Toxicological Assessment of ISS Air Quality: November 2012 – March 2013 (Increment 34)

A summary of the analytical results from 12 mini-grab sample containers (mGSCs) collected on ISS and returned aboard 32S is shown in Table 1. Complete data tables of all measured concentrations and corresponding T-values based on 180-day SMACs are enclosed. The detection limit for all compounds was 0.05 mg/m^3. The average recoveries of the 3 surrogate standards from the mGSCs were as follows: ^{13}C-acetone, 128 ± 11%; ^{5}D-fluorobenzene, 114 ± 5%; and ^{5}D-chlorobenzene, 108 ± 23%. Shaded rows indicate data that are limited due to the use of expired mGSCs that resulted from a delay in resupply to the ISS. The variability in ^{5}D-chlorobenzene reflects the lower levels of this surrogate recovered from the expired mGSCs. As noted in the table below, mGSC data from the Lab sample collected on 2 January 2013 are considered invalid. Data are not representative of ISS air, and post-analysis testing indicated a leak in the mGSC. Initial measured sample pressures were between 13.9 and 14.1 psia for all samples, indicating nominal sample collection. Samples collected in the US Lab and European Columbus modules on 5 March 2013 were analyzed for argon using gas chromatography.

A summary of the analytical results from 8 pairs of passive-diffusion formaldehyde badges collected on ISS and returned aboard 33S is also provided in Table 1. Positive control recoveries (1 trip and 2 lab controls) were 79%, 87%, and 116%, respectively.

Table 1. Analytical Summary of ISS results

Sample Location	Sample Date	Argon (%)	NMVOCs[a] (mg/m^3)	Freon 218 (mg/m^3)	Alcohols (mg/m^3)	T Value[b] (units)	CO_2 (mg/m^3)	Formaldehyde (μg/m^3)
Lab	11/26/2012		10	20	6.5	0.47	2700	36
SM	11/26/2012		11	21	7.5	0.38	3700	25
JPM	11/26/2012		9.8	21	6.1	0.44	2700	
Lab	1/2/2013		[9.9]	[2.2]	[4.9]	[0.31]	[1500]	43
SM	1/2/2012		17	19	13	0.46	7400	25
Columbus	1/2/2012		15	18	12	0.46	7000	
Lab	2/4/2013		8.8	22	5.3	0.40	6200	50
SM	2/4/2013		9.3	22	5.2	0.45	6300	25
JPM	2/4/2013		9.4	22	5.4	0.46	6700	
Lab	3/5/2013	0.7	8.7	19	5.0	0.42	7900	33
SM	3/5/2013		9.0	19	5.4	0.41	8100	37
Columbus	3/5/2013	0.7	9.3	19	5.4	0.46	8300	
Guideline			*<25*	---	*<5*	*<1*	*<9300*	*<120*

[a] Non-methane volatile organic hydrocarbons, excluding Freon 218
[b] Based on 180-d SMACs and calculated excluding CO_2 and formaldehyde
NOTE: Bracketed data are considered invalid – mGSC did not pass leak test

Toxicological Evaluation of ISS Air Quality: Routine monthly sampling provides a very limited set of samples on which to perform an air quality assessment. However, based on these samples, there is no concern for crew health.

Elevated alcohol values were reported in late November and early January. The alcohol guideline (<5 mg/m^3) is intended to protect the water recovery system from risk of overloading. The health-protective

180-day SMAC for ethanol, the primary contributor to the total alcohol level, is 2000 mg/m^3. We are not aware of a new source of this compound, and levels show a downward trend in February and March.

The primary contributor to the total T-value across all sampling locations throughout this time period was hexamethylcyclotrisiloxane. This compound was measured below levels of health concern; however, it may contribute to periodic accumulation of siloxanes in the water recovery system.

GSCs provide only a snapshot of conditions and are not ideal for evaluating potential CO_2 exposures. However, reported levels were below 4 mmHg (9300 mg/m^3), as requested for this Increment in Chit 10916.

