40
C3H8	3.0100	14723.29	14709.52	14716.405	0.09	Y	2.04534E-04	7889.20	7892.34	7890.770	-0.04	Y	1.614	1.60
i-C4H10	0.6490	3863.14	3855.03	3859.085	0.21	Y	1.68175E-04	1780.78	1781.36	1781.070	-0.03	N/A	0.300	0.30
n-C4H10	0.6500	3913.38	3905.55	3909.465	0.20	Y	1.66263E-04	1967.30	1968.86	1968.080	-0.08	N/A	0.327	0.32
i-C5H12	0.0495	323.74	323.55	323.645	0.06	N/A	1.52945E-04	202.72	202.89	202.805	-0.08	N/A	0.031	0.03
n-C5H12	0.0202	134.16	134.24	134.200	-0.06	N/A	1.50522E-04	72.29	72.04	72.165	0.35	N/A	0.011	0.01
N2	0.3000	1309.58	1308.32	1308.950	0.10	N/A	2.29191E-04	630.64	630.57	630.605	0.01	N/A	0.145	0.14
O2	0.0202	96.96	96.81	96.885	0.15	N/A	2.08495E-04	0.00	0.00	0.000	0.00	N/A	0.000	0.00
CO2	0.0603	264.59	265.53	265.060	-0.35	N/A	2.27496E-04	0.00	0.00	0.000	0.00	N/A	0.000	0.00
											Total		100.770	100.00
											Heating Value (Btu/SCF)			1104.03

S.C.H/STTE
2019.11.19

19/11/2019

Data file : C:\CHEM32\2\DATA\LNG\191119-14.D
Sample Name : LNG CAL GAS
REPORT NO : N/A Page of
LOCATION : MLNG LAB
CYLINDER NO. : D603343
SAMPLING DATE : N/A
SAMPLING TIME : N/A
SAMPLING METHOD : N/A
SAMPLED BY : N/A
ANALYSIS DATE : 19/11/2019
ANALYSIS METHOD : TES-LAB-BMS 81E
ANALYSED BY : SM
GC USED : 7890 B LAB 6

Injection Date : 19/11/2019 Injection Time : 7:11:02 AM
Acq Operator : SYSTEM
Acq. Method : C:\CHEM32\2\METHODS\L761519.M
Last Changed : Mon, 18. Nov. 2019, 01:24:35 pm



