



**HyCoRA – Hydrogen
Contaminant Risk Assessment
Grant agreement no: 621223**

**Deliverable 3.2
Measurement of hydrogen quality
variation at various HRS with
different fuel feedstock**

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Confidentiality: **Public**

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1. Summary

In collaboration with Clean Energy Partnership, sampling from five HRS in Germany has been conducted. Three additional samples were collected from Norway and eight samples were sent for analysis by Smart Chemistry for full compliance with ISO 14687-2 and SAE J2719 standards. The feedstock for the samples collected were very diverse, making up a unique dataset when it comes to hydrogen fuel quality control. The strategy for sampling worked perfectly and only small adjustments are required for future sampling campaigns. The results were presented at the 3rd International Workshop on Hydrogen Transportation in Tokyo June 24-26 2015 and was given a lot of attention. SINTEF has been asked to participate in standardization (TC197/WG24) of the sampling protocols since the EU and US procedures are different and SINTEF has experience from both. Future sampling campaigns will include sampling of particles.

2. Introduction

As part of the H2Moves Scandinavia project, SINTEF has previously performed hydrogen fuel quality control on HRS in Norway. For the HyCoRA project, a new sampling methodology had become publicly available through Linde: By using a T-piece during hydrogen refuelling of FCHEV, sampling could be conducted more efficiently. The sampling instrumentation has been previously reported¹. As a FCHEV is required as sink, the coordination with CEP was crucial for efficiency as they provided empty vehicles at every HRS.

¹ HyCoRA D3.1 Hydrogen sampling unit tested and certified.

3. Selection of HRS

Two criteria were essential for the selection of publicly available HRS: fuel feedstock and geographic location. As Scandinavia is strongly dominated by electrolytic hydrogen, it was planned to collect samples from mainland Europe with natural gas feedstock.

As the sampling strategy required a FCHEV as sink for hydrogen, the optimal distance between HRS would be close to the range of the vehicle. Unless the vehicle is close to empty, the sampling volume collected would be too small for analysis

It was initially planned to use SINTEF's MB F-Cell for the sampling campaign. At the time of planning of the campaign, refuelling in Sweden was not available within the range of the vehicle (ca. 350 km). The only option for connection between Norway and mainland Europe was by ferry:

- Norway - Denmark
- Norway - Germany

Although it is well known that FCHEV have travelled by ferry in this region, SINTEF found it appropriate to request formal acceptance for taking FCHEV as well as pressurized sample canisters on the ferry. It turned out to be impossible to get written permission. There does not appear to be a directive for transport of hydrogen fuelled vehicles on ferries.

It was then contemplated to use an ICE vehicle with the FCHEV on a trailer. However, when asking permission for sampling from the refuelling stations in Northern Germany, the Clean Energy Partnership offered to provide assistance at each HRS as well as an empty FCHEV. This simplified the planning considerable. It was decided to use ICE vehicle to go down to Germany by ferry with empty sample cylinders, and return via the Øresund Bridge with hydrogen in the sample cylinders. The route is illustrated in Figure 1.



Figure 1. Route for the 1st HRS sampling campaign. Blue indicates transport by ferry.

After a discussion with CEP it was decided to collect five samples from HRSs in Hamburg and Berlin. This would provide feedstock from SMR, SMR mixed with biological feedstock, and on-site water electrolysis. Additionally, compressed as well as liquid storage would be represented in the feedstock.

4. Sampling

The Linde sampling instrumentation was used as previously described in HyCoRA D 3.1 Hydrogen sampling unit tested and certified. As expected, no manual override of the HRS was required. Depending mostly on the FCHEV hydrogen mass level, between 95 and 135 bar was collected in the cylinders. The collected samples are summarized in Table 1.

Table 1. HRS sampling table.

HRS	Date and Time	Feedstock	Storage	Sample ID
Porsgrunn	28.11.2014	Chlor-alkaline	Compressed	HY-6
Drammen	28.11.2014	Water electrolysis (trucked in)	Compressed	HY-7
Oslo	31.10.2014	Water electrolysis (trucked in)	Compressed	HY-8
Hamburg, HafenCity, Oberbaumbrücke	09.12.2014	Water electrolysis (on-site)	Compressed	HY-1
Hamburg, Bramfelder Chaussee	09.12.2014	SMR	Compressed	HY-2
Berlin, Sachsendamm	10.12.2014	SMR/Bio	Liquid	HY-3
Berlin, Holzmarktstrasse	10.12.2014	SMR/Bio	Liquid	HY-4
Hamburg, Schnackenburgallee	11.12.2014	Water electrolysis (on-site)	Compressed	HY-5

The SMR/Bio feedstock for Berlin indicates a renewable source add-in to steam-methane reformed hydrogen. The renewable source is Linde's hydrogen production from pyrolysis of glycerol. The ratio of renewable to fossil contribution was not given, but is expected to be low.

As previously noted in D 3.1, Linde Spectraseal 10 L cylinders with stainless steel valve were used for sampling. Prior to use the cylinders were vacuumed to 1-5 mbar.

CEP had provided instructions on how to conduct sampling at their HRS with respect to HES, so SINTEF personnel were wearing personal safety effects like clothing, helmet, eye and hearing protection as well as gloves and shoes. Before sample, the area was secured with cones to avoid interfering traffic from people and vehicles.

The H2 Logic HRS in Hamburg Schnackenburgallee was not yet commissioned on Dec 11 2014. When sampling was conducted, a major leak in the hose breakaway was discovered. This triggered the HRS safety resulting in fuelling shutdown. The Linde Qualitizer assumedly froze to the nozzle: it could be removed from the vehicle receptacle but not from the nozzle. A manual decoupling was performed by H2 Logic personnel after the hose was depressurized and the nozzle heated/allowed to heat up. The start of sampling is shown in Figure 2.



Figure 2. Sampling at H2 Logic HRS in Hamburg. The HRS was under commissioning.

In addition to the five samples from Germany, further three samples from Norway were added to the set of total eight samples collected for the 1st HRS sampling campaign. For this purpose the FCHEV was used.

5. Analysis

Upon return to Norway, the set of eight sample cylinders were transferred to 16 smaller Entech cylinders (500 mL, Silonite lined). This process was performed cautiously in order to avoid contamination of the samples. A cycle of evaluation to 1 mbar followed by pressurization to 10 bar with hydrogen 5.0 was repeated three times before the

Shipment was conducted by agent TNT Norway and the cost for all eight samples sent from Oslo to Sacramento was approximately €2000.

With samples collected in late November / early December 2014, the samples were sent to the US on January 8, 2015. The analytical results from Smart Chemistry were received on February 5 2015. This is detailed because of the fact that the stability of the samples in the cylinders has not been validated. This is a task that will be addressed in HyCoRA at a later stage.

Analytical methods

Smart Chemistry analyses the samples for compliance with SAE J2719. This standard is harmonized with ISO 14687-2. Table 2 summarizes the ASTM methods applied.

Table 2. ASTM analytical methods applied for compliance with SAE J2719/ISO 14687-2. TS designates Total Sulphur and C-X organohalides.

	ASTM	Analytical technique	Pre concentration
THC (C1)	WK34574	GC-MS	Cryo/TD/Cryo
He	D1946	GC-TCD	
N ₂ , Ar, O ₂ , H ₂ O	D7649	GC-MS	
CO ₂	D7649	GC-MS	
CO	D1946	GC-PDHID	Cryo
HCHO	WK34574	GC-MS	Cryo/TD/Cryo
HCOOH	WK34574 (v1)	GC-ELCD	Cryo/TD/Cryo
NH ₃	WK34574 (v1)	GC-ELCD	Cryo/TD/Cryo
HCl, HBr, Cl ₂	WK34574 (v1)	GC-ELCD	Cryo/TD/Cryo
TS	D7652	GC-SCD	Cryo/TD/Cryo
C-X	WK34574	GC-MS	Cryo/TD/Cryo

Work Item WK34574 is now available from ASTM as [D7892-15](#).

The pre-concentration strategy applied is quite complex and will be described in detail. The following steps are involved in the Cryo/TD/Cryo pre-concentration strategy:

1. 400 mL sample is cryo focussed in a glass bead trap at -150 °C
2. Compounds are slowly desorbed by heating to 10 °C retaining water in the trap
3. Sample adsorbed to Tenax trap at -60 °C
4. Thermal desorption from Tenax by heating to 180 °C
5. Cryo-focussing of sample at -170 °C in cryo-focussing column
6. Release of focussed compounds into GC column by rapid heating of cryo-focussing column to 80 °C

In another version of WK34574, formic acid, ammonia, HCl, HBr and Cl₂ is analysed by a similar procedure but with where the mass spectrometry detector is replaced by an electrolytic conductivity detector.

Total halogenate analysis is the sum of two different methods for organic and inorganic halogenates respectively.

Total sulphur assessment is performed by ASTM D7652 with the application of a sulphur chemiluminescence detector. Total sulphur is the designation of the sum of the analysed concentrations of H₂S, COS, CH₃SH, CH₃CH₂SH, CH₃SCH₃, CS₂, (CH₃)₂CHSH, (CH₃)₃CSH, n-C₃H₇SH, n-C₄H₉SH and Tetrahydrothiophene.

6. Results

The analytical results from Smart Chemistry is summarized in Table 3.

Table 3. Analytical results from Smart Chemistry. WE indicates Water Electrolysis, SME Steam Methane Reforming and CA indicates Chlor-Alkaline feedstock. C and L indicate Compressed and Liquid hydrogen storage respectively. Violation of the impurity tolerance levels given in the first column is marked with red font.

ID	Tol	HY-1	HY-2	HY-3	HY-4	HY-5	HY-6	HY-7	HY-8
Feed		WE	SMR	SMR/BIO	SMR/BIO	WE	CA	WE	WE
Storage		C	C	L	L	C	C	C	C
On-site		Y	N	N	N	Y	N	N	N
H ₂ O	5	< 1	< 1	< 1	< 1	< 1	2.9	< 1	< 1
THC (C1)	2	0.049	0.17	0.04	0.11	0.14	0.55	0.1	0.048
O ₂	5	3.3	3.5	1.7	2.3	2.4	4.1	5.7	1.1
He	300	< 10	< 10	< 10	54	< 10	< 10	< 10	< 10
N ₂ + Ar	100	24	74	10	10	14	1444	34	34
CO ₂	2	< 0.2	< 0.2	< 0.2	< 0.2	0.20	0.43	< 0.2	< 0.2
CO	0.2	0.0040	0.0033	0.001503	0.000661	0.00096	0.0037	0.0014	0.0015
HCHO	0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
CHOOH	0.2	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
NH ₃	0.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TS	0.004	0.000076	0.000051	0.000098	0.00011	0.00008	0.0004	0.00033	0.0001
TX	0.05	0.020	0.013	0.022	0.019	0.018	0.019	0.019	0.028
FI (%)	99.97	99.9973	99.9923	99.9988	99.9934	99.9983	99.8551	99.9960	99.9965

The overall impression given by the fuel quality results is, with a few exceptions, quite good. Sample HY-6 is severely diluted by 1444 ppm nitrogen. As part of the H2 Moves Scandinavia project, QC was performed at this HRS in 2012. The nitrogen level at that time was even higher: 2800 ppm. For sample HY-7, a small violation of the oxygen tolerance was documented.

Fuel Index

Fuel dilution is dominated by nitrogen. With the exception of sample HY-4 where helium dominates at 54 ppm, nitrogen is the main contributor to lowering of the fuel index. The nitrogen levels are shown in Figure 1. Setting aside the chlor-alkaline feedstock, it does not appear to be a correlation between feedstock and nitrogen concentrations. This suggests that nitrogen originates from a different failure mode than production².

² Hsu, J.P., Int. J. Hydrogen Energy, 37 (2912) pp 1770-80.

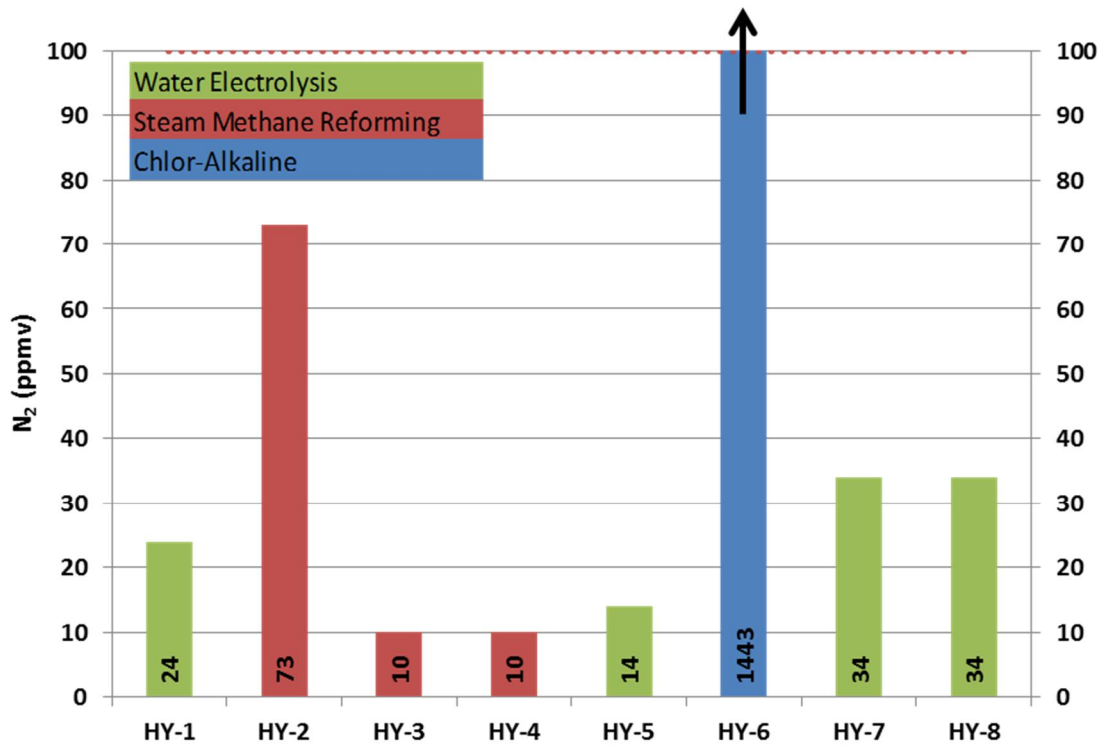


Figure 3. Nitrogen concentrations (ppmv) in samples. The hydrogen feedstock is highlighted.

From Table 4 it can be seen that the oxygen concentration in most samples, and independent of feedstock, is quite close to the 5 ppm tolerance limit.

Table 4. Impurity species contributors to fuel dilution. All values in ppmv.

ID	ToI	HY-1	HY-2	HY-3	HY-4	HY-5	HY-6	HY-7	HY-8
O ₂	5	3.3	3.5	1.7	2.3	2.4	4.1	5.7	1.1
He	300	< 10	< 10	< 10	54	< 10	< 10	< 10	< 10
N ₂	100	24	73	10	10	14	1443	34	34
Ar		< 0.5	0.75	< 0.5	< 0.5	< 0.5	0.67	0.46	< 0.5
Sum		27	77	12	66	16	1448	40	35

Sample contamination by air is a possibility in the sampling strategy applied. Therefore, the ratio of these species in the samples was compared with that of standard air composition. As seen in Table 5, only the nitrogen to oxygen ratio could be calculated for all samples. Only for sample HY-7 does the ratio indicate a possibility of air contamination.

Table 5. Calculated ratios of air constituents found in the samples.

Ratio	Air	HY-1	HY-2	HY-3	HY-4	HY-5	HY-6	HY-7	HY-8
N ₂ :O ₂	3.7	7	21	6	4	6	352	6	31
N ₂ :Ar	84		97				2154	74	
O ₂ :Ar	22		5				6	12	

For one of the samples, HY-5, vacuum was only 5 mbar as compared to 1 mbar for the other cylinders. This is not reflected in the results for N₂.

Sulphur impurities

The tolerance for total sulphur is 4 ppb. The maximum concentration found in any sample was 0.4 ppb. Again, as shown in

Figure 4, the sulphur levels do not appear to correlate with feedstock.