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7/2/2013

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Enclosures Table 1: Analytical concentrations of compounds found in the 32S mGSCs
Table 2: T-values corresponding to analytical concentrations in Table 1, based on 180-day SMACs.

TABLE 1
ANALYTICAL RESULTS OF
SOYUZ 32S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/M^3)											
	AA05468 S/N 2107 LAB 11/26/12 @ 10:28 GMT	AA05469 S/N 2007 JPM 11/26/12 @ 10:30 GMT	AA05470 S/N 2116 SM 11/26/12 @ 10:35 GMT	AA05471 # S/N 2106 LAB 01/02/13 @ 09:40 GMT	AA05472 S/N 2084 COL 01/02/13 @ 09:42 GMT	AA05473 S/N 2008 SM 01/02/13 @ 09:45 GMT	AA05474 S/N 2016 LAB 02/04/13 @ 14:55 GMT	AA05475 S/N 2022 JPM 02/04/13 @ 14:57 GMT	AA05476 S/N 2020 SM 02/04/13 @ 15:00 GMT	AA05477 S/N 2021 LAB 03/05/13 @ 11:29 GMT	AA05478 S/N 2017 COL 03/05/13 @ 11:30 GMT	AA05479 S/N 2012 SM 03/05/13 @ 11:49 GMT
TARGET COMPOUNDS (TO-14/POLAR)												
FREON12	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
CHLOROMETHANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
FREON114	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
METHANOL *	**0.46**	**0.38**	**0.45**	**1.1**	**0.46**	**0.36**	**0.45**	**0.40**	**0.39**	**0.32**	**0.39**	**0.40**
ACETALDEHYDE	0.19	0.20	0.28	0.13	0.26	0.26	0.22	0.24	0.22	0.19	0.19	0.19
VINYLCHLORIDE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
BROMOMETHANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
ETHANOL *	**5.0**	**4.9**	**6.1**	**0.70**	**10**	**12**	**4.2**	**4.4**	**4.1**	**4.0**	**4.2**	**4.2**
CHLOROETHANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
ACETONITRILE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
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
ACETONE	0.31	0.35	0.34	0.28	0.37	0.40	0.38	0.39	0.39	0.32	0.33	0.32
PROPANAL	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
ISOPROPANOL *	0.63	0.39	0.47	**2.8**	0.23	0.29	0.17	0.16	0.21	0.20	0.23	0.34
FREON11	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
FURAN	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
ACRYLONITRILE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
PENTANE	<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-PROPANOL	<0.050	<0.050	<0.050	TRACE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	TRACE	<0.050
METHYLACETATE	TRACE	TRACE	TRACE	<0.050	TRACE	TRACE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1-DICHLOROETHENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
DICHLOROMETHANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	TRACE	TRACE	TRACE
3-CHLOROPROPENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
FREON113	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
N-PROPANOL	TRACE	TRACE	TRACE	<0.050	0.13	<0.050	TRACE	TRACE	TRACE	0.051	0.052	TRACE
1,1-DICHLOROETHANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
BUTANAL	<0.050	<0.050	<0.050	TRACE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-BUTANONE	<0.050	<0.050	<0.050	<0.050	TRACE	TRACE	<0.050	TRACE	<0.050	TRACE	TRACE	TRACE
CIS-1,2-DICHLOROETHENE	<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-METHYLFURAN	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
ETHYLACETATE	TRACE	TRACE	TRACE	TRACE	0.074	0.087	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
HEXANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
CHLOROFORM	<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-BUTENAL	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2-DICHLOROETHANE	TRACE	TRACE	TRACE	<0.050	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,1,1-TRICHLOROETHANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
N-BUTANOL	0.098	0.100	0.099	0.082	0.10	0.11	0.11	0.11	0.12	0.14	0.15	0.13
BENZENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
CARBONTETRACHLORIDE	<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-PENTANONE	<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-METHYLHEXANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2,3-DIMETHYLPENTANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
PENTANAL	<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-METHYLHEXANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2-DICHLOROPROPANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,4-DIOXANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
TRICHLOROETHENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2,5-DIMETHYLFURAN	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
N-HEPTANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
4-METHYL2-PENTANONE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
CIS-1,3-DICHLOROPROPENE	<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-PENTENAL	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
TRANS-1,3-DICHLOROPROPENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,2-TRICHLOROETHANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
TOLUENE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	0.060	0.064	0.060
