

Toxicological Assessment of ISS Air Quality: December 2011 to May 2012



The toxicological assessment of 17 GSCs returned aboard Soyuz 28 and 29 from the ISS is shown in Table 1. The average recoveries of the 3 surrogate standards from the GSCs were as follows: ¹³C-acetone, 110%; fluorobenzene, 107%; and chlorobenzene, 99%. Recoveries from formaldehyde badges, which were returned on 29S, averaged 101%.

Table 1. Analytical Summary of ISS Results

Module/Sample	Date of Sample	NMVOCs ^a (mg/m ³)	Freon 218 (mg/m ³)	T Value ^b (units)	Alcohols (mg/m ³)	Formaldehyde (μg/m ³)
Lab	12/23/11	9	32	0.40	5.9	42
JPM	12/23/11	10	35	0.39	6.2	--
SM	12/23/11	9	33	0.36	5.8	35
COL	01/09/12	10	11	0.76	6.6	--
Lab	01/09/12	11	35	0.50	7.2	55
SM	01/09/12	--	--	--	--	41
Lab	02/01/12	8	36	0.78	5.0	50
JPM	02/01/12	9	23	0.74	5.7	--
SM	02/01/12	--	--	--	--	37
Lab	02/27/12	7	16	0.66	4.6	34
COL	02/27/12	8	17	0.50	5.0	--
SM	02/27/12	9	20	1.02	5.9	38
ATV3 (first entry)	03/29/12	28	2	2.64 (0.94)	5.9	--
Lab	04/03/12	8	15	0.68	4.6	37
JPM	04/03/12	9	18	0.75	5.0	--
SM	04/03/12	8	28	0.72	4.8	27
SM	04/24/12	8	31	0.43	5.1	--
Lab	04/24/12	8	30	0.50	4.6	--
Lab	05/29/12	16	31	0.42	6.8	33
SM	05/29/12	--	--	--	--	32
<i>Guideline</i>		<25	<i>none</i>	<1.0	<5	<120

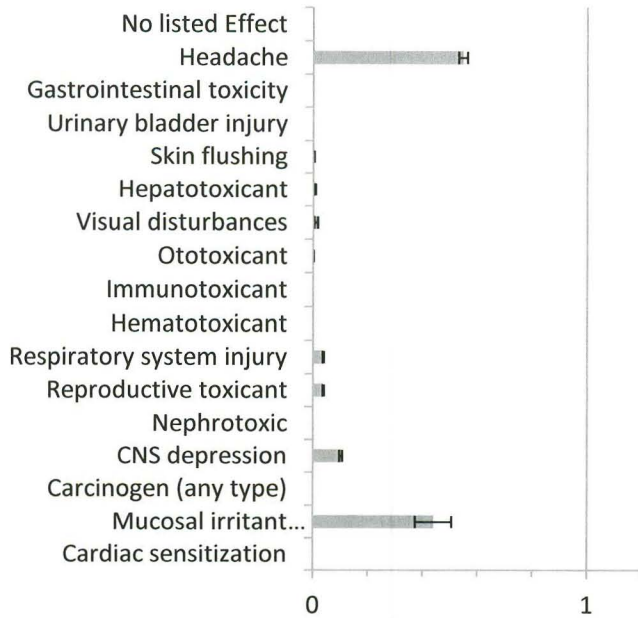
^aNon-methane volatile organic hydrocarbons, excluding Freon 218

^bBased on 180-d SMACs and calculated excluding CO₂ and formaldehyde. Parentheses indicate 7-day SMAC comparison.