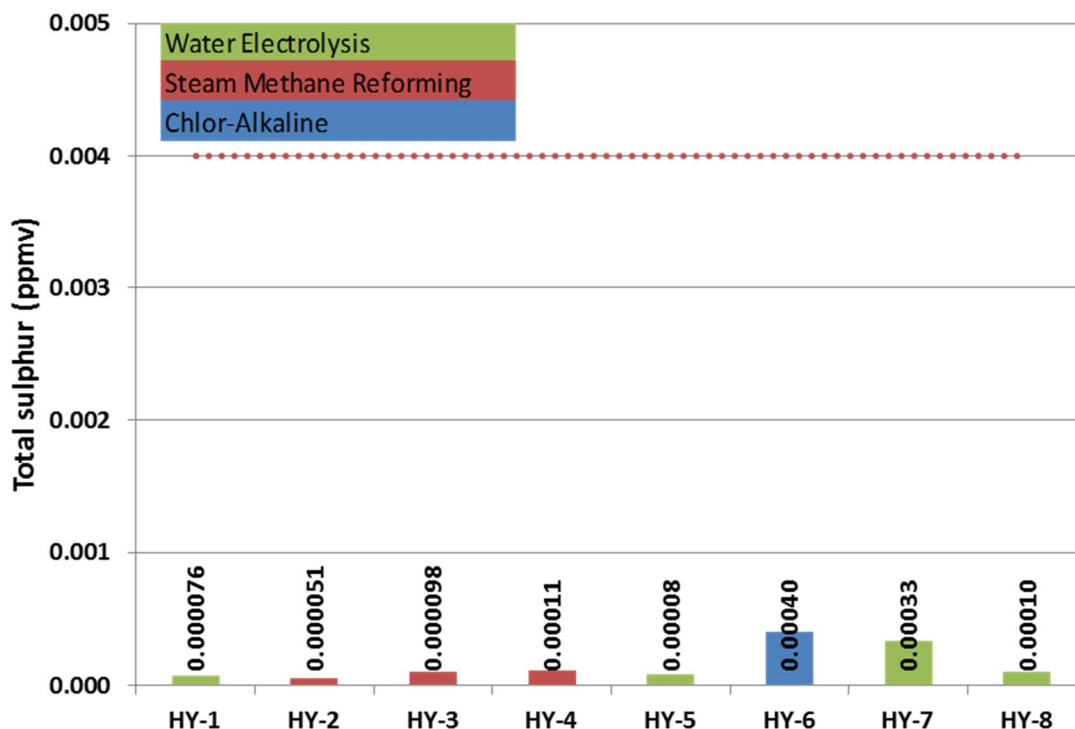


Figure 4. Total sulphur concentrations with hydrogen feedstock indicated.

Only three sulphur species were qualified in the samples: hydrogen disulphide, carbonyl sulphide and carbon disulphide. Table 6 shows no obvious correlation between the speciation of the samples. Interestingly, only the three same species were reported from a US HRS quality control campaign applying the same analytical laboratory³.

³ Results presented at the 3rd International Workshop on Hydrogen Infrastructure and Transportation.

Table 6. Total sulphur concentrations and volume distribution amongst the three species found.

ID		HY-1	HY-2	HY-3	HY-4	HY-5	HY-6	HY-7	HY-8
TS	ppmv	0.000076	0.000051	0.000098	0.00011	0.000080	0.000400	0.000330	0.00010
H ₂ S	frac	0.25	0.37	0.23	0.19	0.30	0.22	0.27	0.39
COS	frac	0.36	0.29	0.59	0.35	0.28	0.38	0.30	0.39
CS ₂	frac	0.38	0.33	0.17	0.50	0.43	0.25	0.42	0.23

Total halogenates concentrations

As shown in Table 2, total halogenates is analysed for by two different methods. The only halogenate found in the samples were tetrachlorohexafluorobutane, C₄Cl₄F₆. It has been proposed by the analysing laboratory that the stainless steel components used in the HRS is purged with PCTFE. No trace of other halogenates was found, even in the sample of chlor-alkaline feedstock.

As seen from Figure 5 the total halogenate concentrations is well below the fuel tolerance limit. Again, no apparent correlation with feedstock was observed. A requirement for the calculated inventory is that the tetrachlorohexafluorobutane isomers does not decompose inside the fuel cell system: on a HCl basis, the found concentrations are four times higher than the tolerance limit. The isomer stability in a fuel cell environment will be further investigated in the HyCoRA project.

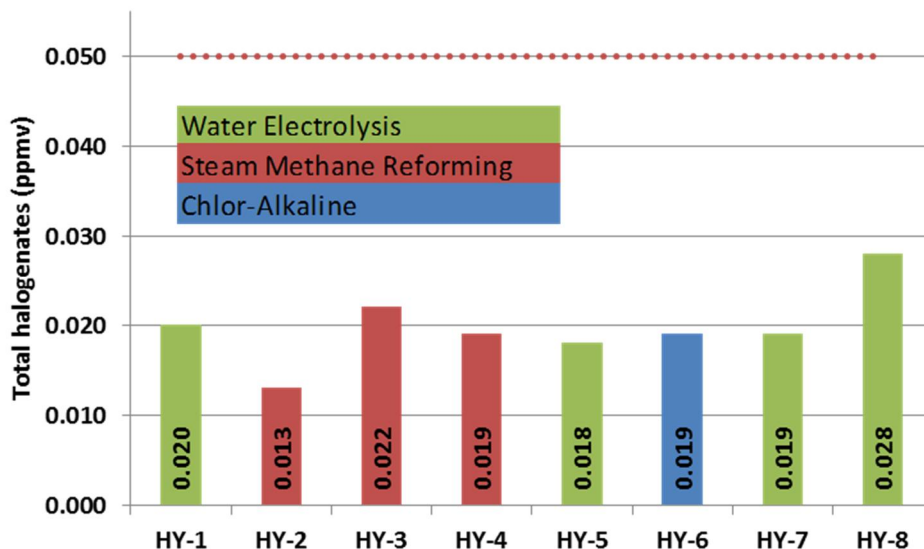


Figure 5. Total halogenate concentration in samples.

Carbon monoxide as canary constituent

As seen from Figure 6, the CO concentration in the samples is very low with respect to the 200 ppbv tolerance limit. It has been shown from simulation of PSA operation⁴ that in the case of failure, CO concentrations will be amongst the first to rise. It has been proposed to apply continuous CO monitoring at the HRS in order to conduct quality control. The concentration levels observed indicates that very sensitive instrumentation (ie. Cavity Ring

⁴ HyCoRA WP4 Risk assessment modelling activity. Collaboration with Argonne National Laboratory.

Down Spectroscopy) is required in order to be able to provide continuous quantitation for early warning of changes in fuel quality.

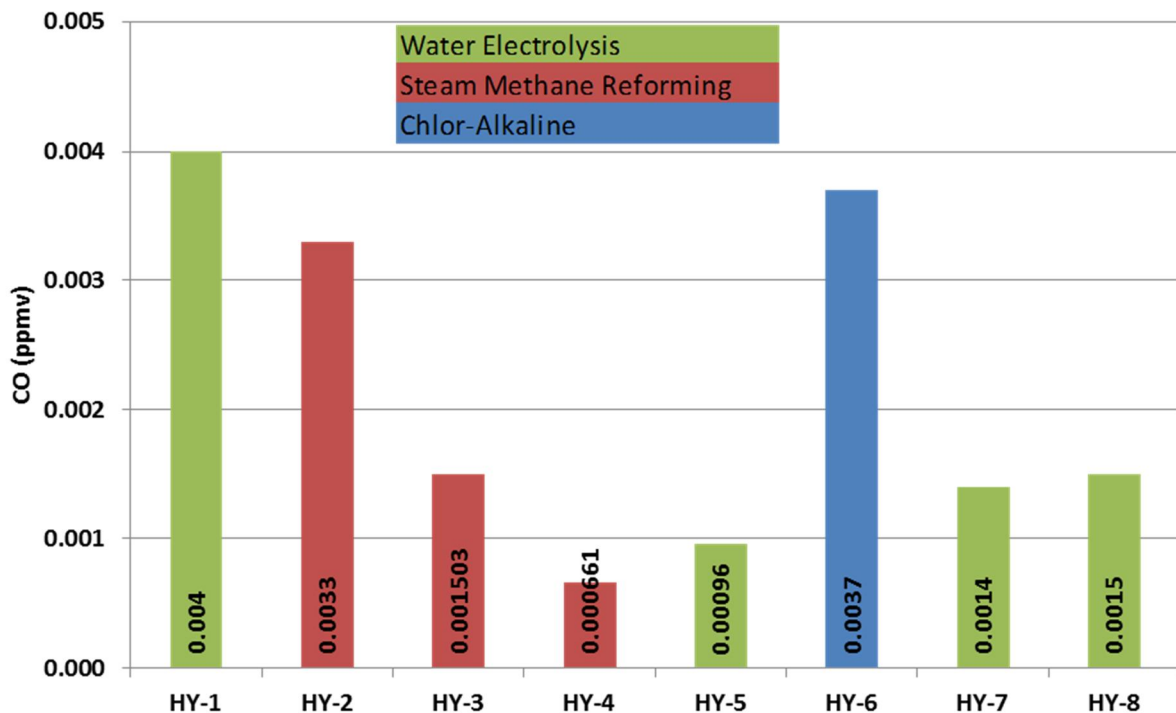


Figure 6. CO concentration in samples.

7. Dissemination

The results from the 1st HRS sampling campaign were presented at the 3rd International Workshop on Hydrogen Infrastructure and Transportation. The results were given great attention, especially because of the sampling methodology and the diversity of HRS feedstock in the results.

It has been proposed by ISO TC197/WG24 to incorporate "T-piece" gas sampling into standard protocol. As SINTEF is the only party with practical experience from both sampling strategies, the WG24 Secretary has asked SINTEF to write this procedure.

A publication summarizing the results are in progress. Target journal is International Journal of Hydrogen Energy.

8. Conclusions and input to next sampling campaign

For the next sampling campaign, the same strategy will be applied. It is planned to include particle sampling meaning that either two vehicles are used for separate sampling. It will be tested whether the two sampling instruments can be connected in series for simultaneous sampling.

9. Appendix 1: Smart Chemistry Analytical Report

Hydrogen Quality			HY-01	HY-02	HY-03	HY-04	HY-05	HY-06	HY-07	HY-08
Constituent	SAE Limits (μmol/mol)	Smart Chemistry Detection Limits (μmol/mol)	Concentration (μmol/mol)	Concentration (μmol/mol)	Concentration (μmol/mol)	Concentration (μmol/mol)	Concentration (μmol/mol)	Concentration (μmol/mol)	Concentration (μmol/mol)	Concentration (μmol/mol)
H ₂ O (ASTM D7649)	5	1	< 1	< 1	< 1	< 1	< 1	2.9	< 1	< 1
Total Hydrocarbons (C ₁ Basis) (ASTM WK34574)	2	0.001*	0.049	0.17	0.04	0.11	0.14	0.55	0.10	0.048
Methane		0.001	0.033	0.055	0.028	0.027	0.024	0.093	0.030	0.042
Acetone			0.0039			0.0039	0.039	0.0078	0.021	
Ethane				0.022	0.0052	0.0052	0.0068	0.38	0.0064	0.0058
Ethanol			0.0044			0.002	0.024	0.0038	0.012	
Isopropyl Alcohol			0.0072	0.0051	0.0051	0.069	0.0099	0.0036		
Propane				0.084			0.033	0.063	0.028	
O ₂ (ASTM D7649)	5	2	3.3	3.5	1.7	2.3	2.4	4.1	5.7	1.1
He (ASTM D1946)	300	10	< 10	< 10	< 10	54	< 10	< 10	< 10	< 10
N ₂ & Ar (ASTM D7649)	100									
N ₂	5		24	73	10	10	14	1443	34	34
Ar	0.5		< 0.5	0.75	< 0.5	< 0.5	< 0.5	0.67	0.46	< 0.5
CO ₂ (ASTM D7649)	2	0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.20	0.43	< 0.2	< 0.2
CO (ASTM D1946)	0.2	0.0008	0.0040	0.0033	0.001503	0.000661	0.00096	0.0037	0.0014	0.0015
Total Sulfur (ASTM D7652)	0.004	0.0001	0.000076	0.000051	0.000098	0.00011	0.000080	0.00040	0.00033	0.00010
Hydrogen Sulfide		0.00001	0.000019	0.000019	0.000023	0.000021	0.000024	0.000086	0.000090	0.000039
Carbonyl Sulfide		0.00001	0.000027	0.000015	0.000058	0.000039	0.000022	0.00015	0.00010	0.000039
Methyl Mercaptan (MTM)		0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Ethyl Mercaptan (ETM)		0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Dimethyl Sulfide (DMS)		0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Carbon Disulfide		0.00001	0.000029	0.000017	0.000017	0.000055	0.000034	0.00016	0.00014	0.000023
Isopropyl Mercaptan (IPM)		0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Tert-Butyl Mercaptan (TBM)		0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
n-Propyl Mercaptan		0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
n-Butyl Mercaptan		0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Tetrahydrothiophene (THT)		0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Formaldehyde (ASTM WK34574)	0.01	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Formic Acid (ASTM D5466)	0.2	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ammonia (ASTM D5466)	0.1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Total Halogenates (ASTM D5466)	0.05		0.020	0.013	0.022	0.019	0.018	0.019	0.019	0.028
Cl ₂		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
HCl		< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
HBr		< 0.007	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Total Organic Halides (32 compounds in red and bold listed in "Non-Methane Hydrocarbons") (ASTM WK34574)		0.001*	0.020	0.013	0.022	0.019	0.018	0.019	0.019	0.028
Tetrachlorohexafluorobutanes		0.001	0.020	0.013	0.022	0.019	0.018	0.019	0.019	0.028

* Smart Chemistry limit is for each individual compound

Sample Receipt Log

Sample Identification	Smart Chemistry Number	Date of Sample Receipt
HY-01	15SIN002-01	1/19/2015
HY-02	15SIN002-02	1/19/2015
HY-03	15SIN003-03	1/19/2015
HY-04	15SIN002-04	1/19/2015
HY-05	15SIN002-05	1/19/2015
HY-06	15SIN002-06	1/19/2015
HY-07	15SIN003-07	1/19/2015
HY-08	15SIN002-08	1/19/2015

Analytical data of Non-Hydrogen Gaseous Constituents is tabulated for each non-hydrogen gaseous constituent in SAE J2719. The analytical data includes calibration standards, sample analysis, spike, or duplicate.

1. Water
2. Total Hydrocarbons
 - 2.1 Methane
 - 2.2 Non-Methane Hydrocarbons
3. Oxygen
4. Helium
5. Nitrogen
6. Argon
7. Carbon Dioxide
8. Carbon Monoxide
9. Sulfur
 - 9.1 H₂S , COS, CH₃SH & CS₂
 - 9.2 Total Sulfurs – The sum of the concentrations of H₂S, COS, CH₃SH, CH₃CH₂SH, CH₃SCH₃, CS₂, (CH₃)₂CHSH, (CH₃)₃CSH, n-C₃H₇SH, n-C₄H₉SH and Tetrahydrothiophene
10. Formaldehyde
11. Formic Acid
12. Ammonia
13. Total Halogenates
 - 13.1 Chlorine
 - 13.2 Hydrogen Chloride
 - 13.3 Hydrogen Bromide
 - 13.4 Total Organic Halides (32 compounds in red and bold listed in "Non-Methane Hydrocarbons")

Analytical Data

1. H₂O ASTM 7649-10

File Name, Sample, Sample Loop Pressure (psi)	H2O Sample RT RF in Pink	or BAD	H2O Sample Area	Co-Injected Peak RT	Co-Injected Peak AREA	Air Containment (uL) while G1042 0.99% N2&O2, 0.24% CO2&Ar injected		H2O CONC. (ppmv)
						RF	RF	
501231B.d - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 348.3	0.00 2.0E-09		0 2.3E-09	28987 31596 20308	757237 432862 131961	0.29 0.31 0.20	1.8E-09	0
50123B.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 370.3	0.00		0 2.1E-09	33601 19900 44862	962742 562519 142840	0.33 0.20 0.45	1.6E-09 1.4E-09	0
15012301.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 315.8	0.00		0 2.0E-09	27212 32486 26191	819325 576259 151687	0.27 0.32 0.26	1.9E-09 1.3E-09	0
15012302.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 294	0.00		0 2.2E-09	33013 35809 33193	812171 501107 138914	0.33 0.36 0.33	1.9E-09 1.5E-09	0
15012303.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 272.1	0.00		0 2.0E-09	44890 69337 38827	957820 531834 150847	0.45 0.69 0.39	1.6E-09 1.4E-09	0
15012304.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 377	0.00		0 2.2E-09	29960 22628 36770	932943 501799 139965	0.30 0.23 0.37	1.6E-09 1.5E-09	0.0
15012305.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 85	0.00		0 2.1E-09	35014 41036 41478	840335 559156 147817	0.35 0.41 0.41	1.8E-09 1.4E-09	0
15012306.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 554	0.00		0	34903 43837 22824	969815 518728 201634	0.35 0.44 0.23	1.6E-09 1.5E-09	0
15012307.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 180.2	0.00		0	40319 44898 50311	984671 595856 181644	0.40 0.45 0.50	1.5E-09 1.3E-09 1.7E-09	0
15012308.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 94.6	0.00		0	55197 70214 39373	931609 523275 182341	0.55 0.70 0.39	1.6E-09 1.5E-09 1.7E-09	0
15012309.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 93.6	0.00		0 2.2E-09	37336 50317 46135	909852 576066 139573	0.37 0.50 0.46	1.7E-09 1.3E-09	0
15012310.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 180	0.00		0	29851 41051 30370	981815 592093 172341	0.30 0.41 0.30	1.6E-09 1.3E-09 1.8E-09	0
15012311.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 367	0.00		0 2.1E-09	32124 49874 43218	925431 537194 146363	0.32 0.50 0.43	1.6E-09 1.4E-09	0.00
15012312.D - HY-03-1,15SIN003-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 386	0.00		0 2.1E-09	42555 34631 41180	969087 525643 148377	0.42 0.34 0.41	1.6E-09 1.4E-09	0
15012313.D - HY-03-1,15SIN003-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 170.3	0.00		0	38270 62726 48903	982602 603219 192844	0.38 0.62 0.49	1.6E-09 1.3E-09 1.6E-09	0
15012314.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 387	0.00		0 2.0E-09	43245 41193 44699	1111103 613513 150869	0.43 0.41 0.44	1.4E-09 1.2E-09	0.00
15012315.D - HY-04-2,15SIN002-04#2;HEATED;85BAR 0.247;F2ML;ES0.02 201.3	0.00		0	58674 60423 44444	1080027 591512 185752	0.58 0.60 0.44	1.4E-09 1.3E-09 1.6E-09	0
15012316.D - HY-04-2,15SIN002-04#2;HEATED;85BAR 0.247;F2ML;ES0.02 193.4	0.00		0 2.3E-09	40368 40769 60626	974219 602543 130063	0.40 0.41 0.60	1.6E-09 1.3E-09	0
15012317.D - HY-05-1,15SIN002-05;HEATED;110BAR 0.247;F2ML;ES0.02 209	0.00		0 2.1E-09	51581 61114 48023	1117009 574449 145240	0.51 0.61 0.48	1.4E-09 1.3E-09	0
15012318.D - HY-05-1,15SIN002-05;HEATED;110BAR 0.247;F2ML;ES0.02 195	0.00		0	39165 47925 53431	1005656 563985 173506	0.39 0.48 0.53	1.5E-09 1.4E-09 1.8E-09	0
15012319.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 373	0.00		0 2.2E-09	43756 38953 47328	1028034 511226 140282	0.44 0.39 0.47	1.5E-09 1.5E-09	0.00
15012320.D - HY-06-1,15SIN002-06;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 299	1.24		200234	27903 39567 30733	867969 640047 175693	0.28 0.39 0.31	1.8E-09 1.2E-09 1.7E-09	2.9
15012321.D - HY-06-1,15SIN002-06;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 261	1.25 2.0E-09		206661	37971 57794 51353	776189 509864 181865	0.38 0.57 0.51	1.5E-09 1.7E-09	3.0
15012322.D - HY-07-1,15SIN002-07;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 197.8	0.00		0 2.4E-09	38588 40192 50182	823960 445989 125627	0.38 0.40 0.50	1.8E-09 1.7E-09	0
15012323.D - HY-07-1,15SIN002-07;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 184.8	0.00 2.5E-09 2.0E-09		0 3.2E-09	30995 38361 30524	614885 380546 96264	0.31 0.38 0.30	1.5E-09 1.7E-09	0
15012324.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 349.6	0.00 2.8E-09		0 1.9E-09	33183 26895 48229	551018 504575 162537	0.33 0.27 0.48	1.5E-09	0.00
15012325.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 863	0.00		0	28571 32590 46028	976725 573973 184144	0.28 0.32 0.46	1.6E-09 1.3E-09 1.7E-09	0
15012326.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 155.3	0.00		0 1.8E-09	50426 31837 28077	1070920 531662 165736	0.50 0.32 0.28	1.4E-09 1.4E-09	0
15012327.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 165	0.00		0	30292 30251 28189	1010563 536901 216333	0.30 0.30 0.28	1.5E-09 1.4E-09 1.4E-09	0