HEXANAL	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
MESITYLOXIDE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2-DIBROMOETHANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
BUTYLACETATE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
OCTANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
TETRACHLOROETHENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
CHLOROBENZENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
ETHYLBENZENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
M/P-XYLENES	<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-HEPTANONE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
CYCLOHEXANONE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
HEPTANAL	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
STYRENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,1,2,2-TETRACHLOROETHANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
O-XYLENE	0.065	0.067	0.071	<0.050	0.062	0.074	0.062	0.066	0.077	0.089	0.089	0.097
NONANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,3,5-TRIMETHYLBENZENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2,4-TRIMETHYLBENZENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,3-DICHLOROBENZENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,4-DICHLOROBENZENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2-DICHLOROBENZENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,2,4-TRICHLOROBENZENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
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
SOYUZ 32S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/M^3)											
	AA05468 S/N 2107 LAB 11/26/12 @ 10:28 GMT	AA05469 S/N 2007 JPM 11/26/12 @ 10:30 GMT	AA05470 S/N 2116 SM 11/26/12 @ 10:35 GMT	AA05471 # S/N 2106 LAB 01/02/13 @ 09:40 GMT	AA05472 S/N 2084 COL 01/02/13 @ 09:42 GMT	AA05473 S/N 2008 SM 01/02/13 @ 09:45 GMT	AA05474 S/N 2016 LAB 02/04/13 @ 14:55 GMT	AA05475 S/N 2022 JPM 02/04/13 @ 14:57 GMT	AA05476 S/N 2020 SM 02/04/13 @ 15:00 GMT	AA05477 S/N 2021 LAB 03/05/13 @ 11:29 GMT	AA05478 S/N 2017 COL 03/05/13 @ 11:30 GMT	AA05479 S/N 2012 SM 03/05/13 @ 11:49 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 &	20	21	21	2.2	18	19	22	22	22	19	19	19
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 &	<0.050	<0.050	<0.050	0.60	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
ISOBUTANE &	<0.050	<0.050	<0.050	1.1	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-METHYL-1-PROPENE &	TRACE	TRACE	TRACE	0.35	TRACE	TRACE	TRACE	TRACE	TRACE	<0.050	<0.050	<0.050
DIMETHYL SULFIDE &	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
CARBON DISULFIDE &	<0.050	<0.050	<0.050	TRACE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
TRIMETHYLSILANOL &	0.14	0.15	0.10	0.28	0.16	0.11	0.13	0.15	0.11	0.15	0.17	0.12
OCTAMETHYLCYCLOTETRASILOXANE &	0.13	0.10	0.09	<0.050	0.09	0.11	0.11	0.12	0.12	0.10	0.11	0.11
DECAMETHYLCYCLOPENTASILOXANE &	0.39	0.44	0.39	<0.050	0.42	0.45	0.49	0.51	0.71	0.53	0.49	0.65
HEXAMETHYLCYCLOTRISILOXANE %	2.6	2.3	1.7	0.32	2.1	2.3	1.8	2.3	2.2	1.9	2.3	1.9
NON-TARGET COMPOUNDS **												
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	0.10	0.10	0.11	0.17	0.13	0.13	0.26	0.26	0.26	0.17	0.17	0.17
1,1-DIFLUOROETHANE	<0.050	<0.050	<0.050	0.60	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
PROPENE	<0.050	<0.050	<0.050	TRACE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
1,3-DIOXOLANE	TRACE	TRACE	TRACE	0.26	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
2-ETHYL-1-HEXANOL	0.13	0.14	0.11	<0.050	0.15	0.11	0.12	0.14	0.12	0.15	0.14	0.12
C9-ALKENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
LIMONENE	TRACE	TRACE	0.056	<0.050	0.065	0.10	0.070	0.069	0.11	0.085	0.075	0.084
C11-ALKANE	<0.050	<0.050	<0.050	0.10	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.050	<0.050	0.19	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.050	<0.050	0.26	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.050	<0.050	0.20	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.050	<0.050	0.18	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.050	<0.050	0.064	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
NONANAL	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
TOTAL ALCOHOLS PLUS ACETONE	**6.5**	**6.1**	**7.5**	**4.9**	**12**	**13**	**5.3**	**5.4**	**5.2**	**5.0**	**5.4**	**5.4**
TARGET COMPOUNDS (GC)												
CARBON MONOXIDE	< 0.23	< 0.23	< 0.23	0.54	0.28	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
METHANE	5.2	5.1	5.4	2.6	7.7	8.2	8.7	8.3	8.7	8.1	7.9	8.2
HYDROGEN	3.1	2.9	3.2	2.6	4.3	4.2	4.0	3.9	4.0	4.1	4.1	4.1
CARBON DIOXIDE	2700	2700	3700	1500	7000	7400	6200	6700	6300	7900	8300	8100
TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	**31**	**31**	**32**	**12**	**33**	**36**	**31**	**31**	**31**	**28**	**28**	**28**
TOTAL CONCENTRATION - OFP (NON-METHANE HYDROCARBONS)	**10**	**9.8**	**11**	**9.9**	**15**	**17**	**8.8**	**9.4**	**9.3**	**8.7**	**9.3**	**9.0**

