JSC TOXICOLOGY GROUP

Valerie Meyers, Ph.D., DABT
NASA JSC/SK4
Houston, TX 77058

Memorandum Number

TOX-VM-2014-04

Voice: (281) 483-4989
Fax: (281) 483-3058
valerie.e.meyers@nasa.gov

DATE: July 23, 2014

SUBJECT: Toxicological Assessment of ISS Air and Water Quality: November 10, 2013 – March 10, 2014 (Increment 38) and Orb-1 First Ingress

SUMMARY: Air quality was nominal on ISS for this period, and potable water remains acceptable for crew consumption.

AIR QUALITY

Twelve mini grab sample containers (mGSCs) were collected on ISS during Increment 38 and were returned on 36S. Of these, 11 were collected as routine monthly samples in the Russian Service Module (SM), US Laboratory (Lab), and either the Japanese Pressurized Module (JPM) or the Columbus module (Col), and 1 was collected during Orbital-1 (Orb-1) first ingress. Two pairs of passive-diffusion formaldehyde badges were also deployed in the US Lab or Russian Service Module (SM) and returned aboard 37S. A summary of the analytical results is provided in Table 1.

Table 1. Analytical Summary of ISS air analyses

Sample Location	Sample Date	NMVOCs[a] (mg/m^3)	Freon 218 (mg/m^3)	Alcohols[b] (mg/m^3)	T-Value[c] (units)	CO_2 (mg/m^3)	Formaldehyde ($\mu g/m^3$)
JPM	12/6/2013	7.9	3.0	4.5	0.47	9100	--
Lab	12/6/2013	7.7	3.9	4.3	0.47	10000	39
SM	12/6/2013	4.8	0.5	2.3	0.69	1700	26
Lab	1/5/2014	8.1	3.9	5.3	0.42	8100	46
Col	1/5/2014	7.6	3.2	5.1	0.38	8100	--
SM	1/5/2014	8.0	2.7	5.1	0.41	8000	31
Orb-1	1/12/2014	25	0.5	4.0	0.52[d] 2.2	3200	--
Lab	2/10/2014	7.9	3.3	4.0	0.49	8000	37
JPM	2/10/2014	8.5	1.6	4.5	0.51	8300	--
SM	2/10/2014	7.6	3.6	4.2	0.43	8200	28
Lab	3/3/2014	7.9	3.7	5.2	0.37	8100	24
SM	3/3/2014	8.0	3.2	5.6	0.34	8100	21
Guideline		*<25*	---	*<5*	*<1*[e]	*<9300*	*<120*

[a]Non-methane volatile organic hydrocarbons, excluding Freon 218
[b]Includes acetone
[c]Sum of the ratios of the measured concentration and the corresponding 180-day SMAC for each compound, excluding CO_2
[d]Value based on 7-day SMACs used for evaluating first ingress.
[e]T-value <1 used to evaluate routine monthly sampling; T-value <3 used to evaluate first ingress samples
NOTE: Data from the December SM mGSC sample are uncharacteristic of ISS air.

As noted in the table above, mGSC data from the SM sample collected on 6 December 2013 are not representative of ISS air, especially with regards to CO2 and Freon 218 levels, and are therefore suspect; however, we were unable to determine the source of the issue, as duplicate analysis confirmed the results, and the post-flight pressure test did not indicate a leak.

Complete data tables of all measured concentrations and corresponding T-values based on 180-day SMACs are enclosed. A separate data table containing T-values based on both the 7-day and 180-day SMACs is enclosed for the (Orb-1) first ingress sample. The detection limit for all target compounds, except m/p-xylenes and hexachloro-1,3-butadiene, was 0.025 mg/m^3. The detection limit for m/p-xylenes, hexachloro-1,3-butadiene, and all non-target compounds was 0.05 mg/m^3. The average recoveries of the 3 surrogate standards from the mGSCs, relative to the laboratory controls, were as follows: ^{13}C-acetone, 103 ± 6%; fluorobenzene-d_5, 99 ± 7%; and chlorobenzene-d_5, 93 ± 19%. For the passive-diffusion formaldehyde badges, positive control recoveries (1 trip and 2 lab controls) were 106%, 128%, and 105%, respectively.

The Air Quality Monitor (AQM) is now operational and certified for use in the US Lab, Columbus, and JEM. Two AQM units, with different gas chromatographic columns, operate simultaneously on the ISS to accurately measure the following target compounds: acetaldehyde, methanol, ethanol, acetone, 2-propanol, 1-butanol, ethyl acetate, dichloromethane, toluene, xylenes (m,p), xylene (o), 2-butanone, hexane, benzene, trimethylsilanol, hexanal, hexamethylcyclotrisiloxane, octamethylcyclotetrasiloxane, decamethylcyclopentasiloxane, propenal, and 1,2-dichloroethane. Table 2 provides the required AQM calibration ranges for the target compounds.

Table 2. AQM calibration ranges for target compounds

Compound	Concentration Range (mg/m^3)	
	Low	High
2-Propanol	0.1	4
Methanol	0.1	3
Acetone	0.1	4
1,2- Dichloroethane	0.1	2
Hexanal	0.1	3
Propenal (Acrolein)	0.03	0.5
Hexane	0.5	8
Benzene	0.1	4
Acetaldehyde	0.1	2
o-Xylene	0.1	1
Octamethylcyclotetrasiloxane (OMCTS)	0.2	3
Decamethylcyclopentasiloxane (DMCTS)*	0.2	3.5
Hexamethylcyclotrisiloxane (HMCTS)	0.2	2
Ethanol	0.5	7
n-Butanol*	0.1	3
Trimethylsilanol*	0.2	6
Ethyl Acetate	0.1	4
Toluene	0.1	4
Dichloromethane	0.1	4
m, p-Xylenes	0.1	2
2-Butanone	0.1	4

*These compounds did not meet validation criteria but reported data are consistently conservative compared to the mGSCs. Results for these compounds are utilized in crew health risk assessment with these caveats.

The AQM units have automated sampling sessions scheduled every 73 hours, resulting in 2-3 run sessions per week. Data are transferred to the ground weekly. Monthly average concentrations for Increment 38 are presented in Table 3.