Date: 01/25/2015 - File Name	Analytical Data Injection	2.1 CH ₄			CH ₄ Response	
		Standard Conc. (PPMV)	Volume of CH ₄ in Standard (μL)	Ret. Time (MIN) of CH ₄	Area of CH ₄	Factor or Conc in ppmv
001F0101.D	G0991,6.0PPMV CO & 4.8PPMV CH4 (SYSTEM:51MTORR) [1L:27TORR] [R20] [FCTV=32,TT@20=119SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=7.0,RP=38PSI)	4.8	0.169323	5.704	621438	2.7E-07
001F0201.D	G0900,0.24PPMV CO & 0.20PPMV CH4 (SYSTEM:48MTORR) [1L:19TORR] [R20] [FCTV=23.2,TT@20=98SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=7.0,RP=38PSI)	0.20	0.004965	5.704	51878	0.57
001F0301.D	G0986,0.018PPMV CO & 0.014PPMV CH4 (SYSTEM:44MTORR) [1L:14TORR] [R20] [FCTV=19.4,TT@20=151SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.5,RP=38PSI)			5.705	47029	0.701
001F0401.D	H2 FOR G983& G0986 (SYSTEM:40MTORR) [1L:41TORR] [R20] [FCTV=54.3,TT@20=291SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.5,RP=38PSI)			5.705	28289	0.144
001F0501.D	15SUN035,1/14/15,9:30AM,65F,R150119 (SYSTEM:37MTORR) [1L:21TORR] [R20] [FCTV=30,TT@20=98SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.5,RP=38PSI)			5.692	15935	0.158
001F0601.D	15SIN002-01,HY-01-1,R150119 (SYSTEM:40MTORR) [1L:157TORR] [R20] [FCTV=189,TT@20=603SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.6,RP=38PSI)			5.691	24864	0.033
001F0701.D	15SIN002-02,HY-02-1,R150119 (SYSTEM:34MTORR) [1L:233TORR] [R20] [FCTV=272,TT@20=829SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.7,RP=38PSI)			5.689	61387	0.055
001F0801.D	15SIN002-03,HY-03-2,R150119 (SYSTEM:34MTORR) [1L:240TORR] [R20] [FCTV=278.3,TT@20=861SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.7,RP=38PSI)			5.677	32634	0.028
001F0901.D	15SIN002-04,HY-04-2,R150119 (SYSTEM:33MTORR) [1L:155TORR] [R20] [FCTV=183.8,TT@20=557SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.8,RP=38PSI)			5.676	20224	0.027
001F1001.D	15SIN002-05,HY-05-1,R150119 (SYSTEM:32MTORR) [1L:210TORR] [R20] [FCTV=245,TT@20=744SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.8,RP=38PSI)			5.673	24027	0.024
001F1101.D	15SIN002-06,HY-06-1,R150119 (SYSTEM:38MTORR) [1L:203TORR] [R20] [FCTV=237.4,TT@20=708SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.7,RP=38PSI)			5.692	90520	0.093
001F1201.D	15SIN002-07,HY-07-1,R150119 (SYSTEM:33MTORR) [1L:187TORR] [R20] [FCTV=221,TT@20=675SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.6,RP=38PSI)			5.684	27003	0.030
001F1301.D	15SIN002-08,HY-08-1,R150119 (SYSTEM:31MTORR) [1L:118TORR] [R20] [FCTV=141,TT@20=640SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.6,RP=38PSI)			5.694	23616	0.042
001F1401.D	G0900,0.24PPMV CO & 0.20PPMV CH4 (SYSTEM:34MTORR) [1L:20TORR] [R20] [FCTV=27,TT@20=82SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.6,RP=38PSI)	0.20	0.005226	5.708	81003	0.84

Smart Chemistry Corporation

3402 La Grande Blvd, Sacramento, CA 95823, (916)391-3300, (916)391-3440 (fax), www.smartchemistry.com, jphsu@smartchemistry.com

Client: SINTEF
Hydrogen Station at:
Sample Type: Hydrogen Fuel
Date Sampled: 12312014,12:00
Date Received: 01192015
Date Analyzed: 01262015
Time Analyzed: 7:31 pm

Field ID #: 400ML 15SIN00201.HY-01-1+22ML G1
Lab Sample ID: 15SIN002-01
Concentration Units: PPBV
Date File Location: 15SIN002TPH.pdf
Data Filename: 15012608.D
Dilution Factor: 1.0

Analytes	MW	CASNUM	MQL (PPBV)	Results (PPBV)	Qualifier	MQL (ug/L)	Results (ug/L)
1,1,1-Trichloroethane	132	71-55-6	1	0	U	0.005	0
1,1,2,2-Tetrachloroethane	166	79-34-5	1	0	U	0.007	0
1,1,2-Trichloroethane	132	79-00-5	1	0	U	0.005	0
1,2-Dibromoethane	186	106-93-4	1	0	U	0.008	0
1,1-Dichloroethane	98	75-34-3	1	0	U	0.004	0
1,1-Dichloroethene	96	75-35-4	1	0	U	0.004	0
1,2,4-Trichlorobenzene	180	120-82-1	1	0	U	0.007	0
1,2,4-Trimethylbenzene	120	95-63-6	1	0	U	0.005	0
1,2-Dichloroethane	98	107-06-2	1	0	U	0.004	0
1,2-Dichloropropane	112	78-87-5	1	0	U	0.005	0
1,3,5-Trimethylbenzene	120	108-67-8	1	0	U	0.005	0
1,3-Butadiene	54	106-99-0	1	0	U	0.002	0
1,2-Dichlorobenzene	146	95-50-1	1	0	U	0.006	0
1,3-Dichlorobenzene	146	541-73-1	1	0	U	0.006	0
1,4-Dichlorobenzene	146	106-46-7	1	0	U	0.006	0
1,4-Dioxane	88	123-91-1	1	0	U	0.004	0
2-Butanone	72	78-93-3	1	0	U	0.003	0
2-Hexanone	100	591-78-6	1	0	U	0.004	0
4-Ethyltoluene	120	622-96-8	1	0	U	0.005	0
4-Methyl-2-Pentanone	100	108-10-1	1	0	U	0.004	0
Acetone	58	67-64-1	1	1.3	=	0.002	0.0031
Acetylene/Ethene	28	9002-88-4	5	0	U	0.006	0
Aldehyde	44	75-07-0	1	0	U	0.002	0
Benzene	78	71-43-2	1	0	U	0.003	0
Benzyl Chloride	126	100-44-7	1	0	U	0.005	0
Bromodichloromethane	162	75-27-4	1	0	U	0.007	0
Bromoform	250	75-25-2	1	0	U	0.01	0
Bromomethane	94	74-83-9	1	0	U	0.004	0
Carbon Disulfide	76	75-15-0	1	0	U	0.003	0
Carbon tetrachloride	152	56-23-5	1	0	U	0.006	0
Chlorobenzene	112	108-90-7	1	0	U	0.005	0
Chloroethane	64	75-00-3	1	0	U	0.003	0
Chloroform	118	67-66-3	1	0	U	0.005	0
Chloromethane	50	74-87-3	1	0	U	0.002	0
cis-1,2-dichloroethene	96	156-59-2	1	0	U	0.004	0
cis-1,3-Dichloropropene	110	10061-01-5	1	0	U	0.005	0
Cyclohexane	84	110-82-7	1	0	U	0.003	0
Dibromochloromethane	206	124-48-1	1	0	U	0.008	0
Dichlorodifluoromethane	120	75-71-8	1	0	U	0.005	0
Ethane	30	74-84-0	5	0	U	0.006	0
Ethanol	46	64-17-5	1	2.2	=	0.002	0.0041
Ethyl Acetate	88	141-78-6	1	0	U	0.004	0
Ethylbenzene	106	100-41-4	1	0	U	0.004	0
Formaldehyde	30	50-0-0	1	0	U	0.001	0
Freon113	186	76-13-1	1	0	U	0.008	0
Freon114	170	76-14-2	1	0	U	0.007	0
Heptane	100	142-82-5	1	0	U	0.004	0
Hexane	86	110-54-3	1	0	U	0.004	0
Hexachlorobutadiene	258	87-68-3	1	0	U	0.01	0
Isopropyl Alcohol	60	67-63-0	1	2.4	=	0.002	0.0059
Methylene chloride	84	75-09-2	1	0	U	0.003	0
Methyl tert-Butyl Ether	88	1634-04-4	1	0	U	0.004	0
Propane	44	74-98-6	2	0	U	0.004	0
Propene	36	115-07-1	1	0	U	0.001	0
Styrene	104	100-42-5	1	0	U	0.004	0
Tetrachloroethene	164	127-18-4	1	0	U	0.007	0
Tetrahydrofuran	72	109-99-9	1	0	U	0.003	0
Toluene	92	108-88-3	2	0	U	0.008	0
trans-1,2-dichloroethene	96	156-60-5	1	0	U	0.004	0
trans-1,3-Dichloropropene	110	10061-02-6	1	0	U	0.005	0
Trichloroethene	130	79-01-6	1	0	U	0.005	0
Trichlorofluoromethane	136	75-69-4	1	0	U	0.006	0
Vinyl acetate	86	108-05-4	1	0	U	0.004	0
Vinyl chloride	62	75-01-4	1	0	U	0.003	0
Xylenes, m&p-	106	108-38-3 & 106-42-3	1	0	U	0.004	0
Xylenes, o-	106	95-47-6	1	0	U	0.004	0
1,2,3,4-Tetrachloro-hexafluorobutane	334	423-38-1	1	19.8	=	0.01	0.27
Bromochloromethane (surrogate), %rec	128	74-97-5		92	=		
4-BFB(surrogate), %recovery	174	460-00-4		104	=		

NOTES:

U - Analytes not detected at, or above the stated detection limit.
0 - A result of zero represents an undetected result at the MQL reported and does not imply an actual value.
PPBV - Parts per billion volume.
MQL - Method quantitation limit.
Surrogate results are in units of percent recovery with control limits: 65 to 135%.
The compounds in red and bold are organic halides.

Tentatively Identified Compound Estimated Concentration (PPBV)

15SIN00201

Smart Chemistry Corporation

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Client: SINTEF
Hydrogen Station at:
Sample Type: Hydrogen Fuel
Date Sampled: 12312014,12:00
Date Received: 01192015
Date Analyzed: 01262015
Time Analyzed: 8:12 pm

Field ID #: 400ML 15SIN00202.HY-02-1+22ML G1
Lab Sample ID: 15SIN002-02
Concentration Units: PPBV
Date File Location: 15SIN002TPH.pdf
Data Filename: 15012609.D
Dilution Factor: 1.0

Analytes	MW	CASNUM	MQL (PPBV)	Results (PPBV)	Qualifier	MQL (ug/L)	Results (ug/L)
1,1,1-Trichloroethane	132	71-55-6	1	0	U	0.005	0
1,1,2,2-Tetrachloroethane	166	79-34-5	1	0	U	0.007	0
1,1,2-Trichloroethane	132	79-00-5	1	0	U	0.005	0
1,2-Dibromoethane	186	106-93-4	1	0	U	0.008	0
1,1-Dichloroethane	98	75-34-3	1	0	U	0.004	0
1,1-Dichloroethene	96	75-35-4	1	0	U	0.004	0
1,2,4-Trichlorobenzene	180	120-82-1	1	0	U	0.007	0
1,2,4-Trimethylbenzene	120	95-63-6	1	0	U	0.005	0
1,2-Dichloroethane	98	107-06-2	1	0	U	0.004	0
1,2-Dichloropropane	112	78-87-5	1	0	U	0.005	0
1,3,5-Trimethylbenzene	120	108-67-8	1	0	U	0.005	0
1,3-Butadiene	54	106-99-0	1	0	U	0.002	0
1,2-Dichlorobenzene	146	95-50-1	1	0	U	0.006	0
1,3-Dichlorobenzene	146	541-73-1	1	0	U	0.006	0
1,4-Dichlorobenzene	146	106-46-7	1	0	U	0.006	0
1,4-Dioxane	88	123-91-1	1	0	U	0.004	0
2-Butanone	72	78-93-3	1	0	U	0.003	0
2-Hexanone	100	591-78-6	1	0	U	0.004	0
4-Ethyltoluene	120	622-96-8	1	0	U	0.005	0
4-Methyl-2-Pentanone	100	108-10-1	1	0	U	0.004	0
Acetone	58	67-64-1	1	0	U	0.002	0
Acetylene/Ethene	28	9002-88-4	5	0	U	0.006	0
Aldehyde	44	75-07-0	1	0	U	0.002	0
Benzene	78	71-43-2	1	0	U	0.003	0
Benzyl Chloride	126	100-44-7	1	0	U	0.005	0
Bromodichloromethane	162	75-27-4	1	0	U	0.007	0
Bromoform	250	75-25-2	1	0	U	0.01	0
Bromomethane	94	74-83-9	1	0	U	0.004	0
Carbon Disulfide	76	75-15-0	1	0	U	0.003	0
Carbon tetrachloride	152	56-23-5	1	0	U	0.006	0
Chlorobenzene	112	108-90-7	1	0	U	0.005	0
Chloroethane	64	75-00-3	1	0	U	0.003	0
Chloroform	118	67-66-3	1	0	U	0.005	0
Chloromethane	50	74-87-3	1	0	U	0.002	0
cis-1,2-dichloroethene	96	156-59-2	1	0	U	0.004	0
cis-1,3-Dichloropropene	110	10061-01-5	1	0	U	0.005	0
Cyclohexane	84	110-82-7	1	0	U	0.003	0
Dibromochloromethane	206	124-48-1	1	0	U	0.008	0
Dichlorodifluoromethane	120	75-71-8	1	0	U	0.005	0
Ethane	30	74-84-0	5	11	=	0.006	0.014
Ethanol	46	64-17-5	1	0	U	0.002	0
Ethyl Acetate	88	141-78-6	1	0	U	0.004	0
Ethylbenzene	106	100-41-4	1	0	U	0.004	0
Formaldehyde	30	50-0-0	1	0	U	0.001	0
Freon113	186	76-13-1	1	0	U	0.008	0
Freon114	170	76-14-2	1	0	U	0.007	0
Heptane	100	142-82-5	1	0	U	0.004	0
Hexane	86	110-54-3	1	0	U	0.004	0
Hexachlorobutadiene	258	87-68-3	1	0	U	0.01	0
Isopropyl Alcohol	60	67-63-0	1	1.7	=	0.002	0.0042
Methylene chloride	84	75-09-2	1	0	U	0.003	0
Methyl tert-Butyl Ether	88	1634-04-4	1	0	U	0.004	0
Propane	44	74-98-6	2	28	E	0.004	0.05
Propene	36	115-07-1	1	0	U	0.001	0
Styrene	104	100-42-5	1	0	U	0.004	0
Tetrachloroethene	164	127-18-4	1	0	U	0.007	0
Tetrahydrofuran	72	109-99-9	1	0	U	0.003	0
Toluene	92	108-88-3	2	0	U	0.008	0
trans-1,2-dichloroethene	96	156-60-5	1	0	U	0.004	0
trans-1,3-Dichloropropene	110	10061-02-6	1	0	U	0.005	0
Trichloroethene	130	79-01-6	1	0	U	0.005	0
Trichlorofluoromethane	136	75-69-4	1	0	U	0.006	0
Vinyl acetate	86	108-05-4	1	0	U	0.004	0
Vinyl chloride	62	75-01-4	1	0	U	0.003	0
Xylenes, m&p-	106	108-38-3 & 106-42-3	1	0	U	0.004	0
Xylenes, o-	106	95-47-6	1	0	U	0.004	0
1,2,3,4-Tetrachloro-hexafluorobutane	334	423-38-1	1	12.7	=	0.01	0.17
Bromochloromethane (surrogate), %rec	128	74-97-5		95	=		
4-BFB(surrogate), %recovery	174	460-00-4		107	=		

NOTES:

U - Analytes not detected at, or above the stated detection limit.
0 - A result of zero represents an undetected result at the MQL reported and does not imply an actual value.
PPBV - Parts per billion volume.
MQL - Method quantitation limit.
Surrogate results are in units of percent recovery with control limits: 65 to 135%.
The compounds in red and bold are organic halides.