Sample composition is not representative of ISS Lab air
* GC/FID data results are in bold
** Quantified using "B" response factor except where noted
& Quantified using a multi-level 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 32S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)											
	AA05468 S/N 2107 LAB 11/26/12 @ 10:28 GMT	AA05469 S/N 2007 JPM 11/26/12 @ 10:30 GMT	AA05470 S/N 2116 SM 11/26/12 @ 10:35 GMT	AA05471 # S/N 2106 LAB 01/02/13 @ 09:40 GMT	AA05472 S/N 2084 COL 01/02/13 @ 09:42 GMT	AA05473 S/N 2008 SM 01/02/13 @ 09:45 GMT	AA05474 S/N 2016 LAB 02/04/13 @ 14:55 GMT	AA05475 S/N 2022 JPM 02/04/13 @ 14:57 GMT	AA05476 S/N 2020 SM 02/04/13 @ 15:00 GMT	AA05477 S/N 2021 LAB 03/05/13 @ 11:29 GMT	AA05478 S/N 2017 COL 03/05/13 @ 11:30 GMT	AA05479 S/N 2012 SM 03/05/13 @ 11:49 GMT
TARGET COMPOUNDS (TO-14/POLAR)												
FREON12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FREON114	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
METHANOL	0.00515	0.00420	0.00505	0.01211	0.00516	0.00397	0.00496	0.00444	0.00432	0.00353	0.00432	0.00448
ACETALDEHYDE	0.04636	0.04984	0.07046	0.03241	0.06435	0.06462	0.05383	0.05961	0.05482	0.04675	0.04797	0.04779
VINYLCHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BROMOMETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHANOL	0.00249	0.00244	0.00305	0.00035	0.00512	0.00588	0.00209	0.00218	0.00204	0.00201	0.00211	0.00209
CHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ACETONITRILE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PROPENAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ACETONE	0.00595	0.00681	0.00645	0.00544	0.00708	0.00763	0.00734	0.00751	0.00754	0.00618	0.00636	0.00622
PROPANAL	0.00227	0.00227	0.00227	0.00227	0.00227	0.00227	0.00227	0.00227	0.00227	0.00227	0.00227	0.00227
ISOPROPANOL	0.00420	0.00261	0.00314	0.01835	0.00150	0.00194	0.00114	0.00107	0.00138	0.00135	0.00151	0.00228
FREON11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FURAN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ACRYLONITRILE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PENTANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-PROPANOL	ND	ND	ND	0.00021	ND	ND	ND	ND	ND	ND	0.00021	ND
METHYLACETATE	0.00021	0.00021	0.00021	ND	0.00021	0.00021	ND	ND	ND	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DICHLOROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00250	0.00250	0.00250
3-CHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FREON113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-PROPANOL	0.00026	0.00026	0.00026	ND	0.00134	ND	0.00026	0.00026	0.00026	0.00052	0.00053	0.00026
1,1-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BUTANAL	ND	ND	ND	0.00192	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTANONE	ND	ND	ND	ND	0.00083	0.00083	ND	0.00083	ND	0.00083	0.00083	0.00083
CIS-1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLFURAN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLACETATE	0.00014	0.00014	0.00014	0.00014	0.00041	0.00048	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014
HEXANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTENAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROETHANE	0.01563	0.01563	0.01563	ND	0.01563	0.01563	0.01563	0.01563	0.01563	0.01563	0.01563	0.01563
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-BUTANOL	0.00244	0.00249	0.00248	0.00205	0.00253	0.00280	0.00276	0.00272	0.00312	0.00354	0.00380	0.00330
BENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBONTETRACHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-PENTANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PENTANAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEXANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROPROPANE	ND	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	ND
TRICHLOROETHENE	ND	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	ND
N-HEPTANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL2-PENTANONE	ND	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	ND
2-PENTENAL	ND	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	ND
1,1,2-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TOLUENE	0.00167	0.00167	0.00167	0.00167	0.00167	0.00167	0.00167	0.00167	0.00167	0.00400	0.00426	0.00399
HEXANAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MESITYLOXIDE	ND	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	ND
BUTYLACETATE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	ND	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	ND
2-HEPTANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HEPTANAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
STYRENE	ND	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	ND
NONANE	0.00176	0.00182	0.00191	ND	0.00167	0.00199	0.00168	0.00179	0.00207	0.00240	0.00240	0.00263
O-XYLENE	ND	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	ND
1,2,4-TRIMETHYLBENZENE	ND	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	ND
1,4-DICHLOROBENZENE	ND	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	ND
1,2,4-TRICHLOROBENZENE	ND	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	ND