Table 3. Average monthly concentrations (mg/m^3) of AQM target compounds

	November	December	January	February	March	Increment Average
2-Propanol	0.15	0.17	0.31	0.16	0.14	0.19
Methanol	0.39	0.39	0.4	0.41	0.38	0.39
Acetone	0.22	0.24	0.30	0.23	0.20	0.24
1,2-Dichloroethane	ND	ND	Trace	Trace	ND	ND
Hexanal	ND	ND	ND	ND	ND	ND
Acrolein	ND	ND	ND	ND	ND	ND
Hexane	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND
Acetaldehyde	0.13	0.12	0.13	0.15	0.13	0.13
o-Xylene	0.07	0.11	0.07	0.09	0.06	0.08
OMCTS	Trace	Trace	Trace	Trace	Trace	Trace
DMCPS	2.9	2.3	2.3	2.1	2.2	2.4
HMCTS	2.3	2.1	2.2	1.9	1.8	2.1
Ethanol	2.2	2.2	2.7	1.8	3.3	2.4
n-Butanol	0.16	0.19	0.17	0.14	0.12	0.16
Trimethylsilanol	0.27	0.29	0.32	0.31	0.28	0.29
Ethyl Acetate	Trace	Trace	Trace	0.19	0.07	0.07
Toluene	Trace	Trace	Trace	Trace	Trace	Trace
Dichloromethane	0.05	0.05	0.05	0.05	0.05	0.05
m-p Xylenes	Trace	Trace	Trace	Trace	ND	Trace
2-butanone	Trace	Trace	Trace	Trace	Trace	Trace

Toxicological Evaluation of ISS Air Quality: Routine monthly sampling provides a very limited set of samples on which to perform an air quality assessment, but is complimentary to in-flight air monitoring data collected by the air quality monitor (AQM). Increment T-values from mGSCs (Table 1 and Figure 1) and the AQM (Figure 2) correlate well, with average total values between 0.4 – 0.5. All values are well below 1 and indicate there is no concern for crew health. Primary contributors to the total T-value across all routine GSC sampling locations throughout this time period were hexamethylcyclotrisiloxane, trimethylsilanol, and decamethylcyclopentasiloxane. These compounds were measured well below levels of health concern but may contribute to periodic accumulation of siloxanes in the water recovery system (see Water Quality section below).