Tentatively Identified Compound Estimated Concentration (PPBV)

15SIN002.xlsm

Smart Chemistry Corporation

3402 La Grande Blvd, Sacramento, CA 95823, (916)391-3300, (916)391-3440 (fax), www.smartchemistry.com, jphsu@smartchemistry.com

Client: SINTEF
Hydrogen Station at:
Sample Type: Hydrogen Fuel
Date Sampled: 12312014,12:00
Date Received: 01192015
Date Analyzed: 01262015
Time Analyzed: 8:51 pm

Field ID #: 400ML 15SIN00203.HY-03-2+22ML G1
Lab Sample ID: 15SIN002-03
Concentration Units: PPBV
Date File Location: 15SIN002TPH.pdf
Data Filename: 15012610.D
Dilution Factor: 1.0

Analytes	MW	CASNUM	MQL (PPBV)	Results (PPBV)	Qualifier	MQL (ug/L)	Results (ug/L)
1,1,1-Trichloroethane	132	71-55-6	1	0	U	0.005	0
1,1,2,2-Tetrachloroethane	166	79-34-5	1	0	U	0.007	0
1,1,2-Trichloroethane	132	79-00-5	1	0	U	0.005	0
1,2-Dibromoethane	186	106-93-4	1	0	U	0.008	0
1,1-Dichloroethane	98	75-34-3	1	0	U	0.004	0
1,1-Dichloroethene	96	75-35-4	1	0	U	0.004	0
1,2,4-Trichlorobenzene	180	120-82-1	1	0	U	0.007	0
1,2,4-Trimethylbenzene	120	95-63-6	1	0	U	0.005	0
1,2-Dichloroethane	98	107-06-2	1	0	U	0.004	0
1,2-Dichloropropane	112	78-87-5	1	0	U	0.005	0
1,3,5-Trimethylbenzene	120	108-67-8	1	0	U	0.005	0
1,3-Butadiene	54	106-99-0	1	0	U	0.002	0
1,2-Dichlorobenzene	146	95-50-1	1	0	U	0.006	0
1,3-Dichlorobenzene	146	541-73-1	1	0	U	0.006	0
1,4-Dichlorobenzene	146	106-46-7	1	0	U	0.006	0
1,4-Dioxane	88	123-91-1	1	0	U	0.004	0
2-Butanone	72	78-93-3	1	0	U	0.003	0
2-Hexanone	100	591-78-6	1	0	U	0.004	0
4-Ethyltoluene	120	622-96-8	1	0	U	0.005	0
4-Methyl-2-Pentanone	100	108-10-1	1	0	U	0.004	0
Acetone	58	67-64-1	1	0	U	0.002	0
Acetylene/Ethene	28	9002-88-4	5	0	U	0.006	0
Aldehyde	44	75-07-0	1	0	U	0.002	0
Benzene	78	71-43-2	1	0	U	0.003	0
Benzyl Chloride	126	100-44-7	1	0	U	0.005	0
Bromodichloromethane	162	75-27-4	1	0	U	0.007	0
Bromoform	250	75-25-2	1	0	U	0.01	0
Bromomethane	94	74-83-9	1	0	U	0.004	0
Carbon Disulfide	76	75-15-0	1	0	U	0.003	0
Carbon tetrachloride	152	56-23-5	1	0	U	0.006	0
Chlorobenzene	112	108-90-7	1	0	U	0.005	0
Chloroethane	64	75-00-3	1	0	U	0.003	0
Chloroform	118	67-66-3	1	0	U	0.005	0
Chloromethane	50	74-87-3	1	0	U	0.002	0
cis-1,2-dichloroethene	96	156-59-2	1	0	U	0.004	0
cis-1,3-Dichloropropene	110	10061-01-5	1	0	U	0.005	0
Cyclohexane	84	110-82-7	1	0	U	0.003	0
Dibromochloromethane	206	124-48-1	1	0	U	0.008	0
Dichlorodifluoromethane	120	75-71-8	1	0	U	0.005	0
Ethane	30	74-84-0	2	2.6	=	0.002	0.0032
Ethanol	46	64-17-5	1	0	U	0.002	0
Ethyl Acetate	88	141-78-6	1	0	U	0.004	0
Ethylbenzene	106	100-41-4	1	0	U	0.004	0
Formaldehyde	30	50-0-0	1	0	U	0.001	0
Freon113	186	76-13-1	1	0	U	0.008	0
Freon114	170	76-14-2	1	0	U	0.007	0
Heptane	100	142-82-5	1	0	U	0.004	0
Hexane	86	110-54-3	1	0	U	0.004	0
Hexachlorobutadiene	258	87-68-3	1	0	U	0.01	0
Isopropyl Alcohol	60	67-63-0	1	1.7	=	0.002	0.0042
Methylene chloride	84	75-09-2	1	0	U	0.003	0
Methyl tert-Butyl Ether	88	1634-04-4	1	0	U	0.004	0
Propane	44	74-98-6	2	0	U	0.004	0
Propene	36	115-07-1	1	0	U	0.001	0
Styrene	104	100-42-5	1	0	U	0.004	0
Tetrachloroethene	164	127-18-4	1	0	U	0.007	0
Tetrahydrofuran	72	109-99-9	1	0	U	0.003	0
Toluene	92	108-88-3	2	0	U	0.008	0
trans-1,2-dichloroethene	96	156-60-5	1	0	U	0.004	0
trans-1,3-Dichloropropene	110	10061-02-6	1	0	U	0.005	0
Trichloroethene	130	79-01-6	1	0	U	0.005	0
Trichlorofluoromethane	136	75-69-4	1	0	U	0.006	0
Vinyl acetate	86	108-05-4	1	0	U	0.004	0
Vinyl chloride	62	75-01-4	1	0	U	0.003	0
Xylenes, m&p-	106	108-38-3 & 106-42-3	1	0	U	0.004	0
Xylenes, o-	106	95-47-6	1	0	U	0.004	0
1,2,3,4-Tetrachloro-hexafluorobutane	334	423-38-1	1	21.5	E	0.01	0.29
Bromochloromethane (surrogate), %rec	128	74-97-5		94	=		
4-BFB(surrogate), %recovery	174	460-00-4		106	=		

NOTES:

U - Analytes not detected at, or above the stated detection limit.
0 - A result of zero represents an undetected result at the MQL reported and does not imply an actual value.
PPBV - Parts per billion volume.
MQL - Method quantitation limit.
Surrogate results are in units of percent recovery with control limits: 65 to 135%.
The compounds in red and bold are organic halides.

Smart Chemistry Corporation

3402 La Grande Blvd, Sacramento, CA 95823, (916)391-3300, (916)391-3440 (fax), www.smartchemistry.com, jphsu@smartchemistry.com

Client: SINTEF
Hydrogen Station at:
Sample Type: Hydrogen Fuel
Date Sampled: 12312014,12:00
Date Received: 01192015
Date Analyzed: 01262015
Time Analyzed: 9:32 pm

Field ID #: 400ML 15SIN00204.HY-04-2+22ML G1
Lab Sample ID: 15SIN002-04
Concentration Units: PPBV
Date File Location: 15SIN002TPH.pdf
Data Filename: 15012611.D
Dilution Factor: 1.0

Analytes	MW	CASNUM	MQL (PPBV)	Results (PPBV)	Qualifier	MQL (ug/L)	Results (ug/L)
1,1,1-Trichloroethane	132	71-55-6	1	0	U	0.005	0
1,1,2,2-Tetrachloroethane	166	79-34-5	1	0	U	0.007	0
1,1,2-Trichloroethane	132	79-00-5	1	0	U	0.005	0
1,2-Dibromoethane	186	106-93-4	1	0	U	0.008	0
1,1-Dichloroethane	98	75-34-3	1	0	U	0.004	0
1,1-Dichloroethene	96	75-35-4	1	0	U	0.004	0
1,2,4-Trichlorobenzene	180	120-82-1	1	0	U	0.007	0
1,2,4-Trimethylbenzene	120	95-63-6	1	0	U	0.005	0
1,2-Dichloroethane	98	107-06-2	1	0	U	0.004	0
1,2-Dichloropropane	112	78-87-5	1	0	U	0.005	0
1,3,5-Trimethylbenzene	120	108-67-8	1	0	U	0.005	0
1,3-Butadiene	54	106-99-0	1	0	U	0.002	0
1,2-Dichlorobenzene	146	95-50-1	1	0	U	0.006	0
1,3-Dichlorobenzene	146	541-73-1	1	0	U	0.006	0
1,4-Dichlorobenzene	146	106-46-7	1	0	U	0.006	0
1,4-Dioxane	88	123-91-1	1	0	U	0.004	0
2-Butanone	72	78-93-3	1	0	U	0.003	0
2-Hexanone	100	591-78-6	1	0	U	0.004	0
4-Ethyltoluene	120	622-96-8	1	0	U	0.005	0
4-Methyl-2-Pentanone	100	108-10-1	1	0	U	0.004	0
Acetone	58	67-64-1	1	1.3	=	0.002	0.0031
Acetylene/Ethene	28	9002-88-4	5	0	U	0.006	0
Aldehyde	44	75-07-0	1	0	U	0.002	0
Benzene	78	71-43-2	1	0	U	0.003	0
Benzyl Chloride	126	100-44-7	1	0	U	0.005	0
Bromodichloromethane	162	75-27-4	1	0	U	0.007	0
Bromoform	250	75-25-2	1	0	U	0.01	0
Bromomethane	94	74-83-9	1	0	U	0.004	0
Carbon Disulfide	76	75-15-0	1	0	U	0.003	0
Carbon tetrachloride	152	56-23-5	1	0	U	0.006	0
Chlorobenzene	112	108-90-7	1	0	U	0.005	0
Chloroethane	64	75-00-3	1	0	U	0.003	0
Chloroform	118	67-66-3	1	0	U	0.005	0
Chloromethane	50	74-87-3	1	0	U	0.002	0
cis-1,2-dichloroethene	96	156-59-2	1	0	U	0.004	0
cis-1,3-Dichloropropene	110	10061-01-5	1	0	U	0.005	0
Cyclohexane	84	110-82-7	1	0	U	0.003	0
Dibromochloromethane	206	124-48-1	1	0	U	0.008	0
Dichlorodifluoromethane	120	75-71-8	1	0	U	0.005	0
Ethane	30	74-84-0	2	2.6	=	0.002	0.0032
Ethanol	46	64-17-5	1	1	=	0.002	0.0019
Ethyl Acetate	88	141-78-6	1	0	U	0.004	0
Ethylbenzene	106	100-41-4	1	0	U	0.004	0
Formaldehyde	30	50-0-0	1	0	U	0.001	0
Freon113	186	76-13-1	1	0	U	0.008	0
Freon114	170	76-14-2	1	0	U	0.007	0
Heptane	100	142-82-5	1	0	U	0.004	0
Hexane	86	110-54-3	1	0	U	0.004	0
Hexachlorobutadiene	258	87-68-3	1	0	U	0.01	0
Isopropyl Alcohol	60	67-63-0	1	23	E	0.002	0.056
Methylene chloride	84	75-09-2	1	0	U	0.003	0
Methyl tert-Butyl Ether	88	1634-04-4	1	0	U	0.004	0
Propane	44	74-98-6	2	0	U	0.004	0
Propene	36	115-07-1	1	0	U	0.001	0
Styrene	104	100-42-5	1	0	U	0.004	0
Tetrachloroethene	164	127-18-4	1	0	U	0.007	0
Tetrahydrofuran	72	109-99-9	1	0	U	0.003	0
Toluene	92	108-88-3	2	0	U	0.008	0
trans-1,2-dichloroethene	96	156-60-5	1	0	U	0.004	0
trans-1,3-Dichloropropene	110	10061-02-6	1	0	U	0.005	0
Trichloroethene	130	79-01-6	1	0	U	0.005	0
Trichlorofluoromethane	136	75-69-4	1	0	U	0.006	0
Vinyl acetate	86	108-05-4	1	0	U	0.004	0
Vinyl chloride	62	75-01-4	1	0	U	0.003	0
Xylenes, m&p-	106	108-38-3 & 106-42-3	1	0	U	0.004	0
Xylenes, o-	106	95-47-6	1	0	U	0.004	0
1,2,3,4-Tetrachloro-hexafluorobutane	334	423-38-1	1	19.4	=	0.01	0.27
Bromochloromethane (surrogate), %rec	128	74-97-5		106	=		
4-BFB(surrogate), %recovery	174	460-00-4		113	=		

NOTES:

U - Analytes not detected at, or above the stated detection limit.
 0 - A result of zero represents an undetected result at the MQL reported and does not imply an actual value.
 PPBV - Parts per billion volume.
 MQL - Method quantitation limit.
 Surrogate results are in units of percent recovery with control limits: 65 to 135%.
The compounds in red and bold are organic halides.

Tentatively Identified Compound Estimated Concentration (PPBV)

15SIN002.xlsm

Smart Chemistry Corporation

3402 La Grande Blvd, Sacramento, CA 95823, (916)391-3300, (916)391-3440 (fax), www.smartchemistry.com, jphsu@smartchemistry.com

Client:
Hydrogen Station at:
Sample Type: Hydrogen Fuel
Date Sampled: 12312014,12:00
Date Received: 01192015
Date Analyzed: 01262015
Time Analyzed: 10:12 pm

Field ID #: 400ML 15SIN00205.HY-05-1+22ML G1
Lab Sample ID: 15SIN00205
Concentration Units: PPBV
Date File Location: 15SIN002TPH.pdf
Data Filename: 15012612.D
Dilution Factor: 1.0