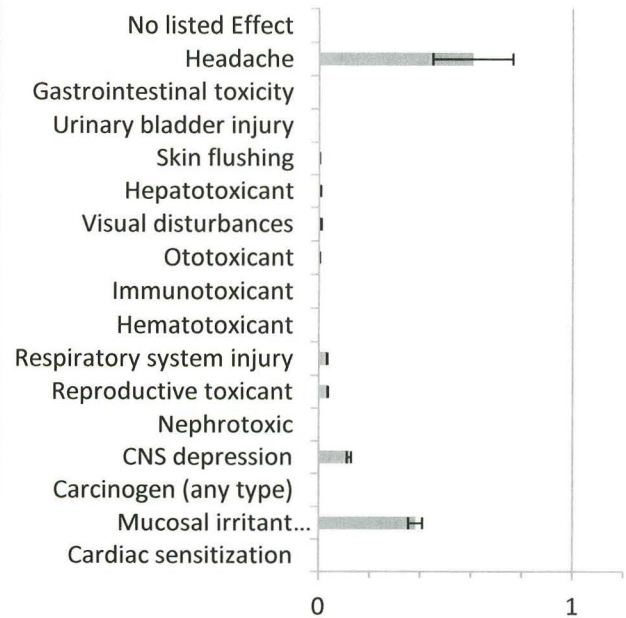
General Observations about ISS Air Quality: This is a very limited set of samples on which to perform an air quality assessment. However, based on these samples, we have no reason to believe that nominal ISS air is unsafe to breathe. Formaldehyde values were up some in January and early February, but were decreased to ~30 μg/m³ by late February. The relatively high T value at ATV3 first entry was due to the presence of hexamethylcyclotrisiloxane, trimethylsilanol, and fluorotrimethylsilane, all compounds that are reasonably well removed by the air revitalization systems.

Air Quality Monitor DTO: The figures below summarize the potential for any health effects based on data from the Air Quality Monitor (AQM) DTO, CO₂ monitors, and formaldehyde badges. Each panel is an average of weekly panels created during the designated month with the SD of those values shown as limit bars. By remaining consistently below T=1, these data show that the air quality is nominal and stable.

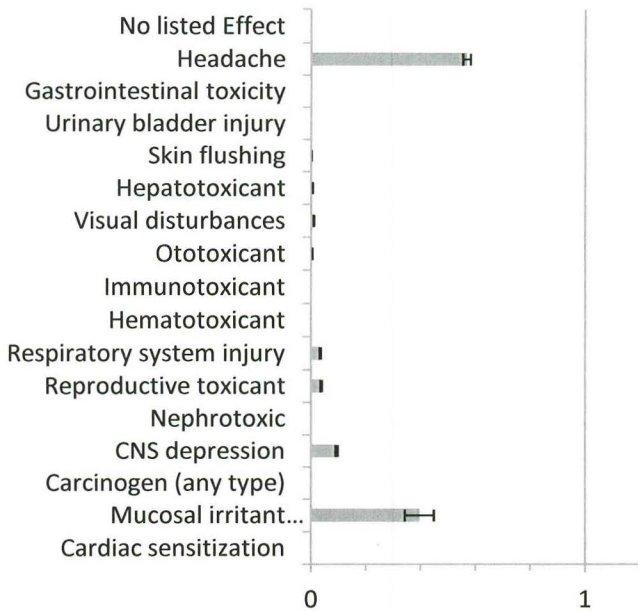
January 2012



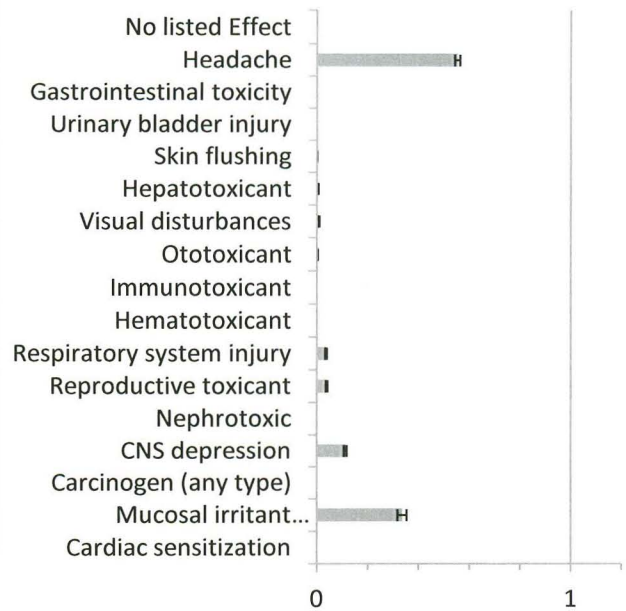
March 2012



February 2012



April 2012




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Enclosures Table 1: Analytical concentrations of compounds found in the Soyuz 28&29 GSCs
Table 2: T-values of the compounds in table 1