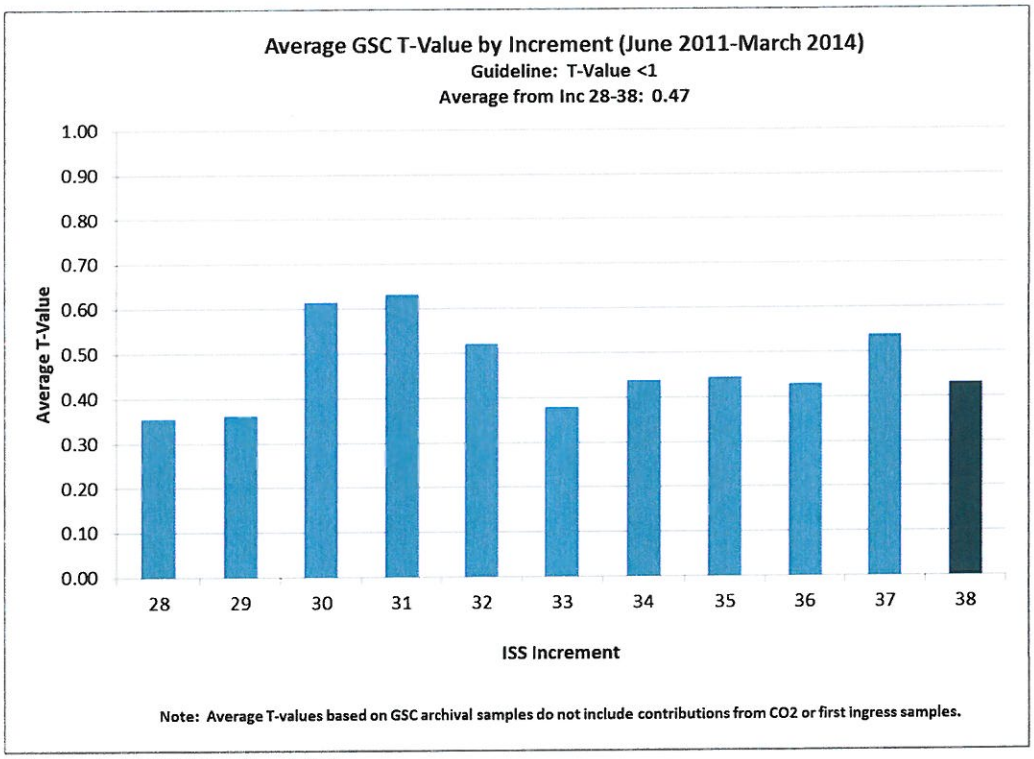

Figure 1. GSC T-value table

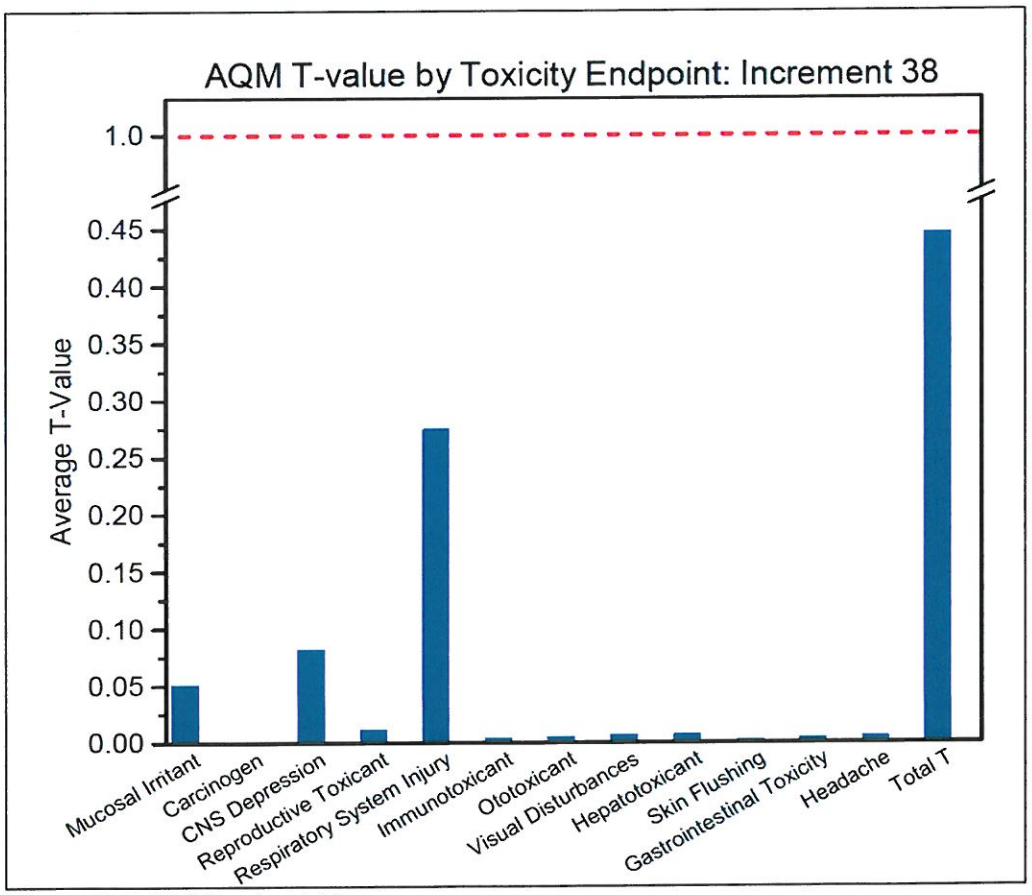

Figure 2. AQM T-value table

Formaldehyde levels in the US Lab (shown in Table 1) are consistent with historical levels. Concentrations in the Russian SM are generally lower than the US, but all levels are well below the SMAC of 120 $\mu g/m^3$. Alcohol values in some routine monthly mGSC samples slightly exceeded the alcohol guideline of <5 mg/m^3, which is intended to protect the water recovery system from risk of overloading. The mGSCs provide only a snapshot of conditions and are not ideal for evaluating potential CO_2 exposures; however, reported levels were elevated in the December 2013 samples (near or exceeding 4 mmHg or 9300 mg/m^3). During this timeframe, the Node 3 CDRA had sorbent bed clogging issues and temperature sensor faults that interrupted CO_2 scrubbing. The amine swingbed was utilized periodically to reduce CO_2 levels until maintenance was performed to address these issues. Levels returned to nominal levels for the remainder of the Increment.

The CO_2 and Freon 218 levels measured in the Orb-1 first ingress sample indicate that some mixing occurred with the ISS atmosphere prior to sample collection. The measured T-value of 0.52 based on 7-day SMACs at Orb-D1 first ingress was well below levels of concern for crew health. The predicted value based on the pre-flight off-gas test data was 1.1. This values accounts for the 9 days (actual) that passed between final pre-launch hatch closure and hatch opening on orbit, the measured offgassing rate of 0.085 T-units per day and the 68% of cargo loaded at the time of the test (9 days x 0.085 T-units/0.68). The predicted value is substantially more conservative than the measured value at first ingress, but the test accurately predicted the primary contributors to the total T-value, which were hexamethylcyclo-trisiloxane, trimethylsilanol, and acetaldehyde. The only off-gas contributor identified in the preflight off-gas test that was not identified in the first ingress sample was fluorotrimethylsilane. The total NMVOCs in the first entry sample equaled the 25 mg/m^3 guideline, so odors may have been noted, but all compounds were well below their individual health-based values.

WATER QUALITY

Archive samples were collected from the potable water dispenser (PWD) in the US Lab and the SVO-ZV and the SRV-K systems in the Russian segment during Increment 37 and were returned on 35S. A summary of the analytical results from those samples is provided in Table 2. Complete data tables for the water analyses are found in analytical chemistry report #2014-WFL-ISSWQ-003.1.

Table 4. Analytical Summary of ISS water analyses

Sample Location	Sample Date	TOC (mg/L)	DMSD (mg/L)	Conductivity (µS/cm)	Total Iodine (mg/L)	Total Silver (µg/L)
PWD (ambient)	2/3/2014	<0.10	<0.5	2	<0.05	--
PWD (hot)	2/24/2014	0.13	<0.5	2	<0.05	--
SVO-ZV	2/24/2014	1.1	<0.5	480[a]	--	98
SRV-K	2/24/2014	0.47	<0.5	179[a]	--	11
Guideline		*<3*	*<35*	--	*<0.2*	*>100*

[a]Russian water system is intentionally mineralized.

Toxicological Evaluation of ISS Water Quality: Routine monthly sampling provides a very limited set of samples on which to perform a water quality assessment; however, data from archive samples are complimentary to in-flight monitoring data collected by the total organic carbon analyzer protoflight unit 2 (TOCA PFU2) and the colorimetric water quality monitor kit (CWQMK). Total organic carbon (TOC) trending data from in-flight and archival sampling of the US potable water system are shown in Figure 3. The TOC concentration in the WPA product water remained below the limit of detection (0.29 mg/L) during Increment 38.