Analytes	MW	CASNUM	MQL (PPBV)	Results (PPBV)	Qualifier	MQL (ug/L)	Results (ug/L)
1,1,1-Trichloroethane	132	71-55-6	1	0	U	0.005	0
1,1,2,2-Tetrachloroethane	166	79-34-5	1	0	U	0.007	0
1,1,2-Trichloroethane	132	79-00-5	1	0	U	0.005	0
1,2-Dibromoethane	186	106-93-4	1	0	U	0.008	0
1,1-Dichloroethane	98	75-34-3	1	0	U	0.004	0
1,1-Dichloroethene	96	75-35-4	1	0	U	0.004	0
1,2,4-Trichlorobenzene	180	120-82-1	1	0	U	0.007	0
1,2,4-Trimethylbenzene	120	95-63-6	1	0	U	0.005	0
1,2-Dichloroethane	98	107-06-2	1	0	U	0.004	0
1,2-Dichloropropane	112	78-87-5	1	0	U	0.005	0
1,3,5-Trimethylbenzene	120	108-67-8	1	0	U	0.005	0
1,3-Butadiene	54	106-99-0	1	0	U	0.002	0
1,2-Dichlorobenzene	146	95-50-1	1	0	U	0.006	0
1,3-Dichlorobenzene	146	541-73-1	1	0	U	0.006	0
1,4-Dichlorobenzene	146	106-46-7	1	0	U	0.006	0
1,4-Dioxane	88	123-91-1	1	0	U	0.004	0
2-Butanone	72	78-93-3	1	0	U	0.003	0
2-Hexanone	100	591-78-6	1	0	U	0.004	0
4-Ethyltoluene	120	622-96-8	1	0	U	0.005	0
4-Methyl-2-Pentanone	100	108-10-1	1	0	U	0.004	0
Acetone	58	67-64-1	1	13	=	0.002	0.031
Acetylene/Ethene	28	9002-88-4	5	0	U	0.006	0
Aldehyde	44	75-07-0	1	0	U	0.002	0
Benzene	78	71-43-2	1	0	U	0.003	0
Benzyl Chloride	126	100-44-7	1	0	U	0.005	0
Bromodichloromethane	162	75-27-4	1	0	U	0.007	0
Bromoform	250	75-25-2	1	0	U	0.01	0
Bromomethane	94	74-83-9	1	0	U	0.004	0
Carbon Disulfide	76	75-15-0	1	0	U	0.003	0
Carbon tetrachloride	152	56-23-5	1	0	U	0.006	0
Chlorobenzene	112	108-90-7	1	0	U	0.005	0
Chloroethane	64	75-00-3	1	0	U	0.003	0
Chloroform	118	67-66-3	1	0	U	0.005	0
Chloromethane	50	74-87-3	1	0	U	0.002	0
cis-1,2-dichloroethene	96	156-59-2	1	0	U	0.004	0
cis-1,3-Dichloropropene	110	10061-01-5	1	0	U	0.005	0
Cyclohexane	84	110-82-7	1	0	U	0.003	0
Dibromochloromethane	206	124-48-1	1	0	U	0.008	0
Dichlorodifluoromethane	120	75-71-8	1	0	U	0.005	0
Ethane	30	74-84-0	2	3.4	=	0.002	0.0042
Ethanol	46	64-17-5	1	12	=	0.002	0.023
Ethyl Acetate	88	141-78-6	1	0	U	0.004	0
Ethylbenzene	106	100-41-4	1	0	U	0.004	0
Formaldehyde	30	50-0-0	1	0	U	0.001	0
Freon113	186	76-13-1	1	0	U	0.008	0
Freon114	170	76-14-2	1	0	U	0.007	0
Heptane	100	142-82-5	1	0	U	0.004	0
Hexane	86	110-54-3	1	0	U	0.004	0
Hexachlorobutadiene	258	87-68-3	1	0	U	0.01	0
Isopropyl Alcohol	60	67-63-0	1	3.3	=	0.002	0.0081
Methylene chloride	84	75-09-2	1	0	U	0.003	0
Methyl tert-Butyl Ether	88	1634-04-4	1	0	U	0.004	0
Propane	44	74-98-6	2	11	=	0.004	0.02
Propene	36	115-07-1	1	0	U	0.001	0
Styrene	104	100-42-5	1	0	U	0.004	0
Tetrachloroethene	164	127-18-4	1	0	U	0.007	0
Tetrahydrofuran	72	109-99-9	1	0	U	0.003	0
Toluene	92	108-88-3	2	0	U	0.008	0
trans-1,2-dichloroethene	96	156-60-5	1	0	U	0.004	0
trans-1,3-Dichloropropene	110	10061-02-6	1	0	U	0.005	0
Trichloroethene	130	79-01-6	1	0	U	0.005	0
Trichlorofluoromethane	136	75-69-4	1	0	U	0.006	0
Vinyl acetate	86	108-05-4	1	0	U	0.004	0
Vinyl chloride	62	75-01-4	1	0	U	0.003	0
Xylenes, m&p-	106	108-38-3 & 106-42-3	1	0	U	0.004	0
Xylenes, o-	106	95-47-6	1	0	U	0.004	0
1,2,3,4-Tetrachloro-hexafluorobutane	334	423-38-1	1	17.8	=	0.01	0.24
Bromochloromethane (surrogate), %rec	128	74-97-5		100	=		
4-BFB(surrogate), %recovery	174	460-00-4		116	=		

NOTES:

U - Analytes not detected at, or above the stated detection limit.
0 - A result of zero represents an undetected result at the MQL reported and does not imply an actual value.
PPBV - Parts per billion volume.
MQL - Method quantitation limit.
Surrogate results are in units of percent recovery with control limits: 65 to 135%.
The compounds in red and bold are organic halides.

Tentatively Identified Compound Estimated Concentration (PPBV)

15SIN002.xlsm

Smart Chemistry Corporation

3402 La Grande Blvd, Sacramento, CA 95823, (916)391-3300, (916)391-3440 (fax), www.smartchemistry.com, jphsu@smartchemistry.com

Client: SINTEF
Hydrogen Station at:
Sample Type: Hydrogen Fuel
Date Sampled: 12312014,12:00
Date Received: 01192015
Date Analyzed: 01262015
Time Analyzed: 10:51 pm

Field ID #: 389ML 15SIN00206, HY-06-1+22ML G11
Lab Sample ID: 15SIN00206
Concentration Units: PPBV
Date File Location: 15SIN002TPH.pdf
Data Filename: 15012613.D
Dilution Factor: 1.0

Analytes	MW	CASNUM	MQL (PPBV)	Results (PPBV)	Qualifier	MQL (ug/L)	Results (ug/L)
1,1,1-Trichloroethane	132	71-55-6	1	0	U	0.005	0
1,1,2,2-Tetrachloroethane	166	79-34-5	1	0	U	0.007	0
1,1,2-Trichloroethane	132	79-00-5	1	0	U	0.005	0
1,2-Dibromoethane	186	106-93-4	1	0	U	0.008	0
1,1-Dichloroethane	98	75-34-3	1	0	U	0.004	0
1,1-Dichloroethene	96	75-35-4	1	0	U	0.004	0
1,2,4-Trichlorobenzene	180	120-82-1	1	0	U	0.007	0
1,2,4-Trimethylbenzene	120	95-63-6	1	0	U	0.005	0
1,2-Dichloroethane	98	107-06-2	1	0	U	0.004	0
1,2-Dichloropropane	112	78-87-5	1	0	U	0.005	0
1,3,5-Trimethylbenzene	120	108-67-8	1	0	U	0.005	0
1,3-Butadiene	54	106-99-0	1	0	U	0.002	0
1,2-Dichlorobenzene	146	95-50-1	1	0	U	0.006	0
1,3-Dichlorobenzene	146	541-73-1	1	0	U	0.006	0
1,4-Dichlorobenzene	146	106-46-7	1	0	U	0.006	0
1,4-Dioxane	88	123-91-1	1	0	U	0.004	0
2-Butanone	72	78-93-3	1	0	U	0.003	0
2-Hexanone	100	591-78-6	1	0	U	0.004	0
4-Ethyltoluene	120	622-96-8	1	0	U	0.005	0
4-Methyl-2-Pentanone	100	108-10-1	1	0	U	0.004	0
Acetone	58	67-64-1	1	2.6	=	0.002	0.0062
Acetylene/Ethene	28	9002-88-4	5	0	U	0.006	0
Aldehyde	44	75-07-0	1	0	U	0.002	0
Benzene	78	71-43-2	1	0	U	0.003	0
Benzyl Chloride	126	100-44-7	1	0	U	0.005	0
Bromodichloromethane	162	75-27-4	1	0	U	0.007	0
Bromoform	250	75-25-2	1	0	U	0.01	0
Bromomethane	94	74-83-9	1	0	U	0.004	0
Carbon Disulfide	76	75-15-0	1	0	U	0.003	0
Carbon tetrachloride	152	56-23-5	1	0	U	0.006	0
Chlorobenzene	112	108-90-7	1	0	U	0.005	0
Chloroethane	64	75-00-3	1	0	U	0.003	0
Chloroform	118	67-66-3	1	0	U	0.005	0
Chloromethane	50	74-87-3	1	0	U	0.002	0
cis-1,2-dichloroethene	96	156-59-2	1	0	U	0.004	0
cis-1,3-Dichloropropene	110	10061-01-5	1	0	U	0.005	0
Cyclohexane	84	110-82-7	1	0	U	0.003	0
Dibromochloromethane	206	124-48-1	1	0	U	0.008	0
Dichlorodifluoromethane	120	75-71-8	1	0	U	0.005	0
Ethane	30	74-84-0	2	190	E	0.002	0.23
Ethanol	46	64-17-5	1	1.9	=	0.002	0.0036
Ethyl Acetate	88	141-78-6	1	0	U	0.004	0
Ethylbenzene	106	100-41-4	1	0	U	0.004	0
Formaldehyde	30	50-0-0	1	0	U	0.001	0
Freon113	186	76-13-1	1	0	U	0.008	0
Freon114	170	76-14-2	1	0	U	0.007	0
Heptane	100	142-82-5	1	0	U	0.004	0
Hexane	86	110-54-3	1	0	U	0.004	0
Hexachlorobutadiene	258	87-68-3	1	0	U	0.01	0
Isopropyl Alcohol	60	67-63-0	1	1.2	=	0.002	0.0029
Methylene chloride	84	75-09-2	1	0	U	0.003	0
Methyl tert-Butyl Ether	88	1634-04-4	1	0	U	0.004	0
Propane	44	74-98-6	2	21	E	0.004	0.038
Propene	36	115-07-1	1	0	U	0.001	0
Styrene	104	100-42-5	1	0	U	0.004	0
Tetrachloroethene	164	127-18-4	1	0	U	0.007	0
Tetrahydrofuran	72	109-99-9	1	0	U	0.003	0
Toluene	92	108-88-3	2	0	U	0.008	0
trans-1,2-dichloroethene	96	156-60-5	1	0	U	0.004	0
trans-1,3-Dichloropropene	110	10061-02-6	1	0	U	0.005	0
Trichloroethene	130	79-01-6	1	0	U	0.005	0
Trichlorofluoromethane	136	75-69-4	1	0	U	0.006	0
Vinyl acetate	86	108-05-4	1	0	U	0.004	0
Vinyl chloride	62	75-01-4	1	0	U	0.003	0
Xylenes, m&p-	106	108-38-3 & 106-42-3	1	0	U	0.004	0
Xylenes, o-	106	95-47-6	1	0	U	0.004	0
1,2,3,4-Tetrachloro-hexafluorobutane	334	423-38-1	1	19.3	=	0.01	0.26
Bromochloromethane (surrogate), %rec	128	74-97-5		99	=		
4-BFB(surrogate), %recovery	174	460-00-4		113	=		

NOTES:

U - Analytes not detected at, or above the stated detection limit.
0 - A result of zero represents an undetected result at the MQL reported and does not imply an actual value.
PPBV - Parts per billion volume.
MQL - Method quantitation limit.
Surrogate results are in units of percent recovery with control limits: 65 to 135%.
The compounds in red and bold are organic halides.

Tentatively Identified Compound Estimated Concentration (PPBV)

15SIN002.xlsm

Smart Chemistry Corporation

3402 La Grande Blvd, Sacramento, CA 95823, (916)391-3300, (916)391-3440 (fax), www.smartchemistry.com, jphsu@smartchemistry.com

Client:
Hydrogen Station at:
Sample Type: Hydrogen Fuel
Date Sampled: 12312014,12:00
Date Received: 01192015
Date Analyzed: 01262015
Time Analyzed: 11:29 pm

Field ID #: 400ML 15SIN00207.HY-07-1+22ML G1
Lab Sample ID: 15SIN00207
Concentration Units: PPBV
Date File Location
Data Filename: 15012614.D
Dilution Factor: 1.0

Analytes	MW	CASNUM	ML (PPBV)	Results (PPBV)	Qualifier	ML (ug/L)	Results (ug/L)
1,1,1-Trichloroethane	132	71-55-6	1	0	U	0.005	0
1,1,2,2-Tetrachloroethane	166	79-34-5	1	0	U	0.007	0
1,1,2-Trichloroethane	132	79-00-5	1	0	U	0.005	0
1,2-Dibromoethane	186	106-93-4	1	0	U	0.008	0
1,1-Dichloroethane	98	75-34-3	1	0	U	0.004	0
1,1-Dichloroethene	96	75-35-4	1	0	U	0.004	0
1,2,4-Trichlorobenzene	180	120-82-1	1	0	U	0.007	0
1,2,4-Trimethylbenzene	120	95-63-6	1	0	U	0.005	0
1,2-Dichloroethane	98	107-06-2	1	0	U	0.004	0
1,2-Dichloropropane	112	78-87-5	1	0	U	0.005	0
1,3,5-Trimethylbenzene	120	108-67-8	1	0	U	0.005	0
1,3-Butadiene	54	106-99-0	1	0	U	0.002	0
1,2-Dichlorobenzene	146	95-50-1	1	0	U	0.006	0
1,3-Dichlorobenzene	146	541-73-1	1	0	U	0.006	0
1,4-Dichlorobenzene	146	106-46-7	1	0	U	0.006	0
1,4-Dioxane	88	123-91-1	1	0	U	0.004	0
2-Butanone	72	78-93-3	1	0	U	0.003	0
2-Hexanone	100	591-78-6	1	0	U	0.004	0
4-Ethyltoluene	120	622-96-8	1	0	U	0.005	0
4-Methyl-2-Pentanone	100	108-10-1	1	0	U	0.004	0
Acetone	58	67-64-1	1	6.9	=	0.002	0.016
Acetylene/Ethene	28	9002-88-4	5	0	U	0.006	0
Aldehyde	44	75-07-0	1	0	U	0.002	0
Benzene	78	71-43-2	1	0	U	0.003	0
Benzyl Chloride	126	100-44-7	1	0	U	0.005	0
Bromodichloromethane	162	75-27-4	1	0	U	0.007	0
Bromoform	250	75-25-2	1	0	U	0.01	0
Bromomethane	94	74-83-9	1	0	U	0.004	0
Carbon Disulfide	76	75-15-0	1	0	U	0.003	0
Carbon tetrachloride	152	56-23-5	1	0	U	0.006	0
Chlorobenzene	112	108-90-7	1	0	U	0.005	0
Chloroethane	64	75-00-3	1	0	U	0.003	0
Chloroform	118	67-66-3	1	0	U	0.005	0
Chloromethane	50	74-87-3	1	0	U	0.002	0
cis-1,2-dichloroethene	96	156-59-2	1	0	U	0.004	0
cis-1,3-Dichloropropene	110	10061-01-5	1	0	U	0.005	0
Cyclohexane	84	110-82-7	1	0	U	0.003	0
Dibromochloromethane	206	124-48-1	1	0	U	0.008	0
Dichlorodifluoromethane	120	75-71-8	1	0	U	0.005	0
Ethane	30	74-84-0	2	3.2	=	0.002	0.0039
Ethanol	46	64-17-5	1	5.9	=	0.002	0.011
Ethyl Acetate	88	141-78-6	1	0	U	0.004	0
Ethylbenzene	106	100-41-4	1	0	U	0.004	0
Formaldehyde	30	50-0-0	1	0	U	0.001	0
Freon113	186	76-13-1	1	0	U	0.008	0
Freon114	170	76-14-2	1	0	U	0.007	0
Heptane	100	142-82-5	1	0	U	0.004	0
Hexane	86	110-54-3	1	0	U	0.004	0
Hexachlorobutadiene	258	87-68-3	1	0	U	0.01	0
Isopropyl Alcohol	60	67-63-0	1	0	U	0.002	0
Methylene chloride	84	75-09-2	1	0	U	0.003	0
Methyl tert-Butyl Ether	88	1634-04-4	1	0	U	0.004	0
Propane	44	74-98-6	2	9.4	=	0.004	0.017
Propene	36	115-07-1	1	0	U	0.001	0
Styrene	104	100-42-5	1	0	U	0.004	0
Tetrachloroethene	164	127-18-4	1	0	U	0.007	0
Tetrahydrofuran	72	109-99-9	1	0	U	0.003	0
Toluene	92	108-88-3	2	0	U	0.008	0
trans-1,2-dichloroethene	96	156-60-5	1	0	U	0.004	0
trans-1,3-Dichloropropene	110	10061-02-6	1	0	U	0.005	0
Trichloroethene	130	79-01-6	1	0	U	0.005	0
Trichlorofluoromethane	136	75-69-4	1	0	U	0.006	0
Vinyl acetate	86	108-05-4	1	0	U	0.004	0
Vinyl chloride	62	75-01-4	1	0	U	0.003	0
Xylenes, m&p-	106	108-38-3 & 106-42-3	1	0	U	0.004	0
Xylenes, o-	106	95-47-6	1	0	U	0.004	0
1,2,3,4-Tetrachloro-hexafluorobutane	334	423-38-1	1	18.8	=	0.01	0.26
Bromochloromethane (surrogate), %rec	128	74-97-5		91	=		
4-BFB(surrogate), %recovery	174	460-00-4		105	=		

NOTES:

U - Analytes not detected at, or above the stated detection limit.
0 - A result of zero represents an undetected result at the MQL reported and does not imply an actual value.
PPBV - Parts per billion volume.
MQL - Method quantitation limit.
Surrogate results are in units of percent recovery with control limits: 65 to 135%.
The compounds in red and bold are organic halides.