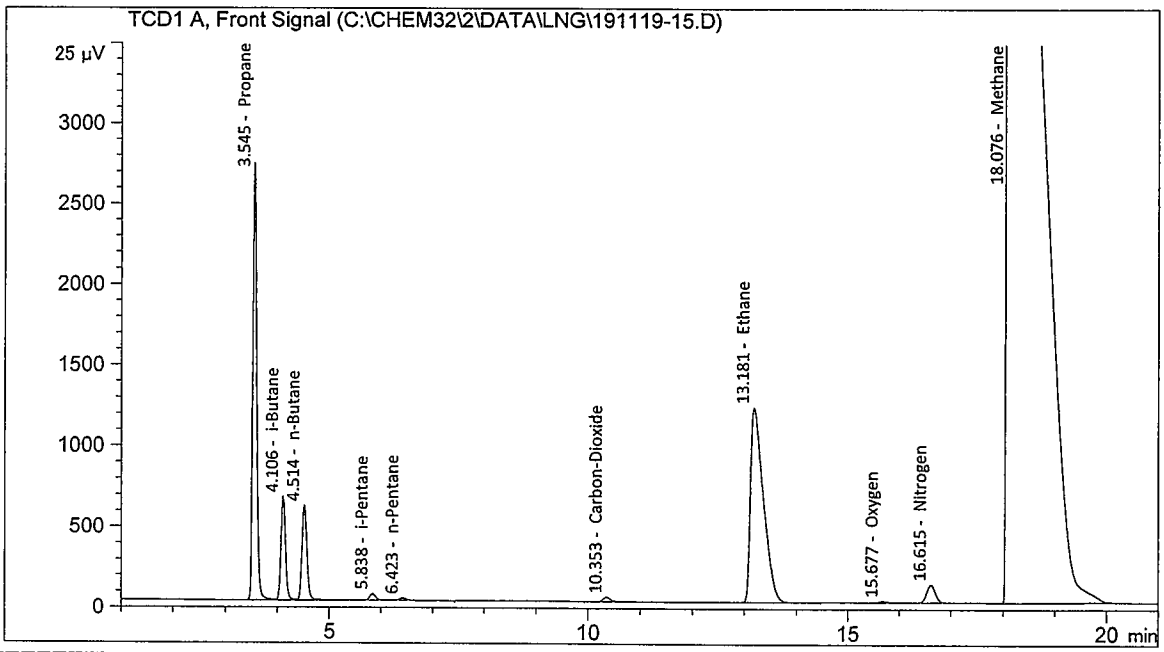
Customized Report: BMS81E

RT [min]	Type	Area	Amt/Area	Amount (% mol)	Name
3.545	BV	14723.29	2.04814e-4	3.0155	Propane
4.106	VV	3863.14	1.68350e-4	0.6504	i-Butane
4.514	VB	3913.38	1.66444e-4	0.6514	n-Butane
5.837	BB	323.74	1.52519e-4	0.0494	i-Pentane
6.422	BBA	134.16	1.50611e-4	0.0202	n-Pentane
10.354	BB	264.59	2.27059e-4	0.0601	Carbon-Dioxide
13.182	BBA	20677.84	2.17736e-4	4.5023	Ethane
15.677	BB	96.96	2.09045e-4	0.0203	Oxygen
16.615	BB	1309.58	2.29170e-4	0.3001	Nitrogen
18.075	BB	293407.41	3.08763e-4	90.5933	Methane
Totals:				99.8629	

*** End of Report ***

Data file : C:\CHEM32\2\DATA\LNG\191119-15.D
Sample Name : LNG CAL GAS
REPORT NO : N/A Page of
LOCATION : MLNG LAB
CYLINDER NO. : D603343
SAMPLING DATE : N/A
SAMPLING TIME : N/A
SAMPLING METHOD : N/A
SAMPLED BY : N/A
ANALYSIS DATE : 19/11/2019
ANALYSIS METHOD : TES-LAB-BMS 81E
ANALYSED BY : SM
GC USED : 7890 B LAB 6

Injection Date : 19/11/2019 Injection Time : 7:32:18 AM
Acq Operator : SYSTEM
Acq. Method : C:\CHEM32\2\METHODS\L761519.M
Last Changed : Mon, 18. Nov. 2019, 01:24:35 pm