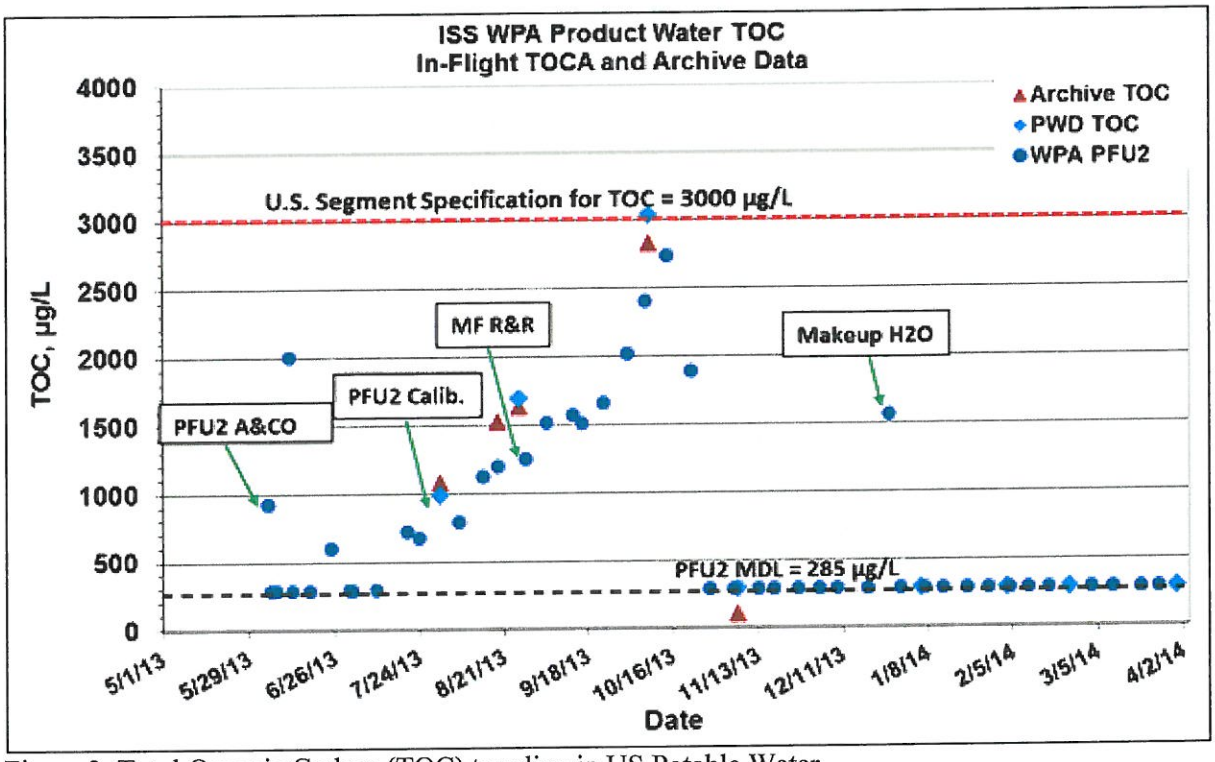

Figure 3. Total Organic Carbon (TOC) trending in US Potable Water

Conductivity provides an indirect measure of the amount of total inorganic contaminants. Inorganic levels in US water were very low, as expected. In the Russian segment, calcium, magnesium, and inorganic carbon levels in the SVO-ZV remain well above historic averages, but below levels of concern for crew health. Manganese levels (54 µg/L) in the SVO-ZV slightly exceeded the MORD limit of 50 µg/L but remained well below the US SWEG of 300 µg/L. No measured compounds exceeded MORD limits in the SRV-K sample. Iodine and silver are biocides used on the US and Russian segments, respectively. Iodine is added to the water produced by the WPA but is removed prior to crew consumption to avoid potential thyroid damage. Total iodine levels measured in the US water samples were below levels of concern for human consumption. Conversely, silver levels in Russian water samples are expected to remain above the minimal effective biocidal level of 100 µg/L. Levels in the SRV-K sample continue to decline and were well below this acceptable level, which increases the risk of microbial growth. Levels in the SVO-ZV were also slightly below the acceptable biocide limit. Additional information on the results from microbial analyses run on these samples can be obtained from the Soyuz 36 post-flight report issued by the Environmental Microbiology group.

Valerie Meyers

Valerie Meyers, Ph.D., DABT
NASA Toxicologist

7/23/14
Date

Enclosures
Table 1: Analytical concentrations of compounds found in the mGSCs returned on 36S
Table 2: T-values corresponding to analytical concentrations in Table 1, based on 180-day SMACs
Table 2A: T-values corresponding to the analytical concentrations in Table 1, based on 180-day and 7-day SMACs for Orb-1 first ingress

TABLE 1
ANALYTICAL RESULTS OF
36S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/M^3)											
	AA05686 S/N 2049 JPM 12/6/13 @ 14:42 GMT	AA05687 S/N 2043 LAB 12/6/13 @ 14:45 GMT	AA05688 S/N 2044 SM 12/6/13 @ 14:50 GMT	AA05689 S/N 2053 LAB 1/5/14 @ 14:35 GMT	AA05690 S/N 2042 COL 1/5/14 @ 14:37 GMT	AA05691 S/N 2054 SM 1/5/14 @ 14:39 GMT	AA05692 S/N 2056 ORB-1 INGRESS 1/12/14 @ 17:30 GMT	AA05693 S/N 2057 LAB 2/10/14 @ 11:52 GMT	AA05694 S/N 2066 JPM 2/10/14 @ 11:56 GMT	AA05695 S/N 2065 SM 2/10/14 @ 12:01 GMT	AA05696 S/N 2068 LAB 3/3/14 @ 14:24 GMT	AA05697 S/N 2062 SM 3/3/14 @ 14:27 GMT
TARGET COMPOUNDS (TO-15)												
FREON12	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CHLOROMETHANE	<0.025	<0.025	TRACE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
FREON114	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
METHANOL	0.39	0.39	0.19	0.42	0.38	0.37	0.35	0.38	0.39	0.39	0.34	0.34
ACETALDEHYDE	0.19	0.20	0.25	0.25	0.23	0.22	0.26	0.20	0.20	0.28	0.18	0.19
VINYLCHLORIDE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
BROMOMETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
ETHANOL *	**3.4**	**3.2**	0.80	**4.1**	**4.1**	**4.1**	1.3	**2.9**	**3.2**	**3.2**	**4.3**	**4.7**
CHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
ACETONITRILE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
PROPENAL	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
ACETONE	0.41	0.42	0.26	0.42	0.37	0.35	0.46	0.42	0.43	0.39	0.35	0.37
PROPANAL	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	0.039	TRACE	TRACE	TRACE	TRACE	TRACE
ISOPROPANOL	0.17	0.14	0.94	0.23	0.19	0.17	1.8	0.21	0.22	0.16	0.15	0.16
FREON11	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
FURAN	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
ACRYLONITRILE	TRACE	TRACE	<0.025	TRACE	TRACE	TRACE	<0.025	TRACE	TRACE	TRACE	TRACE	TRACE
PENTANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2-METHYL-2-PROPANOL	<0.025	<0.025	0.18	<0.025	<0.025	<0.025	0.048	<0.025	<0.025	TRACE	<0.025	<0.025
METHYLACETATE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	TRACE	0.088	0.089	0.10	TRACE	TRACE
1,1-DICHLOROETHENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
DICHLOROMETHANE	TRACE	TRACE	<0.025	TRACE	TRACE	TRACE	TRACE	<0.025	<0.025	<0.025	<0.025	<0.025