Tentatively Identified Compound Estimated Concentration (PPBV)
15SIN002.xlsm

Smart Chemistry Corporation

3402 La Grande Blvd, Sacramento, CA 95823, (916)391-3300, (916)391-3440 (fax), www.smartchemistry.com, jphsu@smartchemistry.com

Client:
Hydrogen Station at:
Sample Type: Hydrogen Fuel
Date Sampled: 12312014,12:00
Date Received: 01192015
Date Analyzed: 01272015
Time Analyzed: 12:09 am

Field ID #: 400ML 15SIN00208, HY-08-1+22ML G11
Lab Sample ID: 15SIN00208
Concentration Units: PPBV
Date File Location
Data Filename: 15012615.D
Dilution Factor: 1.0

Analytes	MW	CASNUM	MQL (PPBV)	Results (PPBV)	Qualifier	MQL (ug/L)	Results (ug/L)
1,1,1-Trichloroethane	132	71-55-6	1	0	U	0.005	0
1,1,2,2-Tetrachloroethane	166	79-34-5	1	0	U	0.007	0
1,1,2-Trichloroethane	132	79-00-5	1	0	U	0.005	0
1,2-Dibromoethane	186	106-93-4	1	0	U	0.008	0
1,1-Dichloroethane	98	75-34-3	1	0	U	0.004	0
1,1-Dichloroethene	96	75-35-4	1	0	U	0.004	0
1,2,4-Trichlorobenzene	180	120-82-1	1	0	U	0.007	0
1,2,4-Trimethylbenzene	120	95-63-6	1	0	U	0.005	0
1,2-Dichloroethane	98	107-06-2	1	0	U	0.004	0
1,2-Dichloropropane	112	78-87-5	1	0	U	0.005	0
1,3,5-Trimethylbenzene	120	108-67-8	1	0	U	0.005	0
1,3-Butadiene	54	106-99-0	1	0	U	0.002	0
1,2-Dichlorobenzene	146	95-50-1	1	0	U	0.006	0
1,3-Dichlorobenzene	146	541-73-1	1	0	U	0.006	0
1,4-Dichlorobenzene	146	106-46-7	1	0	U	0.006	0
1,4-Dioxane	88	123-91-1	1	0	U	0.004	0
2-Butanone	72	78-93-3	1	0	U	0.003	0
2-Hexanone	100	591-78-6	1	0	U	0.004	0
4-Ethyltoluene	120	622-96-8	1	0	U	0.005	0
4-Methyl-2-Pentanone	100	108-10-1	1	0	U	0.004	0
Acetone	58	67-64-1	1	0	U	0.002	0
Acetylene/Ethene	28	9002-88-4	5	0	U	0.006	0
Aldehyde	44	75-07-0	1	0	U	0.002	0
Benzene	78	71-43-2	1	0	U	0.003	0
Benzyl Chloride	126	100-44-7	1	0	U	0.005	0
Bromodichloromethane	162	75-27-4	1	0	U	0.007	0
Bromoform	250	75-25-2	1	0	U	0.01	0
Bromomethane	94	74-83-9	1	0	U	0.004	0
Carbon Disulfide	76	75-15-0	1	0	U	0.003	0
Carbon tetrachloride	152	56-23-5	1	0	U	0.006	0
Chlorobenzene	112	108-90-7	1	0	U	0.005	0
Chloroethane	64	75-00-3	1	0	U	0.003	0
Chloroform	118	67-66-3	1	0	U	0.005	0
Chloromethane	50	74-87-3	1	0	U	0.002	0
cis-1,2-dichloroethene	96	156-59-2	1	0	U	0.004	0
cis-1,3-Dichloropropene	110	10061-01-5	1	0	U	0.005	0
Cyclohexane	84	110-82-7	1	0	U	0.003	0
Dibromochloromethane	206	124-48-1	1	0	U	0.008	0
Dichlorodifluoromethane	120	75-71-8	1	0	U	0.005	0
Ethane	30	74-84-0	2	2.9	=	0.002	0.0036
Ethanol	46	64-17-5	1	0	U	0.002	0
Ethyl Acetate	88	141-78-6	1	0	U	0.004	0
Ethylbenzene	106	100-41-4	1	0	U	0.004	0
Formaldehyde	30	50-0-0	1	0	U	0.001	0
Freon113	186	76-13-1	1	0	U	0.008	0
Freon114	170	76-14-2	1	0	U	0.007	0
Heptane	100	142-82-5	1	0	U	0.004	0
Hexane	86	110-54-3	1	0	U	0.004	0
Hexachlorobutadiene	258	87-68-3	1	0	U	0.01	0
Isopropyl Alcohol	60	67-63-0	1	0	U	0.002	0
Methylene chloride	84	75-09-2	1	0	U	0.003	0
Methyl tert-Butyl Ether	88	1634-04-4	1	0	U	0.004	0
Propane	44	74-98-6	2	0	U	0.004	0
Propene	36	115-07-1	1	0	U	0.001	0
Styrene	104	100-42-5	1	0	U	0.004	0
Tetrachloroethene	164	127-18-4	1	0	U	0.007	0
Tetrahydrofuran	72	109-99-9	1	0	U	0.003	0
Toluene	92	108-88-3	2	0	U	0.008	0
trans-1,2-dichloroethene	96	156-60-5	1	0	U	0.004	0
trans-1,3-Dichloropropene	110	10061-02-6	1	0	U	0.005	0
Trichloroethene	130	79-01-6	1	0	U	0.005	0
Trichlorofluoromethane	136	75-69-4	1	0	U	0.006	0
Vinyl acetate	86	108-05-4	1	0	U	0.004	0
Vinyl chloride	62	75-01-4	1	0	U	0.003	0
Xylenes, m&p-	106	108-38-3 & 106-42-3	1	0	U	0.004	0
Xylenes, o-	106	95-47-6	1	0	U	0.004	0
1,2,3,4-Tetrachloro-hexafluorobutane	334	423-38-1	1	28.1	E	0.01	0.38
Bromochloromethane (surrogate), %rec	128	74-97-5		100	=		
4-BFB(surrogate), %recovery	174	460-00-4		116	=		

NOTES:

U - Analytes not detected at, or above the stated detection limit.
 0 - A result of zero represents an undetected result at the MQL reported and does not imply an actual value.
 PPBV - Parts per billion volume.
 MQL - Method quantitation limit.
 Surrogate results are in units of percent recovery with control limits: 65 to 135%.
The compounds in red and bold are organic halides.

Tentatively Identified Compound Estimated Concentration (PPBV)

15SIN002.xlsm

Analytical Data

3. O₂ STM 7649-10

File Name, Sample, Sample Loop Pressure (psi)	O2 Sample RT OR Apparent Injection Vol. (uL)	O2 Sample Area	Co-Injected Peak RT, or O2 Conc. (ppmv) in P0136	Co-Injected Peak AREA	O2 RF at Low Conc.	O2 RF at High Conc.	O2 CONC. (ppmv)
1501231B.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 348.3	0.00	0	92491 92981 76469	1161207 706185 261384	2.5E-08 2.6E-08 2.7E-08	2.7E-08 2.2E-08 2.4E-08	0.0
150123B.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 370.3	0.00	0	86954 80741 81603	1280366 722073 267548	2.9E-08 2.6E-08 3.5E-08	2.5E-08 2.2E-08 2.4E-08	0.0
15012301.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 315.8	1.10	34898	87417 81541 78144	1171892 756602 258665	2.6E-08 3.0E-08 2.9E-08	2.7E-08 2.1E-08 2.4E-08	6.5
15012302.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 294	1.09	34808	78187 76723 82342	1225719 718311 245693	3.2E-08 3.3E-08 3.0E-08	2.6E-08 2.2E-08 2.6E-08	6.5
15012303.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 272.1	1.09	36478	78200 73893 74658	1260599 730040 263195		2.5E-08 2.2E-08 2.4E-08	7
15012304.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 377	0.00	0	78525 69048 72918	1212285 716470 230826	3.0E-08 3.1E-08 3.5E-08	2.6E-08 2.2E-08 2.7E-08	0.0
15012305.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 85	1.12	21335	78941 79917 71195	1219487 724805 263541	3.2E-08 3.4E-08 3.8E-08	2.6E-08 2.2E-08 2.4E-08	4.0
15012306.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 554	1.13	13442	71232 75485 72240	1171028 725624 258790	3.6E-08 3.7E-08 3.0E-08	2.7E-08 2.2E-08 2.4E-08	2.5
15012307.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 180.2	1.11	18550	81599 80625 74957	1182686 738980 244524	3.3E-08 3.5E-08 3.2E-08	2.7E-08 2.1E-08 2.6E-08	3.5
15012308.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 94.6	1.12	17596	85123 85440 78405	1129140 644407 256926	3.7E-08 3.4E-08 3.4E-08	2.8E-08 2.4E-08 2.5E-08	3.3
15012309.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 93.6	1.11	24906	72953 82276 87868	1181768 694320 233988	3.6E-08 3.6E-08 3.3E-08	2.7E-08 2.3E-08 2.7E-08	4.6
15012310.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 180	1.13	13357	60597 76519 75861	1168083 697105 252075	3.9E-08 3.5E-08 3.2E-08	2.7E-08 2.3E-08 2.5E-08	2.5
15012311.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 367	0.00	0	82628 79476 75402	1166709 694520 231242	3.0E-08 3.7E-08 3.7E-08	2.7E-08 2.3E-08 2.7E-08	0.0
15012312.D - HY-03-1,15SIN003-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 386	1.10	8374	80804 77711 82569	1205815 700315 255162	3.4E-08 3.2E-08 3.3E-08	2.6E-08 2.2E-08 2.5E-08	1.6
15012313.D - HY-03-1,15SIN003-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 170.3	1.12	9869	82892 92503 88407	1255297 717249 249883	3.2E-08 3.6E-08 3.3E-08	2.5E-08 2.2E-08 2.5E-08	1.8
15012314.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 387	0.00	0	87925 90402 86509	1228171 690612 236642	3.2E-08 3.0E-08 3.3E-08	2.6E-08 2.3E-08 2.7E-08	0.0
15012315.D - HY-04-2,15SIN002-04#2;HEATED;85BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 201.3	1.10	12024	90902 81605 77182	1281818 693746 234990	3.6E-08 3.4E-08 3.6E-08	2.5E-08 2.3E-08 2.7E-08	2.2
15012316.D - HY-04-2,15SIN002-04#2;HEATED;85BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 193.4	1.12	12450	85566 82761 87842	1239442 678454 226945	3.1E-08 3.3E-08 3.8E-08	2.5E-08 2.3E-08 2.8E-08	2.3
15012317.D - HY-05-1,15SIN002-05;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 209	1.10	13524	83912 79458 86423	1269152 679124 221253	3.6E-08 3.4E-08 3.4E-08	2.5E-08 2.3E-08 2.8E-08	2.5
15012318.D - HY-05-1,15SIN002-05;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 195	1.11	12615	75889 82023 82399	1149109 693133 236713	3.5E-08 3.6E-08 3.7E-08	2.7E-08 2.3E-08 2.7E-08	2.4
15012319.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 373	0.00	0	74112 64046 69330	1094882 573799 183681		2.9E-08 2.7E-08 3.4E-08	0.0
15012320.D - HY-06-1,15SIN002-06;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 299	1.10	23463	48181 55320 48889	958653 661860 224077		3.3E-08 2.4E-08 2.8E-08	4.4
15012321.D - HY-06-1,15SIN002-06;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 261	1.11	20035	54321 58220 61036	900900 542838 205542		2.9E-08 3.1E-08 3.2E-08	3.7
15012322.D - HY-07-1,15SIN002-07;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 197.8	1.11	31873	61379 60321 61154	993931 484484 188829		3.2E-08 3.2E-08 3.3E-08	5.9
15012323.D - HY-07-1,15SIN002-07;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 184.8	1.10	29749	52506 59793 46774	693017 451517 113580		3.5E-08 3.5E-08 5.5E-08	5.5
15012324.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 349.6	0.00	0	61406 43437 49971	603972 485711 196947		3.2E-08 3.2E-08 3.2E-08	0.0
15012325.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 863	0.00	0	60975 60662 67286	1117396 653314 253911		2.8E-08 2.4E-08 2.5E-08	0.0
15012326.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 155.3	1.13	6374	72759 58671 59294	1168408 575742 231725		2.7E-08 2.7E-08 2.7E-08	1.2
15012327.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 165	1.11	5671	66047 60888 40274	1129642 655333 224880		2.8E-08 2.4E-08 2.8E-08	1.1

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Analytical Data

4. He

Date of
Analysis

01/26/2015

Instrumentation

GC/TCD

File Name	Helium Retention Time (min)	Helium Retention Time (min)	Helium Standard Conc. (PPMV)	Area	Response Factor (RF)	Sample Concentration (PPMV)
001F0101.D	G0999 (445 PPMV HE IN HYDROGEN). OT=40C.	3.881	445	40.94	10.9	
001F0201.D	G0812 (164.2 PPMV HE IN HYDROGEN). OT=40C.	3.833	164.2	14.17	11.6	
001F0301.D	G0634 (9.2 PPMV HE IN HYDROGEN). OT=40C.	4.138	9.2	1.27	7.2	
001F0501.D	G1045 (77.3 PPMV HE IN HYDROGEN). OT=40C.	3.831	77.3	7.36	10.5	
001F0601.D	15SUN035,1/14/15,9:30AM,65F. OT=40C.	3.866		21.84		239
001F0701.D	15SIN002-01,HY-01-1,R150119. OT=40C.	4.012		0.82		9.0
001F0801.D	15SIN002-02,HY-02-1,R150119. OT=40C.	3.826		0.00		0
001F0901.D	15SIN002-03,HY-03-2,R150119. OT=40C.	4.006		0.83		9.1
001F1001.D	15SIN002-04,HY-04-2,R150119. OT=40C.	4.039		4.95		54
001F1101.D	15SIN002-05,HY-05-1,R150119. OT=40C.	3.826		0.00		0
001F1201.D	15SIN002-06,HY-06-1,R150119. OT=40C.	3.826		0.00		0
001F1301.D	15SIN002-07,HY-07-1,R150119. OT=40C.	3.797		0.57		6.3
001F1401.D	15SIN002-08,HY-08-1,R150119. OT=40C.	3.826		0.00		0
001F1501.D	G1045 (77.3 PPMV HE IN HYDROGEN). OT=40C.	3.826	77.3	7.20	10.7	

Analytical Data

5. N₂ ASTM 7649-10

File Name, Sample, Sample Loop Pressure (psi)	N2 Sample RT OR Apparent Injection Vol. (uL)	N2 Peak 1 Area	Co-Injected Peak RT	Co-Injected Peak AREA	N2 RF at Low Conc.	N2 RF at High Conc.	N2 CONC. (ppmv)
1501231B.d - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 348.3	0.00	0	239621 220600 232709	4747685 3036897 1124806	2.0E-08 2.3E-08 1.6E-08	2.5E-08 1.9E-08 2.1E-08	0.0
1501238.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 370.3	0.00	0	231313 229626 223523	5331809 3197083 1199195	2.3E-08 1.6E-08 3.0E-08	2.2E-08 1.8E-08 2.0E-08	0.0
15012301.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 315.8	1.10	29315	246697 226736 221857	5057092 3321129 1198226	1.9E-08 2.3E-08 2.0E-08	2.3E-08 1.8E-08 2.0E-08	5.1
15012302.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 294	1.10	34481	217217 218247 221177	5385610 3244166 1171199	2.4E-08 2.6E-08 2.4E-08	2.2E-08 1.8E-08 2.0E-08	6.0
15012303.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 272.1	1.10	49667	214074 197292 196283	5535118 3315960 1221406	3.1E-08 3.0E-08 3.0E-08	2.1E-08 1.8E-08 1.9E-08	8.7
15012304.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 377	0.00	0	212955 181333 206703	5416241 3277041 1096260	2.3E-08 2.3E-08 2.8E-08	2.2E-08 1.8E-08 2.1E-08	0.0
15012305.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 85	1.11	157665	221664 230770 209890	5398916 3321603 1222773	2.5E-08 2.7E-08 3.0E-08	2.2E-08 1.8E-08 1.9E-08	28
15012306.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 554	1.13	112569	219861 222080 225589	5214337 3318468 1271527	2.5E-08 2.9E-08 1.8E-08	2.2E-08 1.8E-08 1.8E-08	20
15012307.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 180.2	1.10	148179	228527 239542 240977	5385591 3474656 1184551	2.7E-08 2.8E-08 3.0E-08	2.2E-08 1.7E-08 2.0E-08	26
15012308.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 94.6	1.12	413206	262493 253403 228681	5181495 3125476 1256143	3.0E-08 3.8E-08 2.6E-08	2.3E-08 1.9E-08 1.9E-08	72
15012309.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 93.6	1.10	441703	216949 247030 264826	5428543 3392186 1245817	2.7E-08 2.9E-08 2.6E-08	2.2E-08 1.7E-08 1.9E-08	77
15012310.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 180	1.12	400299	189255 223405 213028	5371239 3429336 1245540	2.6E-08 2.8E-08 2.3E-08	2.2E-08 1.7E-08 1.9E-08	70
15012311.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 367	0.00	0	249450 234834 220333	5407495 3365100 1183265	2.1E-08 3.1E-08 2.9E-08	2.2E-08 1.7E-08 2.0E-08	0.0
15012312.D - HY-03-1,15SIN003-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 386	1.11	39697	235254 237247 259882	5612078 3390563 1282333	2.7E-08 2.3E-08 2.4E-08	2.1E-08 1.7E-08 1.8E-08	6.9
15012313.D - HY-03-1,15SIN003-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 170.3	1.12	76047	219271 264021 276174	5785975 3450681 1239077	2.7E-08 3.3E-08 2.6E-08	2.0E-08 1.7E-08 1.9E-08	13.3
15012314.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 387	0.00	0	273382 263994 290293	5838577 3442429 1229279	2.4E-08 2.4E-08 2.3E-08	2.0E-08 1.7E-08 1.9E-08	0.0
15012315.D - HY-04-2,15SIN002-04#2;HEATED;85BAR 0.247;F2ML;ES0.02 201.3	1.11	57552	275841 255239 238098	6085280 3450095 1248903	3.0E-08 3.3E-08 2.8E-08	1.9E-08 1.7E-08 1.9E-08	10
15012316.D - HY-04-2,15SIN002-04#2;HEATED;85BAR 0.247;F2ML;ES0.02 193.4	1.12	59329	241217 223102 259268	6007006 3404458 1186416	2.5E-08 2.8E-08 3.3E-08	1.9E-08 1.7E-08 2.0E-08	10
15012317.D - HY-05-1,15SIN002-05;HEATED;110BAR 0.247;F2ML;ES0.02 209	1.10	80026	250320 205819 247731	6135324 3362496 1198189	3.0E-08 4.1E-08 2.8E-08	1.9E-08 1.7E-08 2.0E-08	14
15012318.D - HY-05-1,15SIN002-05;HEATED;110BAR 0.247;F2ML;ES0.02 195	1.11	83451	229018 250370 244103	5543837 3469347 1233300	2.6E-08 2.8E-08 3.1E-08	2.1E-08 1.7E-08 1.9E-08	15
15012319.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 373	0.00	0	229681 141694 178379	5418991 2963533 968781	2.8E-08	2.2E-08 2.0E-08 2.4E-08	0.0
15012320.D - HY-06-1,15SIN002-06;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 299	1.10	7937875	92231 87651 96023	4763915 3386932 1193887		1.7E-08 2.0E-08	1385
15012321.D - HY-06-1,15SIN002-06;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 261	1.12	8601598	90271 132296 142200	4514381 2803760 1123961		2.1E-08 2.1E-08	1501
15012322.D - HY-07-1,15SIN002-07;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 197.8	1.10	198740	107850 91495 132380	4940923 2502987 1007662		2.4E-08 2.3E-08 2.3E-08	35
15012323.D - HY-07-1,15SIN002-07;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 184.8	1.10	188694	91170 95277 96415	3596906 2391751 602709		2.4E-08	33
15012324.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 349.6	0.00	0	109859 70274 84108	3021764 2508542 1047237		2.3E-08 2.2E-08	3.9E-08 0.0
15012325.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 863	0.00	0	177814 201215 201828	5481661 3345120 1286194	2.7E-08 2.6E-08	2.1E-08 1.7E-08 1.8E-08	0.0
15012326.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 155.3	1.10	183851	216955 188926 152359	5797475 2967964 1254245		2.0E-08 2.0E-08 1.9E-08	32
15012327.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 165	1.10	208068	200444 164701 127116	5563793 3342250 1228317	2.5E-08 3.0E-08	2.1E-08 1.7E-08 1.9E-08	36