TABLE 1A
ANALYTICAL RESULTS OF
SOYUZ 28S RETURN MINI-GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m3)									
	AA05284	AA05286	AA05287	AA05289	AA05290	AA05291	AA05292	AA05293	AA05294	AA05295
	S/N 2089	S/N 2080	S/N 2090	S/N 2095	S/N 2103	S/N 2087	S/N 2079	S/N 2096	S/N 2081	S/N 2099
	COL 01/09/12 @ 11:00 GMT	LAB 02/01/12 @ 11:45 GMT	JPM 02/01/12 @ 11:50 GMT	LAB 02/27/12 @ 13:30 GMT	COL 02/27/12 @ 13:30 GMT	SM 02/27/12 @ 13:30 GMT	ATV3 03/29/12 @ 18:10 GMT	LAB 04/03/12 @ 13:00 GMT	JPM 04/03/12 @ 13:00 GMT	SM 04/03/12 @ 13:00 GMT
TARGET COMPOUNDS (TO-14/POLAR)										
FREON12	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
CHLOROMETHANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
FREON114	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
METHANOL	0.72	0.66	0.80	0.52	0.34	0.94	0.40	0.47	0.54	0.44
ACETALDEHYDE	0.21	0.21	0.19	0.23	0.17	0.31	0.36	0.16	0.18	0.23
VINYLCHLORIDE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
BROMOMETHANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
ETHANOL *	4.6	3.0	3.3	3.2	3.5	2.9	3.0	3.2	3.4	3.3
CHLOROETHANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
ACETONITRILE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
PROPENAL	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
ACETONE	0.42	0.52	0.50	0.35	0.36	0.64	0.55	0.42	0.45	0.45
PROPANAL	0.052	<0.096	0.055	0.053	TRACE	<0.15	0.085	TRACE	TRACE	TRACE
ISOPROPANOL	0.71	0.61	0.91	0.43	0.50	1.3	1.8	0.34	0.37	0.47
FREON11	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
FURAN	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
ACRYLONITRILE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
PENTANE	TRACE	<0.096	TRACE	TRACE	TRACE	<0.15	TRACE	TRACE	TRACE	TRACE
2-METHYL-2-PROPANOL	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.072	<0.050	<0.050	<0.050
METHYLACETATE	TRACE	<0.096	TRACE	TRACE	TRACE	<0.15	<0.050	TRACE	TRACE	TRACE
1,1-DICHLOROETHENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
DICHLOROMETHANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.070	<0.050	<0.050	<0.050
3-CHLOROPROPENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
FREON113	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
N-PROPANOL	TRACE	TRACE	0.067	TRACE	TRACE	<0.15	TRACE	TRACE	0.054	TRACE