3-CHLOROPROPENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
FREON113	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
N-PROPANOL	0.040	0.060	TRACE	0.039	0.046	0.035	0.029	0.030	0.12	0.029	0.026	TRACE
1,1-DICHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
BUTANAL	<0.025	<0.025	TRACE	<0.025	<0.025	<0.025	TRACE	<0.025	<0.025	<0.025	<0.025	<0.025
2-BUTANONE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	1.2	TRACE	TRACE	TRACE	TRACE	TRACE
CIS-1,2-DICHLOROETHENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2-METHYLFURAN	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
ETHYLACETATE	0.029	0.027	TRACE	0.031	0.026	0.029	0.067	0.22	0.23	0.24	0.036	0.038
HEXANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CHLOROFORM	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2-BUTENAL	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
1,2-DICHLOROETHANE	TRACE	TRACE	<0.025	0.027	TRACE	TRACE	<0.025	TRACE	TRACE	TRACE	TRACE	TRACE
1,1,1-TRICHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
N-BUTANOL	0.070	0.078	0.047	0.071	0.066	0.064	0.053	0.060	0.13	0.063	0.043	0.045
BENZENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CARBONTETRACHLORIDE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2-PENTANONE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2-METHYLHEXANE	TRACE	TRACE	<0.025	<0.025	<0.025	<0.025	TRACE	TRACE	TRACE	TRACE	<0.025	<0.025
2,3-DIMETHYLPENTANE	TRACE	TRACE	<0.025	<0.025	<0.025	<0.025	<0.025	TRACE	TRACE	TRACE	<0.025	<0.025
PENTANAL	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
3-METHYLHEXANE	0.049	0.049	TRACE	TRACE	TRACE	TRACE	0.029	0.047	0.049	0.051	<0.025	TRACE
1,2-DICHLOROPROPANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
1,4-DIOXANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
TRICHLOROETHENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2,5-DIMETHYLFURAN	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
N-HEPTANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	TRACE	TRACE	TRACE	<0.025	<0.025
4-METHYL2-PENTANONE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	TRACE	<0.025	<0.025	<0.025	<0.025	<0.025
CIS-1,3-DICHLOROPROPENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2-PENTENAL	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
TRANS-1,3-DICHLOROPROPENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
1,1,2-TRICHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
TOLUENE	TRACE	TRACE	<0.025	TRACE	TRACE	TRACE	0.11	<0.025	TRACE	TRACE	<0.025	<0.025
HEXANAL	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
MESITYLOXIDE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
1,2-DIBROMOETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
BUTYLACETATE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
OCTANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
TETRACHLOROETHENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CHLOROBENZENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
ETHYLBENZENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
M/P-XYLENES	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.061	<0.050	<0.050	<0.050	<0.050	<0.050
2-HEPTANONE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CYCLOHEXANONE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
HEPTANAL	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
STYRENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
1,1,2,2-TETRACHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
O-XYLENE	0.045	0.047	<0.025	0.032	0.028	0.032	0.028	0.062	0.060	0.072	0.026	0.028
NONANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
1,3,5-TRIMETHYLBENZENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
1,2,4-TRIMETHYLBENZENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
1,3-DICHLOROBENZENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
1,4-DICHLOROBENZENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
1,2-DICHLOROBENZENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
1,2,4-TRICHLOROBENZENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
HEXACHLORO-1,3-BUTADIENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