Analytical Data

6. Ar

ASTM 7649-10 Date of Analysis 12/3D/2050

File Name, Sample, Sample Loop Pressure (psi)	Ar Sample RT or BAD RF	Ar Sample Area	Co-Injected Peak RT	Co-Injected Peak AREA	RF	RF	Ar CONC. (ppmv)	Appraent Injection Vol. (uL)
1501231B.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 348.3	0.00	0 1.6E-08	25350 24997 23734	89093 55325 21468	1.6E-08 1.6E-08 1.6E-08	 1.3E-08 1.3E-08	0.0	
1501238.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 370.3	0.00	0	25016 24218 22763	98878 57333 21217	1.6E-08 1.6E-08 1.8E-08	 1.4E-08 1.3E-08	0.0	
15012301.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 315.8	1.09 1.6E-08	12688	24699 21850 23251	90003 58817 21484	1.6E-08 1.8E-08 1.7E-08	 1.2E-08 1.3E-08	1.5	104
15012302.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 294	1.09	13675	24241 24935 23892	99087 56872 20463	1.7E-08 1.6E-08 1.7E-08	 1.4E-08 1.4E-08	1.7	112
15012303.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 272.1	1.10	13322	28416 23444 26022	103152 60507 20695	1.5E-08 1.9E-08 1.6E-08	 1.4E-08 1.4E-08	2	109
15012304.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 377	0.00	0	26939 18115 25273	97171 56454 18596	1.5E-08 1.6E-08	 1.4E-08 1.5E-08	0	
15012305.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 85	1.12	3482	26816 22951 25515	99728 61368 20637	1.5E-08 1.8E-08 1.6E-08	 1.1E-08 1.4E-08	0.42	
15012306.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 554	0.00	0	20446 25100 24377	94739 65611 22632	2.0E-08 1.7E-08 1.6E-08	 1.5E-08 1.2E-08	0	
15012307.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 180.2	0.00	0	28254 24470 20900	99009 64270 20463	1.5E-08 1.7E-08 2.0E-08	 1.4E-08 1.4E-08	0	
15012308.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 94.6	1.12	6253	25564 25085 23589	96007 54358 21491	1.7E-08 1.8E-08 1.7E-08	 1.3E-08 1.3E-08	0.76	
15012309.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 93.6	1.10	6457	24416 27758 28959	104632 60152 20014	1.7E-08 1.5E-08 1.4E-08	 1.2E-08 1.4E-08	0.78	
15012310.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 180	1.14	5936	17260 23457 23799	99961 59555 21385	1.4E-08 1.8E-08 1.7E-08	 1.2E-08 1.3E-08	0.72	
15012311.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 367	0.00	0	26672 26354 24423	103248 57851 21362	1.5E-08 1.6E-08 1.7E-08	 1.4E-08 1.3E-08	0.0	
15012312.D - HY-03-1,15SIN003-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 386	0.00	0	25055 25602 24013	104288 59645 20425	1.7E-08 1.6E-08 1.7E-08	 1.2E-08 1.4E-08	0	
15012313.D - HY-03-1,15SIN003-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 170.3	0.00	0	29427 29571 26944	109041 60769 19540	1.4E-08 1.5E-08 1.6E-08	 1.2E-08 1.4E-08	0	
15012314.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 387	0.00	0	28853 29772 29553	110786 62641 21255	1.4E-08 1.4E-08 1.4E-08	 1.3E-08 1.3E-08	0.0	
15012315.D - HY-04-2,15SIN002-04#2;HEATED;85BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 201.3	0.00	0	30413 29115 25733	112453 59492 21253	1.4E-08 1.5E-08 1.6E-08	 1.2E-08 1.3E-08	0	
15012316.D - HY-04-2,15SIN002-04#2;HEATED;85BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 193.4	0.00	0	28346 30107 28903	109741 64714 19473	1.5E-08 1.4E-08 1.5E-08	 1.3E-08 1.4E-08	0	
15012317.D - HY-05-1,15SIN002-05;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 209	0.00	0	30656 29830 31628	110925 58403 19854	1.4E-08 1.5E-08 1.3E-08	 1.3E-08 1.2E-08	0	
15012318.D - HY-05-1,15SIN002-05;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 195	0.00	0	29236 26143 27554	104918 61715 20620	1.4E-08 1.6E-08 1.5E-08	 1.3E-08 1.4E-08	0	
15012319.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 373	0.00	0	25407 29350 26106	101007 50222 16036	1.6E-08 1.4E-08 1.6E-08	 1.4E-08 1.7E-08	0.0	
15012320.D - HY-06-1,15SIN002-06;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 299	1.11	5390	22793 29453 27083	89032 59151 20591	1.8E-08 1.4E-08 1.5E-08	 1.6E-08 1.4E-08	0.65	
15012321.D - HY-06-1,15SIN002-06;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 261	1.12 1.6E-08	5688	29411 27453 27649	87760 48072 19653	1.4E-08 1.6E-08 1.5E-08	 1.5E-08 1.4E-08	0.69	
15012322.D - HY-07-1,15SIN002-07;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 197.8	1.13	2935	30916 31379 28470	93087 46756 18149	1.3E-08 1.3E-08 1.5E-08	 1.5E-08 1.5E-08	0.36	
15012323.D - HY-07-1,15SIN002-07;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 184.8	1.10 2.0E-08 1.7E-08	4630	26801 32917 23110	68556 41863 11510	1.5E-08 1.2E-08 1.7E-08	 1.5E-08 1.4E-08	0.56	
15012324.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 349.6	0.00 2.4E-08 1.6E-08	0	28860 21017 27328	58036 44110 17630	1.4E-08 1.9E-08 1.5E-08	 1.4E-08 1.5E-08	0.0	
15012325.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 863	0.00	0	22850 24490 22832	100500 58077 21058	1.7E-08 1.6E-08 1.8E-08	 1.4E-08 1.3E-08	0.0	
15012326.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 155.3	1.10	2868	27078 20824 22071	107404 50759 22674	1.6E-08 1.9E-08 1.8E-08	 1.4E-08 1.2E-08	0.3	
15012327.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 165	0.00	0	27770 23286 12823	102708 60111 22113	1.4E-08 1.7E-08 1.7E-08	 1.4E-08 1.3E-08	0.0	

Analytical Data

7. CO₂

ASTM 7649-10

Date of Analysis

12/3D/2050

File Name, Sample, Sample Loop Pressure (psi)	CO2 Sample RT	CO2 Sample Area	Co-Injected Peak RT	Co-Injected Peak AREA	RF	Conc. CO2 in Air (PPMV)	CO2 CONC. (ppmv)	Appraent Injection Vol. (uL)
1501231B.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 348.3	0.00	0	75281	39434	4.9E-09	17	0.0	0
		5.2E-09	78187	43705	4.7E-09	38		
			71039	9053		19		
1501238.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 370.3	0.00	0	78060	63831	4.7E-09	27	0.0	0
		5.2E-09	80755	51635	4.6E-09	44		
			71520	8217		18		
15012301.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 315.8	1.10	37109	79130	30796	4.7E-09	13	1.5	100
			76214	18208	4.9E-09	16		
			77524	10174	4.8E-09	22		
15012302.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 294	1.10	40966	80922	28475	4.6E-09	12	1.7	110
			81051	31331	4.6E-09	27		
			71731	7352		16	5.2E-09	
15012303.D - G1043, 1.6PPMV CO2&AR, 6.6PPMV N2&O2;HEATED 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 272.1	1.10	40010	82713	35006	4.5E-09	15	1.6	108
			77319	26063	4.8E-09	22		
			76935	5679	4.8E-09	12		
15012304.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 377	0.00	0	87869	45067	4.2E-09	19	0.0	
	5.8E-09		63453	33387		29		
			78156	5618	4.7E-09	12		
15012305.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 85	0.00	0	83816	49352	4.4E-09	21	0	
			77419	32133	4.8E-09	28		
			77019	6171	4.8E-09	13		
15012306.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 554	0.00	0	68556	43077		19	0	
	5.4E-09	5.1E-09	77754	22197	4.8E-09	19		
			73222	11745		25		
15012307.D - HY-01-1,15SIN002-01;HEATED;92BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 180.2	0.00	0	85684	47207	4.3E-09	20	0	
		5.3E-09	85452	38963	4.3E-09	34		
			70310	8426		18		
15012308.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 94.6	0.00	0	77512	44390	4.8E-09	19	0	
			81324	41459	4.6E-09	36		
			74624	17277	5.0E-09	37		
15012309.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 93.6	0.00	0	76329	29905	4.9E-09	13	0	
			84634	41418	4.4E-09	36		
			85820	6742	4.3E-09	15		
15012310.D - HY-02-1,15SIN002-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 180	0.00	0	51815	42212		18	0	
	7.1E-09		73582	45497		39		
	5.0E-09		82016	8936	4.5E-09	19		
15012311.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 367	0.00	0	83709	52511	4.4E-09	23	0.0	
			85795	40415	4.3E-09	35		
			80394	6975	4.6E-09	15		
15012312.D - HY-03-1,15SIN003-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 386	0.00	0	81696	77420	4.5E-09	33	0	
			84272	28754	4.4E-09	25		
			80202	8908	4.6E-09	19		
15012313.D - HY-03-1,15SIN003-01;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 170.3	0.00	0	94289	47310	3.9E-09	20	0	
			98082	16083	3.8E-09	14		
			93828	4388	3.9E-09	9		
15012314.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 387	0.00	0	90045	70737	4.1E-09	30	0.0	
			91734	29261	4.0E-09	25		
			88653	6515	4.2E-09	14		
15012315.D - HY-04-2,15SIN002-04#2;HEATED;85BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 201.3	0.00	0	86781	37071	4.3E-09	16	0	
			90444	20730	4.1E-09	18		
			84147	15632	4.4E-09	34		
15012316.D - HY-04-2,15SIN002-04#2;HEATED;85BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 193.4	0.00	0	93331	40458	4.0E-09	17	0	
			103456	24266	3.6E-09	21		
			97388	6615	3.8E-09	14		
15012317.D - HY-05-1,15SIN002-05;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 209	1.11	5266	99885	51630	3.7E-09	22	0.21	
			102292	16067	3.6E-09	14		
			101669	4745	3.6E-09	10		
15012318.D - HY-05-1,15SIN002-05;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 195	1.10	4718	95216	57888	3.9E-09	25	0.19	
			90015	24318	4.1E-09	21		
			93509	5631	4.0E-09	12		
15012319.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 373	0.00	0	82335	58840	4.5E-09	25	0.0	
			97414	16943	3.8E-09	15		
			94702	5363	3.9E-09	12		
15012320.D - HY-06-1,15SIN002-06;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 299	1.10	11012	84601	47925	4.4E-09	21	0.45	
			105517	19082	3.5E-09	16		
			91071	5721	4.1E-09	12		
15012321.D - HY-06-1,15SIN002-06;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 261	1.12	10139	99416	49539	3.7E-09	21	0.41	
			97618	49797	3.8E-09	43		
			100074	7192	3.7E-09	15		
15012322.D - HY-07-1,15SIN002-07;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 197.8	0.00	0	110468	46723	3.4E-09	20	0	
			111692	14153	3.3E-09	12		
			100398	6964	3.7E-09	15		
15012323.D - HY-07-1,15SIN002-07;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 184.8	0.00	0	90988	28939	4.1E-09	12	0	
			104000	21311	3.6E-09	18		
			79718	11301	4.6E-09	24		
15012324.D - PRAXAIR UHP H2;HEATED;OT=50C 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 349.6	0.00	0	105251	20715	3.5E-09	9	0	
			72348	14134	5.1E-09	12		
			89912	6209	4.1E-09	13		
15012325.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 863	0.00	0	72417	35638		15	0	
	5.1E-09		77168	27275	4.8E-09	23		
			74924	8079	4.9E-09	17		
15012326.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 155.3	0.00	0	84681	104235	4.4E-09	45	0	
			69087	21393		18		
	5.4E-09		75823	6374	4.9E-09	14		
15012327.D - HY-08-1,15SIN002-08;HEATED;110BAR 3 10UL G1042 0.99% N2&O2, 0.247;F2ML;ES0.02 165	0.00	0	79487	43941	4.7E-09	19	0	
		8.7E-09	77204	27493	4.8E-09	24		
			42712	12574		27		

Date: 01/25/2015 - File Name	Analytical Data Injection	8. CO Ret. Time (MIN) of CO Area of CO CO Response Factor or Conc in ppmv
001F0101.D	G0991,6.0PPMV CO & 4.8PPMV CH4 (SYSTEM:51MTORR) [1L:27TORR] [R20] [FCTV=32,TT@20=119SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=7.0,RP=38PSI)	8.493 450459 4.7E-07
001F0201.D	G0900,0.24PPMV CO & 0.20PPMV CH4 (SYSTEM:48MTORR) [1L:19TORR] [R20] [FCTV=23.2,TT@20=98SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=7.0,RP=38PSI)	8.512 36468 1.6E-07
001F0301.D	G0986,0.018PPMV CO & 0.014PPMV CH4 (SYSTEM:44MTORR) [1L:14TORR] [R20] [FCTV=19.4,TT@20=151SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.5,RP=38PSI)	8.547 1474 2.2E-07
001F0401.D	H2 FOR G983& G0986 (SYSTEM:40MTORR) [1L:41TORR] [R20] [FCTV=54.3,TT@20=291SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.5,RP=38PSI)	8.549 1391 0.0049
001F0501.D	15SUN035,1/14/15,9:30AM,65F,R150119 (SYSTEM:37MTORR) [1L:21TORR] [R20] [FCTV=30,TT@20=98SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.5,RP=38PSI)	8.565 242 0.0017
001F0601.D	15SIN002-01,HY-01-1,R150119 (SYSTEM:40MTORR) [1L:157TORR] [R20] [FCTV=189,TT@20=603SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.6,RP=38PSI)	8.512 4258 0.0040
001F0701.D	15SIN002-02,HY-02-1,R150119 (SYSTEM:34MTORR) [1L:233TORR] [R20] [FCTV=272,TT@20=829SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.7,RP=38PSI)	8.504 5196 0.0033
001F0801.D	15SIN002-03,HY-03-2,R150119 (SYSTEM:34MTORR) [1L:240TORR] [R20] [FCTV=278.3,TT@20=861SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.7,RP=38PSI)	8.5 2474 0.0015
001F0901.D	15SIN002-04,HY-04-2,R150119 (SYSTEM:33MTORR) [1L:155TORR] [R20] [FCTV=183.8,TT@20=557SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.8,RP=38PSI)	8.517 703 0.00066
001F1001.D	15SIN002-05,HY-05-1,R150119 (SYSTEM:32MTORR) [1L:210TORR] [R20] [FCTV=245,TT@20=744SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.8,RP=38PSI)	8.503 1383 0.00096
001F1101.D	15SIN002-06,HY-06-1,R150119 (SYSTEM:38MTORR) [1L:203TORR] [R20] [FCTV=237.4,TT@20=708SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.7,RP=38PSI)	8.503 5173 0.00371
001F1201.D	15SIN002-07,HY-07-1,R150119 (SYSTEM:33MTORR) [1L:187TORR] [R20] [FCTV=221,TT@20=675SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.6,RP=38PSI)	8.517 1739 0.00136
001F1301.D	15SIN002-08,HY-08-1,R150119 (SYSTEM:31MTORR) [1L:118TORR] [R20] [FCTV=141,TT@20=640SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.6,RP=38PSI)	8.535 1230 0.00152
001F1401.D	G0900,0.24PPMV CO & 0.20PPMV CH4 (SYSTEM:34MTORR) [1L:20TORR] [R20] [FCTV=27,TT@20=82SC]] (AT=765.4)(OT=80C)(5TH 2M GS TRAP IN LIQ. N2)(CF=6.6,RP=38PSI)	8.511 33975 1.8E-07