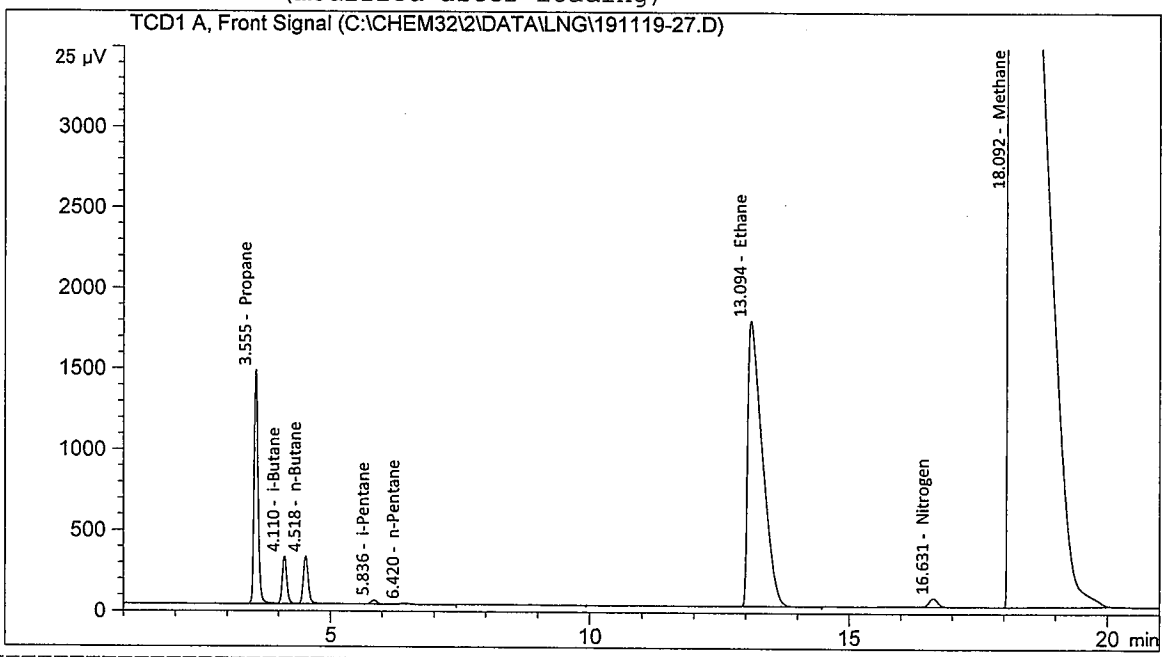
Customized Report: BMS81E

RT [min]	Type	Area	Amt/Area	Amount (% mol)	Name
3.545	BV	14709.52	2.04814e-4	3.0127	Propane
4.106	VV	3855.03	1.68350e-4	0.6490	i-Butane
4.514	VB	3905.55	1.66444e-4	0.6501	n-Butane
5.838	BB	323.55	1.52519e-4	0.0493	i-Pentane
6.423	BBA	134.24	1.50611e-4	0.0202	n-Pentane
10.353	BB	265.53	2.27059e-4	0.0603	Carbon-Dioxide
13.181	BBA	20680.99	2.17736e-4	4.5030	Ethane
15.677	BB	96.81	2.09045e-4	0.0202	Oxygen
16.615	BB	1308.32	2.29170e-4	0.2998	Nitrogen
18.076	BB	293416.47	3.08763e-4	90.5961	Methane
Totals:				99.8608	

*** End of Report ***

Data file : C:\CHEM32\2\DATA\LNG\191119-27.D
Sample Name : LNG
REPORT NO : LNG CORRELATION Page of
CARGO NO : N/A
LOCATION : MLNG LABORATORY
CYLINDER NO. : CTM191015-2
SAMPLING DATE : 15/10/2019
SAMPLING TIME : N/A
SAMPLING METHOD : N/A
SAMPLED BY : N/A
ANALYSIS DATE : 19/11/2019
ANALYSIS METHOD : TES-LAB-BMS 81E
ANALYSED BY : LBM,SM
GC USED : 7890 B LAB 6

Injection Date : 19/11/2019 Injection Time : 1:11:36 PM
Acq Operator : SYSTEM
Acq. Method : C:\CHEM32\2\METHODS\L761519.M
Last Changed : Tue, 19. Nov. 2019, 08:26:48 am
(modified after loading)



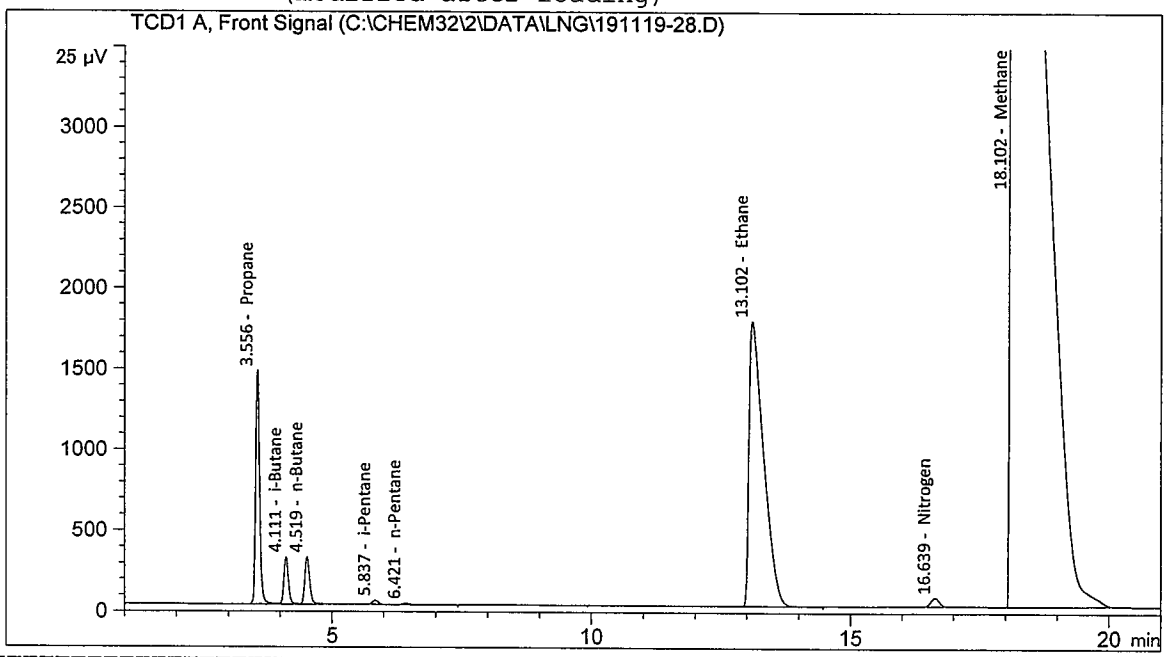
Customized Report: BMS81E

RT [min]	Type	Area	Amt/Area	Amount (% mol)	Name
3.555	BV	7889.20	2.04534e-4	1.6136	Propane
4.110	VV	1780.78	1.68175e-4	0.2995	i-Butane
4.518	VB	1967.30	1.66263e-4	0.3271	n-Butane
5.836	BB	202.72	1.52945e-4	0.0310	i-Pentane
6.420	BB	72.29	1.50521e-4	0.0109	n-Pentane
0.000		0.00	0.00000	0.0000	Carbon-Dioxide
13.094	BBA	34189.77	2.18091e-4	7.4565	Ethane
0.000		0.00	0.00000	0.0000	Oxygen
16.631	BB	630.64	2.29192e-4	0.1445	Nitrogen
18.092	BB	293838.00	3.09227e-4	90.8625	Methane
Totals:				100.7456	