1,1-DICHLOROETHANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
BUTANAL	TRACE	TRACE	TRACE	<0.050	<0.050	TRACE	TRACE	<0.050	<0.050	<0.050
2-BUTANONE	TRACE	<0.096	TRACE	<0.050	<0.050	<0.15	0.056	TRACE	TRACE	TRACE
CIS-1,2-DICHLOROETHENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
2-METHYLFURAN	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
ETHYLACETATE	0.091	0.11	0.10	0.058	0.062	TRACE	0.10	0.060	0.064	0.060
HEXANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
CHLOROFORM	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
2-BUTENAL	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,2-DICHLOROETHANE	TRACE	<0.096	TRACE	TRACE	TRACE	<0.15	<0.050	TRACE	TRACE	TRACE
1,1,1-TRICHLOROETHANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
N-BUTANOL	0.12	0.13	0.14	0.086	0.23	TRACE	0.14	0.12	0.13	0.12
BENZENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
CARBONTETRACHLORIDE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
2-PENTANONE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
2-METHYLHEXANE	<0.050	<0.096	TRACE	<0.050	<0.050	<0.15	TRACE	<0.050	<0.050	<0.050
2,3-DIMETHYLPENTANE	<0.050	<0.096	TRACE	<0.050	<0.050	<0.15	0.074	<0.050	<0.050	<0.050
PENTANAL	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	TRACE	<0.050	<0.050	<0.050
3-METHYLHEXANE	TRACE	TRACE	0.070	<0.050	TRACE	<0.15	0.11	<0.050	<0.050	<0.050
1,2-DICHLOROPROPANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,4-DIOXANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
TRICHLOROETHENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
2,5-DIMETHYLFURAN	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
N-HEPTANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	TRACE	<0.050	<0.050	<0.050
4-METHYL2-PENTANONE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	TRACE	<0.050	<0.050	<0.050
CIS-1,3-DICHLOROPROPENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
2-PENTENAL	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
TRANS-1,3-DICHLOROPROPENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,1,2-TRICHLOROETHANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
TOLUENE	0.051	TRACE	TRACE	TRACE	TRACE	<0.15	0.40	TRACE	TRACE	0.052
HEXANAL	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	TRACE	<0.050	<0.050	<0.050
MESITYLOXIDE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,2-DIBROMOETHANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
BUTYLACETATE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
OCTANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
TETRACHLOROETHENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
CHLOROBENZENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
ETHYLBENZENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
M/P-XYLENES	<0.050	<0.096	TRACE	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050

2-HEPTANONE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
CYCLOHEXANONE	<0.050	<0.096	TRACE	<0.050	<0.050	<0.15	0.051	<0.050	TRACE	<0.050
HEPTANAL	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
STYRENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,1,2,2-TETRACHLOROETHANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
O-XYLENE	0.075	TRACE	0.092	0.053	0.061	<0.15	0.13	0.058	0.066	0.067
NONANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,3,5-TRIMETHYLBENZENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,2,4-TRIMETHYLBENZENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,3-DICHLOROBENZENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,4-DICHLOROBENZENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,2-DICHLOROBENZENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,2,4-TRICHLOROBENZENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
HEXACHLORO-1,3-BUTADIENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050

SPECIAL INTEREST COMPOUNDS***										
1,3-BUTADIENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
ETHYLENE OXIDE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
CARBON DISULFIDE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	TRACE	<0.050	<0.050	<0.050
2-METHYL-2-PROPENAL	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	TRACE	<0.050	<0.050	<0.050
3-BUTEN-2-ONE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
2-ETHOXYETHANOL	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
DIMETHYLDISULFIDE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
OCTAFLUOROPROPANE**	11	36	23	16	17	20	2.2	15	18	28
TRIMETHYLSILANOL**	0.18	0.15	0.17	0.13	0.15	TRACE	0.99	0.15	0.20	0.15
HEXAMETHYLCYCLOTETRAISOXANE**	1.5	1.5	1.5	1.1	1.5	1.4	16	1.4	1.8	1.5
OCTAMETHYLCYCLOTETRAISOXANE**	0.098	0.10	0.11	0.074	0.098	TRACE	0.50	0.090	0.11	0.099
DECAMETHYLCYCLOPENTASILOXANE**	0.79	0.61	0.64	0.52	0.61	0.59	1.0	0.62	0.72	0.66

NON-TARGET COMPOUNDS***										
SULFURHEXAFLUORIDE	0.12	0.11	0.079	0.12	0.12	TRACE	<0.050	0.086	0.11	0.14
1,1,1,2-TETRAFLUROETHANE	0.078	TRACE	0.070	0.068	0.073	<0.15	<0.050	0.063	0.068	0.070
FORMALDEHYDE	TRACE	TRACE	TRACE	TRACE	<0.050	TRACE	<0.050	TRACE	TRACE	TRACE
PROPENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
1,1-DIFLUOROETHANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	TRACE	<0.050	<0.050	<0.050
CHLORODIFLUOROMETHANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
CARBONYLSULFIDE	<0.050	<0.096	TRACE	<0.050	<0.050	<0.15	0.080	<0.050	<0.050	<0.050
ISOBUTANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.13	<0.050	<0.050	<0.050