11. HCOOH

Date of Analysis

02/01/2015

FILE NAME	Injection	Volume of Hydrogen (mL)	Volume Injected (uL) of HCOOH Standard @ 5600.00%	Volume of HCOOH (uL) Injected in Standard & Spike Analysis	RET TIME OF HCOOH PEAK 1	AREAT OF HCOOH_PEAK 1	RET TIME OF HCOOH PEAK 2	AREAT OF HCOOH_PEAK 2	Response Factor of Sample Conc in ppmv, Spike Recovery	HCOOH Spiking Concentration (ppmv)
001F0101.D	44UL G1048 (56PPMV HCOOH IN H2). H2O. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=150C. N MODE.PS:MEDDLE. PUMP=FAST. OT=80C.LIQ.N2. DB BY H2O.	500	44	0.0025	0.149	308221	0.237	46977	6.9E-09	
001F0201.D	44UL G1048 (56PPMV HCOOH IN H2)+500ML 14CSU007-01#6. H2O. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=200C. N MODE.PS:MEDDLE. PUMP=FAST. OT=80C.LIQ.N2. DB BYH2O.	500	44	0.0025	0.148	90551	0.269	31042	2.0E-08	0.005
001F0301.D	500ML 14CSU007-01#6. H2O. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=150C. NMODE.PS:MEDDLE. PUMP=FAST. OT=80C.LIQ.N2. DB BY H2O.	500			0.143	1253	0.227	3362	0.00019	
001F0401.D	500ML 15SIN002-01.HY-01-1.R150119. H2O. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=150C. N MODE.PS:MEDDLE. PUMP=FAST. OT=80C.LIQ.N2. DB BY H2O.	500			0.133	1103	0.219	2463	0.000063	
001F0501.D	44UL G1048 (56PPMV HCOOH IN H2)+500ML 15SIN002-01.HY-01-1.R150119. H2O. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=150C. N MODE.PS:MEDDLE. PUMP=FAST. OT=80C.LIQ.N2. DB BY H2O.	500	44	0.0025	0.124	227938	0.257	48767	8.9E-09	0.005
001F0601.D	500ML 15SIN002-02.HY-02-1.R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.071	92392	0.259	0	0.00078	
001F0701.D	44UL G1048 (56PPMV HCOOH IN H2)+500ML 15SIN002-02.HY-02-1.R150119. N-PROPANOL.CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	44	0.0025	0.063	558852	0.259	22681	4.2E-09	0.005
001F0801.D	500ML 15SIN002-03.HY-03-2.R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500					0.272	34603	0.00042	
001F0901.D	44UL G1048 (56PPMV HCOOH IN H2)+500ML 15SIN002-03.HY-03-2.R150119. N-PROPANOL.CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	44	0.0025			0.281	410410	6.0E-09	0.005
001F1001.D	500ML 15SIN002-04.HY-04-2.R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.176	1127	0.317	0	0.000011	
001F1101.D	44UL G1048 (56PPMV HCOOH IN H2)+500ML 15SIN002-04.HY-04-2.R150119. N-PROPANOL.CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	44	0.0025	0.158	227268	0.317	287240	4.8E-09	0.005
001F1201.D	500ML 15SIN002-05.HY-05-1.R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.129	1052	0.246	1117	0.000012	
001F1301.D	44UL G1048 (56PPMV HCOOH IN H2)+500ML 15SIN002-05.HY-05-1.R150119. N-PROPANOL.CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	44	0.0025	0.124	345055	0.267	547248	2.8E-09	0.005
001F1401.D	500ML 15SIN002-06.HY-06-1.R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.131	0	0.318	0	0	
001F1501.D	44UL G1048 (56PPMV HCOOH IN H2)+500ML 15SIN002-06.HY-06-1.R150119. N-PROPANOL.CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	44	0.0025	0.131	21499	0.318	46152	3.6E-08	0.005
001F1601.D	500ML 15SIN002-07.HY-07-1.R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.134	0	0.311	2759	0.000025	
001F1701.D	44UL G1048 (56PPMV HCOOH IN H2)+500ML 15SIN002-07.HY-07-1.R150119. N-PROPANOL.CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	44	0.0025	0.134	535258	0.316	6221	4.6E-09	0.005
001F1801.D	500ML 15SIN002-08.HY-08-1.R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.14	0	0.313	1003	0.000076	
001F1901.D	44UL G1048 (56PPMV HCOOH IN H2)+500ML 15SIN002-08.HY-08-1.R150119. N-PROPANOL.CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=150C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	44	0.0025	0.14	497569	0.304	149086	3.8E-09	0.005

12. NH₃

Date of Analysis 01/28/2015

FILE NAME	Injection	H2 VOLUME (ML)	Volume Injected (uL) of NH3 Standard @ 5457 PPMV	Injected Standard Volume (uL)	RET TIME OF NH3	AREA OF NH3	Response Factor or Sample Conc in ppmv, Spike Recovery	NH3 Spiking Concentration (ppmv)
001F0301.D	0.1UL G0929 (5457 PPMV NH3 IN H2)+500ML 15SIN002-01, HY-01-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500	0.1	0.0005457	0.236	491931	1.1E-09	0.001
001F0501.D	500ML 15SIN002-01, HY-01-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500			0.176	4991	0.000011	
001F0601.D	500ML 15SIN002-02, HY-02-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500			0.222	109104	0.000213	
001F0801.D	0.1UL G0929 (5457 PPMV NH3 IN H2)+500ML 15SIN002-02, HY-02-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500	0.1	0.0005457	0.176	559816	9.7E-10	0.001
001F0901.D	500ML 15SIN002-02, HY-02-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500			0.205	91602	0.000179	
001F1201.D	0.1UL G0929 (5457 PPMV NH3 IN H2)+500ML 15SIN002-03, HY-03-2, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500	0.1	0.0005457	0.229	268927	2.0E-09	0.001
001F1301.D	500ML 15SIN002-03, HY-03-2, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500			0.162	27189	0.000110	
001F1401.D	500ML 15SIN002-04, HY-04-2, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500			0.183	50994	0.000248	
001F1501.D	0.1UL G0929 (5457 PPMV NH3 IN H2)+500ML 15SIN002-04, HY-04-2, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500	0.1	0.0005457	0.204	224378	2.4E-09	0.001
001F1601.D	500ML 15SIN002-05, HY-05-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500			0.139	1726	0.000008	
001F1701.D	0.1UL G0929 (5457 PPMV NH3 IN H2)+500ML 15SIN002-05, HY-05-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500	0.1	0.0005457	0.169	245979	2.2E-09	0.001
001F1901.D	500ML 15SIN002-06, HY-06-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500			0.185	3079	0.000024	
001F2001.D	0.1UL G0929 (5457 PPMV NH3 IN H2)+500ML 15SIN002-06, HY-06-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500	0.1	0.0005457	0.201	139421	3.9E-09	0.001
001F2101.D	500ML 15SIN002-07, HY-07-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500			0.143	2861	0.000019	
001F2201.D	0.1UL G0929 (5457 PPMV NH3 IN H2)+500ML 15SIN002-07, HY-07-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500	0.1	0.0005457	0.175	166438	3.3E-09	0.001
001F2301.D	500ML 15SIN002-08, HY-08-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500			0.15	2741	0.000036	
001F2401.D	0.1UL G0929 (5457 PPMV NH3 IN H2)+500ML 15SIN002-08, HY-08-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500	0.1	0.0005457	0.201	82713	6.6E-09	0.001
001F2501.D	500ML 15SUN035-01, 1/14/15, 9:30AM, 65F, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500			0.156	5932	0.000042	
001F2601.D	0.1UL G0929 (5457 PPMV NH3 IN H2)+500ML 15SUN035-01, 1/14/15, 9:30AM, 65F, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=200C. H MODE. PS: MEDDLE. OT=80C.	500	0.1	0.0005457	0.198	155002	3.5E-09	0.001

13.1 Cl₂

Date of Analysis 01/29/2015

FILE NAME	Injection	Volume of Hydrogen (mL)	Volume Injected (uL) of Cl ₂ Standard @ 5000.0 PPMV	Volume of Cl ₂ (uL) Injected in Standard & Spike Analysis	RET TIME OF Cl ₂	AREA OF Cl ₂	Response Factor or <i>Sample Conc in ppmv, Spike Recovery</i>	Cl ₂ Spiking Concentration (ppmv)
001F0101.D	500ML 15LIN006-01#2. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.	500			0.437	457979	1.5E-04	
001F0201.D	0.1UL G1022(5000PPMV CL2 IN N2)+500ML 15LIN006-01#2. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.	500	0.1	0.0005	0.416	3565580	1.6E-10	0.001
001F0301.D	500ML 15SIN002-01, HY-01-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.37	477397	1.9E-04	
001F0401.D	0.1UL G1022(5000PPMV CL2 IN N2)+500ML 15SIN002-01, HY-01-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.1	0.0005	0.395	2448600	2.0E-10	0.001
001F0501.D	500ML 15SIN002-02, HY-02-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.331	28952	3.3E-04	
001F0601.D	0.1UL G1022(5000PPMV CL2 IN N2)+500ML 15SIN002-02, HY-02-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.1	0.0005	0.362	88671	5.6E-09	0.001
001F0701.D	500ML 15SIN002-03, HY-03-2, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.351	33219	2.1E-05	
001F0901.D	0.1UL G1022(5000PPMV CL2 IN N2)+500ML 15SIN002-03, HY-03-2, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.1	0.0005	0.324	1614530	3.1E-10	0.001
001F1001.D	500ML 15SIN002-04, HY-04-2, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.345	176720	2.0E-04	
001F1101.D	0.1UL G1022(5000PPMV CL2 IN N2)+500ML 15SIN002-04, HY-04-2, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.1	0.0005	0.403	868467	5.8E-10	0.001
001F1201.D	500ML 15SIN002-05, HY-05-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.36	311474	1.5E-04	
001F1301.D	0.1UL G1022(5000PPMV CL2 IN N2)+500ML 15SIN002-05, HY-05-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.1	0.0005	0.391	2066300	2.4E-10	0.001
001F1401.D	500ML 15SIN002-06, HY-06-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.359	177600	2.2E-04	
001F1501.D	0.1UL G1022(5000PPMV CL2 IN N2)+500ML 15SIN002-06, HY-06-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.1	0.0005	0.371	815557	6.1E-10	0.001
001F1601.D	500ML 15SIN002-07, HY-07-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.365	249825	2.0E-04	
001F1701.D	0.1UL G1022(5000PPMV CL2 IN N2)+500ML 15SIN002-07, HY-07-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.1	0.0005	0.352	1241510	4.0E-10	0.001
001F1801.D	500ML 15SIN002-08, HY-08-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.468	283343	3.7E-04	
001F1901.D	0.1UL G1022(5000PPMV CL2 IN N2)+500ML 15SIN002-08, HY-08-1, R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.1	0.0005	0.361	769268	6.5E-10	0.001

13.2 HCl

Date of Analysis 01/28/2015

FILE NAME	Injection	Volume of Hydrogen (mL)	Volume Injected (uL) of HCl Standard @ 0 PPMV	Volume of HCl (uL) Injected in Standard & Spike Analysis	RET TIME OF HCl	HEIGHT OF HCl	Response Factor or Sample Conc in ppmv, Spike Recovery	HCl Spiking Concentration (ppmv)
001F0101.D	500ML 15SIN002-01, HY-01-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500			0.133	5.85E+03	0.00001	
001F0201.D	0.06UL G1025 (5.7% HCL IN H2)+500ML 15SIN002-01, HY-01-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500	0.06	0.00342	0.127	2.86E+06	1.2E-09	0.007
001F0301.D	500ML 15SIN002-02, HY-02-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500			0.142	5.31E+05	0.00245	
001F0401.D	0.04UL G1025 (5.7% HCL IN H2)+500ML 15SIN002-02, HY-02-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500	0.04	0.00228	0.139	9.87E+05	2.3E-09	0.005
001F0501.D	500ML 15SIN002-03, HY-03-2, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500			0.189	8.41E+04	0.00008	
001F0801.D	0.04UL G1025 (5.7% HCL IN H2)+500ML 15SIN002-03, HY-03-2, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500	0.04	0.00228	0.129	4.93E+06	4.6E-10	0.005
001F0901.D	500ML 15SIN002-04, HY-04-2, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500			0.203	8.39E+04	0.00027	
001F1001.D	0.04UL G1025 (5.7% HCL IN H2)+500ML 15SIN002-04, HY-04-2, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500	0.04	0.00228	0.125	1.41E+06	1.6E-09	0.005
001F1101.D	500ML 15SIN002-05, HY-05-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500			0.205	6.89E+04	0.00030	
001F1301.D	0.04UL G1025 (5.7% HCL IN H2). N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.		0.04	0.00228	0.084	1.90E+06	1.2E-09	
001F1401.D	0.04UL G1025 (5.7% HCL IN H2)+500ML 15SIN002-05, HY-05-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500	0.04	0.00228	0.122	1.05E+06	2.2E-09	0.005
001F1501.D	500ML 15SIN002-06, HY-06-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500			0.21	3.42E+04	0.00019	
001F1601.D	0.04UL G1025 (5.7% HCL IN H2)+500ML 15SIN002-06, HY-06-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500	0.04	0.00228	0.137	8.32E+05	2.7E-09	0.005
001F1701.D	500ML 15SIN002-07, HY-07-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500			0.226	3.38E+04	0.00012	
001F1801.D	0.04UL G1025 (5.7% HCL IN H2)+500ML 15SIN002-07, HY-07-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500	0.04	0.00228	0.126	1.30E+06	1.7E-09	0.005
001F1901.D	500ML 15SIN002-08, HY-08-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1MSCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500			0.202	4.20E+04	0.00017	
001F2001.D	0.04UL G1025 (5.7% HCL IN H2)+500ML 15SIN002-08, HY-08-1, R150119. N-PROPANOL. CF=19.4ML/MIN. MUF=118ML/MIN. 1M SCCC036. INJT=250C. H MODE. PS: MEDDLE. OT=80C.	500	0.04	0.00228	0.124	1.69E+06	2.0E-09	0.005

13.3 HBr

Date of Analysis 01/29/2015

FILE NAME	Injection	Volume of Hydrogen (mL)	Volume Injected (uL) of HBr Standard	Volume of HBr (uL) Injected in Standard & Spike Analysis	RET TIME OF HBr	HEIGHT OF HBr	Response Factor or Sample Conc in ppmv, Spike Recovery	HBr Spiking Concentration (ppmv)
001F0601.D	500ML 15LIN006-01#2. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.415	2.87E+05	6.5E-05	
001F0701.D	1UL G1038 (0.33% HBR IN H2)+500ML 15LIN006-01#2. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	1	0.0033	0.482	2.90E+07	1.1E-10	0.0066
001F0801.D	500ML 15SIN002-01.HY-01-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.454	1.20E+06	1.1E-03	
001F1001.D	0.5UL G1038 (0.33% HBR IN H2)+500ML 15SIN002-01.HY-01-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.5	0.00165	0.38	3.48E+06	4.7E-10	0.0033
001F1201.D	500ML 15SIN002-02.HY-02-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.437	7.36E+04	8.9E-04	
001F1301.D	0.5UL G1038 (0.33% HBR IN H2)+500ML 15SIN002-02.HY-02-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.5	0.00165	0.304	2.74E+05	6.0E-09	0.0033
001F1501.D	500ML 15SIN002-03.HY-03-2,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.395	1.39E+04	3.3E-05	
001F1601.D	0.5UL G1038 (0.33% HBR IN H2)+500ML 15SIN002-03.HY-03-2,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.5	0.00165	0.33	1.37E+06	1.2E-09	0.0033
001F1701.D	500ML 15SIN002-04.HY-04-2,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.38	1.44E+05	3.6E-04	
001F1801.D	0.5UL G1038 (0.33% HBR IN H2)+500ML 15SIN002-04.HY-04-2,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.5	0.00165	0.387	1.31E+06	1.3E-09	0.0033
001F1901.D	500ML 15SIN002-05.HY-05-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.36	1.52E+05	1.9E-05	
001F2001.D	0.5UL G1038 (0.33% HBR IN H2)+500ML 15SIN002-05.HY-05-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.5	0.00165	0.38	2.66E+07	6.2E-11	0.0033
001F2101.D	500ML 15SIN002-06.HY-06-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.421	5.39E+05	4.5E-04	
001F2201.D	500ML 15SIN002-06.HY-06-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.42	3.06E+05	2.5E-04	
001F2301.D	0.5UL G1038 (0.33% HBR IN H2)+500ML 15SIN002-06.HY-06-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.5	0.00165	0.396	3.98E+06	4.1E-10	0.0033
001F2401.D	500ML 15SIN002-07.HY-07-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.395	3.33E+05	2.9E-04	
001F2501.D	0.5UL G1038 (0.33% HBR IN H2)+500ML 15SIN002-07.HY-07-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.5	0.00165	0.358	3.79E+06	4.4E-10	0.0033
001F2601.D	500ML 15SIN002-08.HY-08-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFETUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500			0.411	2.77E+05	1.8E-05	
001F2701.D	0.5UL G1038 (0.33% HBR IN H2)+500ML 15SIN002-08.HY-08-1,R150119. N-PROPANOL. CF=25ML/MIN.MUF=98ML/MIN.-2M PTFE TUBING. INJT=250C.H MODE.PS:MEDDLE. OT=80C.LIQ.N2.DB BY H2O.	500	0.5	0.00165	0.411	5.11E+07	3.2E-11	0.0033