TABLE 1
ANALYTICAL RESULTS OF
36S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/M^3)											
	AA05686 S/N 2049 JPM 12/6/13 @ 14:42 GMT	AA05687 S/N 2043 LAB 12/6/13 @ 14:45 GMT	AA05688 S/N 2044 SM 12/6/13 @ 14:50 GMT	AA05689 S/N 2053 LAB 1/5/14 @ 14:35 GMT	AA05690 S/N 2042 COL 1/5/14 @ 14:37 GMT	AA05691 S/N 2054 SM 1/5/14 @ 14:39 GMT	AA05692 S/N 2056 ORB-1 INGRESS 1/12/14 @ 17:30 GMT	AA05693 S/N 2057 LAB 2/10/14 @ 11:52 GMT	AA05694 S/N 2066 JPM 2/10/14 @ 11:56 GMT	AA05695 S/N 2065 SM 2/10/14 @ 12:01 GMT	AA05696 S/N 2068 LAB 3/3/14 @ 14:24 GMT	AA05697 S/N 2062 SM 3/3/14 @ 14:27 GMT
SPECIAL INTEREST COMPOUNDS **												
1,3-BUTADIENE &	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
ETHYLENE OXIDE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-METHYL-2-PROPENAL	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
3-BUTEN-2-ONE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-ETHOXYETHANOL	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
DIMETHYL DISULFIDE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
OCTAFLUOROPROPANE &	3.0	3.9	0.47	3.9	3.2	2.7	0.50	3.3	1.6	3.6	3.7	3.2
PERFLUORO-2-METHYLPENTANE &	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
CARBONYL SULFIDE &	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	0.031	TRACE	TRACE	TRACE	TRACE	TRACE
ISOBUTANE &	<0.025	<0.025	0.17	TRACE	<0.025	TRACE	0.059	TRACE	<0.025	<0.025	<0.025	<0.025
2-METHYL-1-PROPENE &	TRACE	TRACE	0.077	TRACE	TRACE	TRACE	0.071	TRACE	TRACE	TRACE	TRACE	TRACE
DIMETHYL SULFIDE &	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CARBON DISULFIDE &	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	0.031	TRACE	TRACE	<0.025	TRACE	TRACE
TRIMETHYLSILANOL &	0.17	0.16	1.1	0.17	0.16	0.12	0.51	0.15	0.17	0.12	0.13	0.11
OCTAMETHYLCYCLOTETRASILOXANE &	<0.075	<0.075	<0.075	0.11	TRACE	<0.075	0.15	<0.075	<0.075	<0.075	<0.075	<0.075
DECAMETHYLCYCLOPENTASILOXANE &	0.58	0.58	<0.10	0.39	0.36	0.38	0.19	0.52	0.49	0.36	0.40	0.36
HEXAMETHYLCYCLOTRISILOXANE %	2.1	2.0	0.53	1.7	1.4	1.9	16	2.2	2.3	1.7	1.6	1.3
NON-TARGET COMPOUNDS **												
PROPENE &	<0.050	<0.050	TRACE	<0.050	<0.050	<0.050	TRACE	<0.050	<0.050	<0.050	<0.050	<0.050
PROPANE &	TRACE	TRACE	TRACE	<0.050	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
BUTANE &	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
ISOPRENE &	0.052	0.061	<0.050	<0.050	TRACE	TRACE	<0.050	0.050	0.051	TRACE	0.066	0.051
SULFURHEXAFLUORIDE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,1,2-TETRAFLUOROETHANE	0.051	0.057	<0.050	0.057	0.054	0.053	0.54	0.068	0.060	0.067	0.088	0.070
1,1-DIFLUOROETHANE	<0.050	<0.050	0.056	<0.050	<0.050	<0.050	0.089	<0.050	<0.050	<0.050	<0.050	<0.050
CARBONICACID,DIMETHYLESTER	TRACE	TRACE	<0.050	TRACE	TRACE	TRACE	0.10	TRACE	TRACE	TRACE	TRACE	<0.050
C7-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
C12-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.083	<0.050	<0.050	<0.050	<0.050	<0.050
C12-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.22	<0.050	<0.050	<0.050	<0.050	<0.050
C12-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.16	<0.050	<0.050	<0.050	<0.050	<0.050
C12-ALKANE	<0.050	<0.050	0.053	<0.050	<0.050	<0.050	0.23	<0.050	<0.050	<0.050	<0.050	<0.050
LIMONENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.080	0.090	0.060	0.19	TRACE	TRACE
C12-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.17	<0.050	<0.050	<0.050	<0.050	<0.050
C12-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.19	<0.050	<0.050	<0.050	<0.050	<0.050
C12-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.065	<0.050	<0.050	<0.050	<0.050	<0.050
TOTAL ALCOHOLS PLUS ACETONE	**4.5**	**4.3**	**2.3**	**5.3**	**5.1**	**5.1**	**4.0**	**4.0**	**4.5**	**4.2**	**5.2**	**5.6**
TARGET COMPOUNDS (GC)												
CARBON MONOXIDE	0.48	0.51	4.6	0.36	0.36	0.34	1.8	0.60	0.59	0.56	0.35	0.34
METHANE	3.1	3.1	2.0	4.0	4.1	3.9	1.6	4.3	4.4	4.5	4.7	4.7
HYDROGEN	6.8	6.7	1.7	7.1	7.4	7.1	1.4	6.7	6.9	6.9	5.4	5.7
CARBON DIOXIDE	9100	10000	1700	8100	8100	8000	3200	8000	8300	8200	8100	8100
TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	**11**	**12**	**5.2**	**12**	**11**	**11**	**25**	**11**	**10**	**11**	**12**	**11**
TOTAL CONCENTRATION - OFP (NON-METHANE HYDROCARBONS)	**7.9**	**7.7**	**4.8**	**8.1**	**7.6**	**8.0**	**25**	**7.9**	**8.5**	**7.6**	**7.9**	**8.0**