*** End of Report ***

Data file : C:\CHEM32\2\DATA\LNG\191119-28.D
Sample Name : LNG
REPORT NO : LNG CORRELATION Page of
CARGO NO : N/A
LOCATION : MLNG LABORATORY
CYLINDER NO. : CTM191015-2
SAMPLING DATE : 15/10/2019
SAMPLING TIME : N/A
SAMPLING METHOD : N/A
SAMPLED BY : N/A
ANALYSIS DATE : 19/11/2019
ANALYSIS METHOD : TES-LAB-BMS 81E
ANALYSED BY : LBM,SM
GC USED : 7890 B LAB 6

Injection Date : 19/11/2019 Injection Time : 1:32:53 PM
Acq Operator : SYSTEM
Acq. Method : C:\CHEM32\2\METHODS\L761519.M
Last Changed : Tue, 19. Nov. 2019, 08:26:48 am
(modified after loading)



Customized Report: BMS81E

RT [min]	Type	Area	Amt/Area	Amount (% mol)	Name
3.556	BV	7892.34	2.04534e-4	1.6142	Propane
4.111	VV	1781.36	1.68175e-4	0.2996	i-Butane
4.519	VB	1968.86	1.66263e-4	0.3273	n-Butane
5.837	BB	202.89	1.52945e-4	0.0310	i-Pentane
6.421	BB	72.04	1.50521e-4	0.0108	n-Pentane
0.000		0.00	0.00000	0.0000	Carbon-Dioxide
13.102	BBA	34207.03	2.18091e-4	7.4603	Ethane
0.000		0.00	0.00000	0.0000	Oxygen
16.639	BB	630.57	2.29192e-4	0.1445	Nitrogen
18.102	BB	293976.94	3.09227e-4	90.9055	Methane
Totals:				100.7933	

*** End of Report ***

Method C:\CHEM32\2\METHODS\L761519.M

Calibration Table

General Calibration Setting

Calib. Data Modified : Tuesday, 19 November, 2019 8:26:48 AM
Signals calculated separately : No

Rel. Reference Window : 5.000 %
Abs. Reference Window : 0.000 min
Rel. Non-ref. Window : 5.000 %
Abs. Non-ref. Window : 0.000 min
Uncalibrated Peaks : not reported
Partial Calibration : Yes, identified peaks are recalibrated
Correct All Ret. Times: No, only for identified peaks

Curve Type : Linear
Origin : Included
Weight : Equal

Recalibration Settings:
Average Response : Average all calibrations
Average Retention Time: Floating Average New 75%

Calibration Report Options :
Printout of recalibrations within a sequence:
Calibration Table after Recalibration
Normal Report after Recalibration
If the sequence is done with bracketing:
Results of first cycle (ending previous bracket)

Signal Details

Signal 1: TCD1 A, Front Signal

Overview Table

RT	Sig	Lvl	Amount [Mol %]	Area	Rsp.Factor	Ref	ISTD	#	Compound
3.545	1	1	3.01000	1.47164e4	2.04534e-4	No	No		Propane
4.106	1	1	6.49000e-1	3859.08398	1.68175e-4	No	No		i-Butane
4.514	1	1	6.50000e-1	3909.46533	1.66263e-4	No	No		n-Butane
5.838	1	1	4.95000e-2	323.64561	1.52945e-4	No	No		i-Pentane
6.422	1	1	2.02000e-2	134.20049	1.50521e-4	No	No		n-Pentane
10.353	1	1	6.03000e-2	265.06065	2.27495e-4	No	No		Carbon-Dioxide
13.182	1	1	4.51000	2.06794e4	2.18091e-4	No	No		Ethane
15.677	1	1	2.02000e-2	96.88417	2.08496e-4	No	No		Oxygen
16.615	1	1	3.00000e-1	1309.94867	2.29189e-4	No	No		Nitrogen

Method C:\CHEM32\2\METHODS\L761519.M

RT	Sig	Lvl	Amount [Mol %]	Area	Rsp.Factor	Ref	ISTD	#	Compound
18.075	1	1	90.73080	2.93412e5	3.09227e-4	No	No		Methane

Peak Sum Table

No Entries in table