1-BUTENE &	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	0.42	TRACE	TRACE	TRACE
BUTANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050
FLUOROTRIMETHYLSILANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.11	<0.050	<0.050	<0.050
2-METHYL-1,3-BUTADIENE	0.096	TRACE	0.087	0.068	0.082	TRACE	<0.050	0.088	0.097	0.094
C7-ALKANE	TRACE	<0.096	TRACE	<0.050	TRACE	<0.15	0.059	<0.050	TRACE	TRACE
PINENE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.14	<0.050	<0.050	<0.050
C10-ALKANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.14	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.19	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.19	<0.050	<0.050	<0.050
LIMONENE	TRACE	<0.096	TRACE	TRACE	TRACE	<0.15	TRACE	TRACE	0.054	0.059
C11-ALKANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.27	<0.050	<0.050	<0.050
C10-ALKANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.21	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.20	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	0.063	<0.050	<0.050	<0.050
C10-ALKANE	<0.050	<0.096	<0.050	<0.050	<0.050	<0.15	<0.050	<0.050	<0.050	<0.050

TOTAL ALCOHOLS PLUS ACETONE	6.6	5.0	5.7	4.6	5.0	5.9	5.9	4.6	5.0	4.8
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TARGET COMPOUNDS (GC)										
CARBON MONOXIDE	2.0	<2.2	1.6	1.8	1.7	<3.5	1.2	1.6	1.5	1.7
METHANE	12	15	17	18	18	15	TRACE	15	16	16
HYDROGEN	5.5	6.8	7.1	6.6	6.0	5.7	<0.41	5.0	5.2	5.2
CARBON DIOXIDE	7100	5900	7700	6700	7100	4900	1100	7000	6500	6200

TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	22	44	32	23	25	29	30	23	27	36
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TOTAL CONCENTRATION - OFP (NON-METHANE HYDROCARBONS)	10	8.1	9.2	7.2	8.1	8.8	28	7.5	8.7	8.2
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* GC/FID data results are in bold

** Quantified using one-point calibration

*** Quantified using "B" response factor

& Historical B-factor from instrument Grey was used

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

TRACE: Amount detected is sufficient for compound identification only.

TABLE 1B
ANALYTICAL RESULTS OF
SOYUZ 29S RETURN GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m ³)						
	AA05344 S/N 2102 LAB 12/23/11 @ 19:00 GMT	AA05345 S/N 2088 JPM 12/23/11 @ 19:00 GMT	AA05346 S/N 2083 SM 12/23/11 @ 19:03 GMT	AA05347 S/N 2104 LAB 01/09/12 @ 11:10 GMT	AA05348 S/N 2093 SM 04/24/12 @ 10:40 GMT	AA05349 S/N 2097 LAB 04/24/12 @ 10:44 GMT	AA05351 S/N 2082 LAB 05/29/12 @ 10:20 GMT
	TARGET COMPOUNDS (TO-14/POLAR)						
FREON12	<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
FREON114	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
METHANOL	0.46	0.63	0.52	0.44	0.40	0.38	0.55
ACETALDEHYDE	0.33	0.24	0.25	0.29	0.21	0.25	0.48
VINYLCHELORIDE	<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
ETHANOL *	4.5	4.5	4.3	5.3	3.4	3.0	5.3
CHLOROETHANE	<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
PROPENAL	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
ACETONE	0.29	0.28	0.29	0.38	0.38	0.40	0.36
PROPANAL	TRACE	TRACE	TRACE	TRACE	<0.050	TRACE	TRACE
ISOPROPANOL	0.53	0.65	0.53	0.94	0.56	0.68	0.43
FREON11	<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
ACRYLONITRILE	<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
2-METHYL-2-PROPANOL	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
METHYLACETATE	TRACE	TRACE	TRACE	0.051	<0.050	TRACE	0.16
1,1-DICHLOROETHENE	<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
3-CHLOROPROPENE	<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
N-PROPANOL	TRACE	TRACE	0.052	0.057	<0.050	0.056	0.053
1,1-DICHLOROETHANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
BUTANAL	<0.050	<0.050	<0.050	<0.050	<0.050	TRACE	<0.050