* GC/FID data results are in bold

** Quantified using "B" response factor except where noted

& Quantified using a multi-point calibration

% Response factor generated from an internal study

<: Value is less than the laboratory report detection limit.

TRACE: Amount detected is sufficient for compound identification only.

OFP - Octafluoropropane

TABLE 2
T-VALUES for SOYUZ 36S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)										
	AA05686 S/N 2049 JPM 12/6/13 @ 14:42 GMT	AA05687 S/N 2043 LAB 12/6/13 @ 14:45 GMT	AA05688 S/N 2044 SM 12/6/13 @ 14:50 GMT	AA05689 S/N 2053 LAB 1/5/14 @ 14:35 GMT	AA05690 S/N 2042 COL 1/5/14 @ 14:37 GMT	AA05691 S/N 2054 SM 1/5/14 @ 14:39 GMT	AA05693 S/N 2057 LAB 2/10/14 @ 11:52 GMT	AA05694 S/N 2066 JPM 2/10/14 @ 11:56 GMT	AA05695 S/N 2065 SM 2/10/14 @ 12:01 GMT	AA05696 S/N 2068 LAB 3/3/14 @ 14:24 GMT	AA05697 S/N 2062 SM 3/3/14 @ 14:27 GMT
TARGET COMPOUNDS (TO-15)											
FREON12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROMETHANE	ND	ND	0.00030	ND	ND	ND	ND	ND	ND	ND	ND
FREON114	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
METHANOL	0.00438	0.00434	0.00208	0.00465	0.00423	0.00411	0.00421	0.00435	0.00438	0.00380	0.00381
ACETALDEHYDE	0.04675	0.04964	0.06342	0.06206	0.05797	0.05449	0.04936	0.05103	0.06957	0.04597	0.04779
VINYLCHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BROMOMETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHANOL	0.00169	0.00160	0.00040	0.00204	0.00203	0.00203	0.00145	0.00162	0.00158	0.00214	0.00235
CHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ACETONITRILE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PROPENAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ACETONE	0.00792	0.00808	0.00499	0.00817	0.00712	0.00675	0.00807	0.00818	0.00748	0.00679	0.00703
PROPANAL	0.00114	0.00114	0.00114	0.00114	0.00114	0.00114	0.00114	0.00114	0.00114	0.00114	0.00114
ISOPROPANOL	0.00112	0.00090	0.00629	0.00152	0.00128	0.00111	0.00141	0.00144	0.00103	0.00099	0.00105
FREON11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FURAN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ACRYLONITRILE	0.00446	0.00446	ND	0.00446	0.00446	0.00446	0.00446	0.00446	0.00446	0.00446	0.00446
PENTANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-PROPANOL	ND	ND	0.00146	ND	ND	ND	ND	ND	0.00010	ND	ND
METHYLACETATE	ND	ND	ND	ND	ND	ND	0.00073	0.00074	0.00084	0.00010	0.00010
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DICHLOROMETHANE	0.00125	0.00125	ND	0.00125	0.00125	0.00125	ND	ND	ND	ND	ND
3-CHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FREON113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-PROPANOL	0.00041	0.00062	0.00013	0.00040	0.00047	0.00036	0.00031	0.00122	0.00030	0.00027	0.00013
1,1-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BUTANAL	ND	ND	0.00096	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTANONE	0.00042	0.00042	0.00042	0.00042	0.00042	0.00042	0.00042	0.00042	0.00042	0.00042	0.00042
CIS-1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLFURAN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLACETATE	0.00016	0.00015	0.00007	0.00017	0.00015	0.00016	0.00123	0.00127	0.00133	0.00020	0.00021
HEXANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTENAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROETHANE	0.00781	0.00781	ND	0.01664	0.00781	0.00781	0.00781	0.00781	0.00781	0.00781	0.00781
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-BUTANOL	0.00175	0.00195	0.00118	0.00178	0.00166	0.00160	0.00151	0.00336	0.00159	0.00109	0.00111
BENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBONTETRACHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-PENTANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEXANE	0.00104	0.00104	ND	ND	ND	ND	0.00104	0.00104	0.00104	ND	ND
2,3-DIMETHYLPENTANE	0.00104	0.00104	ND	ND	ND	ND	0.00104	0.00104	0.00104	ND	ND
PENTANAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEXANE	0.00407	0.00409	0.00104	0.00104	0.00104	0.00104	0.00389	0.00411	0.00421	ND	0.00104
1,2-DICHLOROPROPANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIOXANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLFURAN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-HEPTANE	ND	ND	ND	ND	ND	ND	0.00104	0.00104	0.00104	ND	ND
4-METHYL2-PENTANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-PENTENAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TOLUENE	0.00083	0.00083	ND	0.00083	0.00083	0.00083	ND	0.00083	0.00083	ND	ND
HEXANAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MESITYLOXIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DIBROMOETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BUTYLACETATE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M/P-XYLENES	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-HEPTANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HEPTANAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
STYRENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
O-XYLENE	0.00122	0.00126	ND	0.00087	0.00076	0.00088	0.00167	0.00161	0.00195	0.00070	0.00076
NONANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HEXACHLORO-1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 2
T-VALUES for SOYUZ 36S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)										
	AA05686 S/N 2049 JPM 12/6/13 @ 14:42 GMT	AA05687 S/N 2043 LAB 12/6/13 @ 14:45 GMT	AA05688 S/N 2044 SM 12/6/13 @ 14:50 GMT	AA05689 S/N 2053 LAB 1/5/14 @ 14:35 GMT	AA05690 S/N 2042 COL 1/5/14 @ 14:37 GMT	AA05691 S/N 2054 SM 1/5/14 @ 14:39 GMT	AA05693 S/N 2057 LAB 2/10/14 @ 11:52 GMT	AA05694 S/N 2066 JPM 2/10/14 @ 11:56 GMT	AA05695 S/N 2065 SM 2/10/14 @ 12:01 GMT	AA05696 S/N 2068 LAB 3/3/14 @ 14:24 GMT	AA05697 S/N 2062 SM 3/3/14 @ 14:27 GMT
SPECIAL INTEREST COMPOUNDS											
1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLENE OXIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-PROPENAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-BUTEN-2-ONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-ETHOXYETHANOL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DIMETHYL DISULFIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTAFLUOROPROPANE	0.00004	0.00005	0.00001	0.00005	0.00004	0.00003	0.00004	0.00002	0.00004	0.00004	0.00004
PERFLUORO-2-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBONYL SULFIDE	0.00104	0.00104	0.00104	0.00104	0.00104	0.00104	0.00104	0.00104	0.00104	0.00104	0.00104167
ISOBUTANE	ND	ND	0.00071	0.00005	ND	0.00005	0.00005	ND	ND	ND	ND
2-METHYL-1-PROPENE	0.00001	0.00001	0.00007	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
DIMETHYL SULFIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBON DISULFIDE	0.00078	0.00078	0.00078	0.00078	0.00078	0.00078	0.00078	0.00078	ND	0.00078	0.00078125
TRIMETHYLSILANOL	0.04207	0.03955	0.26304	0.04345	0.04031	0.03049	0.03649	0.04306	0.03064	0.03201	0.02779
OCTAMETHYLCYCLOTETRASILOXANE	ND	ND	ND	0.00927	0.00313	ND	ND	ND	ND	ND	ND
DECAMETHYLCYCLOPENTASILOXANE	0.03834	0.03878	ND	0.02596	0.02387	0.02560	0.03439	0.03246	0.02418	0.02694	0.02379
HEXAMETHYLCYCLOTRISILOXANE	0.23304	0.22447	0.05906	0.18433	0.15763	0.21090	0.24863	0.25362	0.18756	0.17280	0.14948
NON-TARGET COMPOUNDS											
PROPENE	ND	ND	0.00058	ND	ND	ND	ND	ND	ND	ND	ND
PROPANE	0.00455	0.00455	0.00455	ND	0.00455	0.00455	0.00455	0.00455	0.00455	0.00455	0.00454545
BUTANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ISOPRENE	0.01719	0.02036	ND	ND	0.00833	0.00833	0.01668	0.01684	0.00833	0.02198	0.01713679
SULFURHEXAFLUORIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1,2-TETRAFLUOROETHANE	0.00049	0.00055	ND	0.00054	0.00052	0.00051	0.00065	0.00058	0.00064	0.00085	0.00068
1,1-DIFLUOROETHANE	ND	ND	0.00084	ND	ND	ND	ND	ND	ND	ND	ND
CARBONICACID,DIMETHYLESTER	0.00001	0.00001	ND	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	ND
C7-ALKANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C12-ALKANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C12-ALKANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C12-ALKANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C12-ALKANE	ND	ND	0.00103	ND	ND	ND	ND	ND	ND	ND	ND
LIMONENE	ND	ND	ND	ND	ND	ND	0.00079	0.00053	0.00161	0.00022	0.00021739
C12-ALKANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C12-ALKANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C12-ALKANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TARGET COMPOUNDS (GC)											
CARBON MONOXIDE	0.02809	0.02972	0.26829	0.02144	0.02109	0.02015	0.03529	0.03489	0.03286	0.02063	0.01995
METHANE	0.00089	0.00089	0.00056	0.00114	0.00116	0.00113	0.00124	0.00126	0.00128	0.00133	0.00134
HYDROGEN	0.01991	0.01966	0.00510	0.02085	0.02187	0.02096	0.01980	0.02025	0.02025	0.01589	0.01690
CARBON DIOXIDE	0.69624	0.78961	0.13070	0.62335	0.62005	0.61254	0.61492	0.63850	0.62949	0.61981	0.62503
TOTAL T-VALUE	**1.17013**	**1.26066**	**0.82023**	**1.03973**	**0.99701**	**1.02552**	**1.10615**	**1.14509**	**1.05465**	**0.99477**	**0.96795**
TOTAL T-VALUE - CO2	**0.47389**	**0.47105**	**0.68953**	**0.41638**	**0.37697**	**0.41299**	**0.49123**	**0.50660**	**0.42515**	**0.37496**	**0.34292**

ND : Value is less than the laboratory report detection limit.
Note: Number of decimal places in T-Values do not represent significant figures of measurements.