TABLE 2
T-VALUES for SOYUZ 32S RETURN GSC AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)											
	AA05468 S/N 2107 LAB 11/26/12 @ 10:28 GMT	AA05469 S/N 2007 JPM 11/26/12 @ 10:30 GMT	AA05470 S/N 2116 SM 11/26/12 @ 10:35 GMT	AA05471 # S/N 2106 LAB 01/02/13 @ 09:40 GMT	AA05472 S/N 2084 COL 01/02/13 @ 09:42 GMT	AA05473 S/N 2008 SM 01/02/13 @ 09:45 GMT	AA05474 S/N 2016 LAB 02/04/13 @ 14:55 GMT	AA05475 S/N 2022 JPM 02/04/13 @ 14:57 GMT	AA05476 S/N 2020 SM 02/04/13 @ 15:00 GMT	AA05477 S/N 2021 LAB 03/05/13 @ 11:29 GMT	AA05478 S/N 2017 COL 03/05/13 @ 11:30 GMT	AA05479 S/N 2012 SM 03/05/13 @ 11:49 GMT
SPECIAL INTEREST COMPOUNDS												
1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLENE OXIDE	ND	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	ND
3-BUTEN-2-ONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-ETHOXYETHANOL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DIMETHYL DISULFIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTAFLUOROPROPANE	0.00024	0.00025	0.00025	0.00003	0.00021	0.00022	0.00026	0.00026	0.00026	0.00022	0.00022	0.00022
PERFLUORO-2-METHYLPENTANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBONYL SULFIDE	ND	ND	ND	0.05026	ND	ND	ND	ND	ND	ND	ND	ND
ISOBUTANE	ND	ND	ND	0.00461	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYL-1-PROPENE	0.00002	0.00002	0.00002	0.00032	0.00002	0.00002	0.00002	0.00002	0.00002	ND	ND	ND
DIMETHYL SULFIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBON DISULFIDE	ND	ND	ND	0.00156	ND	ND	ND	ND	ND	ND	ND	ND
TRIMETHYLSILANOL	0.03567	0.03768	0.02512	0.06944	0.04004	0.02851	0.03335	0.03841	0.02826	0.03756	0.04355	0.03051
OCTAMETHYLCYCLOTETRASILOXANE	0.01079	0.00807	0.00725	ND	0.00754	0.00908	0.00943	0.00994	0.01026	0.00863	0.00932	0.00941
DECAMETHYLCYCLOPENTASILOXANE	0.02626	0.02903	0.02573	ND	0.02784	0.02980	0.03235	0.03374	0.04707	0.03530	0.03286	0.04308
HEXAMETHYLCYCLOTRISILOXANE	0.28484	0.25404	0.18715	0.03503	0.23470	0.25537	0.20385	0.25331	0.24546	0.21666	0.25497	0.20936