C11-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
2-ETHYL-1-HEXANOL	0.13	0.13	<0.050	0.14	0.13	0.13	0.13
C6-ALKENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
C4-SUBSTITUTED BENZENE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
LIMONENE	TRACE	TRACE	<0.050	0.061	0.099	0.088	0.11
C11-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
C11-ALKANE	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

TOTAL ALCOHOLS PLUS ACETONE	5.9	6.2	5.8	7.2	5.1	4.6	6.8
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TARGET COMPOUNDS (GC)							
CARBON MONOXIDE	TRACE	TRACE	TRACE	1.3	1.6	1.5	TRACE
METHANE	12	12	12	12	16	15	10
HYDROGEN	3.5	3.7	3.6	4.0	5.0	4.8	4.5
CARBON DIOXIDE	3800	3600	3600	7400	6300	5900	5700

TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	41	44	41	45	39	39	47
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TOTAL CONCENTRATION - OFP (NON-METHANE HYDROCARBONS)	9.2	9.5	8.7	11	7.7	8.5	16
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* GC/FID data results are in bold

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

TRACE: Amount detected is sufficient for compound identification only.

OFP: Octafluoropropane

2-PENTANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEXANE	ND	ND	0.00208	ND	ND	ND	0.00208	ND	ND	ND	ND
2,3-DIMETHYLPENTANE	ND	ND	0.00208	ND	ND	ND	0.00613	ND	ND	ND	ND
PENTANAL	ND	ND	ND	ND	ND	ND	0.00156	ND	ND	ND	ND
3-METHYLHEXANE	0.00208	0.00400	0.00581	ND	0.00208	ND	0.00942	ND	ND	ND	ND
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	0.00208	ND	ND	ND	ND
4-METHYL2-PENTANONE	ND	ND	ND	ND	ND	ND	0.00018	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	0.00338	0.00320	0.00167	0.00167	0.00167	ND	0.02696	0.00167	0.00167	0.00167	0.00347
HEXANAL	ND	ND	ND	ND	ND	ND	0.00139	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	0.00068	ND	ND	ND	ND	ND	ND	ND	ND
2-HEPTANONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANONE	ND	ND	0.00042	ND	ND	ND	0.00085	ND	0.00042	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	0.00202	0.00130	0.00248	0.00144	0.00165	ND	0.00354	0.00157	0.00179	0.00180	0.00180
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

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
CARBON DISULFIDE	ND	ND	ND	ND	ND	ND	0.00156	ND	ND	ND	ND
2-METHYL-2-PROPENAL	ND	ND	ND	ND	ND	ND	0.01471	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
DIMETHYLDISULFIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTAFLUOROPROPANE	0.00013	0.00042	0.00027	0.00018	0.00020	0.00024	0.00003	0.00018	0.00022	0.00033	0.00033
TRIMETHYLSILANOL	0.04477	0.03773	0.04235	0.03157	0.03654	0.01875	0.24849	0.03871	0.04947	0.03798	0.03798
HEXAMETHYLCYCLOTRISILOXANE	0.16485	0.16164	0.16238	0.11786	0.16477	0.15748	1.73787	0.15235	0.20074	0.16411	0.16411

OCTAMETHYLCYCLOTETRAILOXANE	0.00814	0.00846	0.00876	0.00615	0.00820	0.00625	0.04201	0.00747	0.00910	0.00828
DECAMETHYLCYCLOPENTASILOXANE	0.05242	0.04078	0.04272	0.03457	0.04063	0.03925	0.06935	0.04113	0.04823	0.04421