TABLE 2A
T-VALUES for SOYUZ 36S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)	T-VALUE (7-d SMAC)
	AA05692 S/N 2056 ORB-1 INGRESS 1/12/14 @ 17:30 GMT	AA05692 S/N 2056 ORB-1 INGRESS 1/12/14 @ 17:30 GMT
TARGET COMPOUNDS (TO-15)		
FREON12	ND	ND
CHLOROMETHANE	ND	ND
FREON114	ND	ND
METHANOL	0.00391	0.00391
ACETALDEHYDE	0.06428	0.06428
VINYLCHLORIDE	ND	ND
BROMOMETHANE	ND	ND
ETHANOL	0.00065	0.00065
CHLOROETHANE	ND	ND
ACETONITRILE	ND	ND
PROPENAL	ND	ND
ACETONE	0.00887	0.00887
PROPANAL	0.00354	0.00354
ISOPROPANOL	0.01188	0.01188
FREON11	ND	ND
FURAN	ND	ND
ACRYLONITRILE	ND	ND
PENTANE	ND	ND
2-METHYL-2-PROPANOL	0.00040	0.00032
METHYLACETATE	0.00010	0.00010
1,1-DICHLOROETHENE	ND	ND
DICHLOROMETHANE	0.00125	0.00026
3-CHLOROPROPENE	ND	ND
FREON113	ND	ND
N-PROPANOL	0.00030	0.00030
1,1-DICHLOROETHANE	ND	ND
BUTANAL	0.00096	0.00096
2-BUTANONE	0.04059	0.04059
CIS-1,2-DICHLOROETHENE	ND	ND
2-METHYLFURAN	ND	ND
ETHYLACETATE	0.00037	0.00037
HEXANE	ND	ND
CHLOROFORM	ND	ND
2-BUTENAL	ND	ND
1,2-DICHLOROETHANE	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND
N-BUTANOL	0.00132	0.00066
BENZENE	ND	ND
CARBONTETRACHLORIDE	ND	ND
2-PENTANONE	ND	ND
2-METHYLHEXANE	0.00104	0.00005
2,3-DIMETHYLPENTANE	ND	ND
PENTANAL	ND	ND
3-METHYLHEXANE	0.00244	0.00012
1,2-DICHLOROPROPANE	ND	ND
1,4-DIOXANE	ND	ND
TRICHLOROETHENE	ND	ND
2,5-DIMETHYLFURAN	ND	ND
N-HEPTANE	ND	ND
4-METHYL2-PENTANONE	0.00009	0.00009
CIS-1,3-DICHLOROPROPENE	ND	ND
2-PENTENAL	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND
TOLUENE	0.00732	0.00732
HEXANAL	ND	ND
MESITYLOXIDE	ND	ND
1,2-DIBROMOETHANE	ND	ND
BUTYLACETATE	ND	ND
OCTANE	ND	ND
TETRACHLOROETHENE	ND	ND
CHLOROBENZENE	ND	ND
ETHYLBENZENE	ND	ND
M/P-XYLENES	0.00166	0.00084
2-HEPTANONE	ND	ND
CYCLOHEXANONE	ND	ND
HEPTANAL	ND	ND
STYRENE	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND
O-XYLENE	0.00076	0.00039
NONANE	ND	ND
1,3,5-TRIMETHYLBENZENE	ND	ND
1,2,4-TRIMETHYLBENZENE	ND	ND
1,3-DICHLOROBENZENE	ND	ND
1,4-DICHLOROBENZENE	ND	ND
1,2-DICHLOROBENZENE	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND
HEXACHLORO-1,3-BUTADIENE	ND	ND

TABLE 2A
T-VALUES for SOYUZ 36S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC) AA05692 S/N 2056 ORB-1 INGRESS 1/12/14 @ 17:30 GMT	T-VALUE (7-d SMAC) AA05692 S/N 2056 ORB-1 INGRESS 1/12/14 @ 17:30 GMT
SPECIAL INTEREST COMPOUNDS		
1,3-BUTADIENE	ND	ND
ETHYLENE OXIDE	ND	ND
2-METHYL-2-PROPENAL	ND	ND
3-BUTEN-2-ONE	ND	ND
2-ETHOXYETHANOL	ND	ND
DIMETHYL DISULFIDE	ND	ND
OCTAFLUOROPROPANE	0.00001	0.00001
PERFLUORO-2-METHYLPENTANE	ND	ND
CARBONYL SULFIDE	0.00260	0.00260
ISOBUTANE	0.00025	0.00025
2-METHYL-1-PROPENE	0.00006	0.00006
DIMETHYL SULFIDE	ND	ND
CARBON DISULFIDE	0.00192	0.00192
TRIMETHYLSILANOL	0.12711	0.12711
OCTAMETHYLCYCLOTETRASILOXANE	0.01233	0.00053
DECAMETHYLCYCLOPENTASILOXANE	0.01242	0.00186
HEXAMETHYLCYCLOTRISILOXANE	1.76741	0.17674
NON-TARGET COMPOUNDS		
PROPENE &	0.00058	0.00058
PROPANE &	0.00455	0.00023
BUTANE &	ND	ND
ISOPRENE &	ND	ND
SULFURHEXAFLUORIDE	ND	ND
1,1,1,2-TETRAFLUOROETHANE	0.00515	0.00515
1,1-DIFLUOROETHANE	0.00133	0.00133
CARBONICACID,DIMETHYLESTER	0.00004	0.00004
C7-ALKANE	ND	ND
C12-ALKANE	0.00160	0.00160
C12-ALKANE	0.00433	0.00433
C12-ALKANE	0.00312	0.00312
C12-ALKANE	0.00435	0.00435
LIMONENE	0.00070	0.00070
C12-ALKANE	0.00319	0.00319
C12-ALKANE	0.00370	0.00370
C12-ALKANE	0.00124	0.00124
TARGET COMPOUNDS (GC)		
CARBON MONOXIDE	0.10735	0.02897
METHANE	0.00046	0.00046
HYDROGEN	0.00422	0.00422
CARBON DIOXIDE	0.24380	0.24380
TOTAL T-VALUE	**2.46555**	**0.76357**
TOTAL T-VALUE - CO2	**2.22174**	**0.51977**

ND : Value is less than the laboratory report detection limit.
Note: Number of decimal places in T-Values do not represent significant figures of measurements.