NON-TARGET COMPOUNDS												
SULFURHEXAFLUORIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1,2-TETRAFLUOROETHANE	0.00092	0.00099	0.00103	0.00168	0.00123	0.00125	0.00249	0.00251	0.00251	0.00164	0.00165	0.00163
1,1-DIFLUOROETHANE	ND	ND	ND	0.00899	ND	ND	ND	ND	ND	ND	ND	ND
PROPENE	ND	ND	ND	0.00058	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DIOXOLANE	0.00069	0.00069	0.00069	0.00720	0.00069	0.00069	0.00069	0.00069	0.00069	0.00069	0.00069	0.00069
2-ETHYL-1-HEXANOL	0.00241	0.00261	0.00212	ND	0.00275	0.00204	0.00217	0.00271	0.00227	0.00276	0.00265	0.00225
C9-ALKENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LIMONENE	0.00022	0.00022	0.00048	ND	0.00056	0.00088	0.00061	0.00060	0.00099	0.00074	0.00065	0.00073
C11-ALKANE	ND	ND	ND	0.00215	ND	ND	ND	ND	ND	ND	ND	ND
C11-ALKANE	ND	ND	ND	0.00397	ND	ND	ND	ND	ND	ND	ND	ND
C11-ALKANE	ND	ND	ND	0.00548	ND	ND	ND	ND	ND	ND	ND	ND
C11-ALKANE	ND	ND	ND	0.00427	ND	ND	ND	ND	ND	ND	ND	ND
C11-ALKANE	ND	ND	ND	0.00368	ND	ND	ND	ND	ND	ND	ND	ND
C11-ALKANE	ND	ND	ND	0.00133	ND	ND	ND	ND	ND	ND	ND	ND
NONANAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TARGET COMPOUNDS (GC)												
CARBON MONOXIDE	0.00674	0.00674	0.00674	0.03159	0.01655	0.00674	0.00674	0.00674	0.00674	0.00674	0.00674	0.00674
METHANE	0.00149	0.00146	0.00153	0.00074	0.00219	0.00233	0.00249	0.00238	0.0025	0.0023	0.00226	0.00234
HYDROGEN	0.00919	0.00852	0.00946	0.00770	0.01255	0.01231	0.01179	0.01161	0.01184	0.01205	0.01204	0.01220
CARBON DIOXIDE	0.20892	0.20972	0.28267	0.11333	0.53726	0.56743	0.47581	0.51512	0.48688	0.60768	0.63872	0.62519
TOTAL T-VALUE	**0.67692**	**0.65041**	**0.66298**	**0.43084**	**0.99392**	**1.02658**	**0.87581**	**0.97814**	**0.94100**	**1.02462**	**1.10117**	**1.03877**
TOTAL T-VALUE - CO2	**0.46800**	**0.44069**	**0.38031**	**0.31751**	**0.45666**	**0.45915**	**0.40000**	**0.46302**	**0.45412**	**0.41694**	**0.46245**	**0.41358**

Sample composition is not representative of ISS Lab air
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.