NON-TARGET COMPOUNDS

SULFURHEXAFLUORIDE	0.00010	0.00009	0.00007	0.00010	0.00010	0.00006	ND	0.00007	0.00009	0.00012
1,1,1,2-TETRAFLUOROETHANE	0.00075	0.00046	0.00068	0.00065	0.00070	ND	ND	0.00061	0.00066	0.00067
FORMALDEHYDE	0.20833	0.40000	0.20833	0.20833	ND	0.62500	ND	0.20833	0.20833	0.20833
PROPENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DIFLUOROETHANE	ND	ND	ND	ND	ND	ND	0.00037	ND	ND	ND
CHLORODIFLUOROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBONYLSULFIDE	ND	ND	0.00208	ND	ND	ND	0.00671	ND	ND	ND
ISOBUTANE	ND	ND	ND	ND	ND	ND	0.00054	ND	ND	ND
1-BUTENE	0.00005	0.00010	0.00005	0.00005	0.00005	0.00016	0.00090	0.00005	0.00005	0.00005
BUTANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FLUOROTRIMETHYLSILANE	ND	ND	ND	ND	ND	ND	0.21727	ND	ND	ND
2-METHYL-1,3-BUTADIENE	0.03198	0.01600	0.02900	0.02263	0.02722	0.02500	ND	0.02922	0.03233	0.03125
C7-ALKANE	0.00208	ND	0.00208	ND	0.00208	ND	0.00489	ND	0.00208	0.00208
PINENE	ND	ND	ND	ND	ND	ND	0.00101	ND	ND	ND
C10-ALKANE	ND	ND	ND	ND	ND	ND	0.00307	ND	ND	ND
C11-ALKANE	ND	ND	ND	ND	ND	ND	0.00393	ND	ND	ND
C11-ALKANE	ND	ND	ND	ND	ND	ND	0.00398	ND	ND	ND
LIMONENE	0.00022	ND	0.00022	0.00022	0.00022	ND	0.00022	0.00022	0.00047	0.00052
C11-ALKANE	ND	ND	ND	ND	ND	ND	0.00558	ND	ND	ND
C10-ALKANE	ND	ND	ND	ND	ND	ND	0.00482	ND	ND	ND
C11-ALKANE	ND	ND	ND	ND	ND	ND	0.00423	ND	ND	ND
C11-ALKANE	ND	ND	ND	ND	ND	ND	0.00131	ND	ND	ND
C10-ALKANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TARGET COMPOUNDS (GC)

CARBON MONOXIDE	0.11994	0.00000	0.09328	0.10542	0.10246	0.00000	0.06971	0.09412	0.08636	0.09793
METHANE	0.00349	0.00440	0.00480	0.00523	0.00527	0.00431	0.00023	0.00441	0.00446	0.00445
HYDROGEN	0.01608	0.02010	0.02089	0.01946	0.01769	0.01679	0.00000	0.01484	0.01540	0.01529
CARBON DIOXIDE	0.54794	0.45134	0.59294	0.51896	0.54414	0.37422	0.08143	0.53804	0.50161	0.47797

TOTAL T-VALUE	1.31302	1.23423	1.32989	1.17574	1.04159	1.38589	2.72405	1.21590	1.25269	1.19950
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TOTAL T-VALUE - OFP	1.31288	1.23381	1.32962	1.17556	1.04139	1.38565	2.72402	1.21573	1.25247	1.19917
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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 2B
ANALYTICAL RESULTS OF
SOYUZ 29S RETURN GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)						
	AA05344 S/N 2102 LAB 12/23/11 @ 19:00 GMT	AA05345 S/N 2088 JPM 12/23/11 @ 19:00 GMT	AA05346 S/N 2083 SM 12/23/11 @ 19:03 GMT	AA05347 S/N 2104 LAB 01/09/12 @ 11:10 GMT	AA05348 S/N 2093 SM 04/24/12 @ 10:40 GMT	AA05349 S/N 2097 LAB 04/24/12 @ 10:44 GMT	AA05351 S/N 2082 LAB 05/29/12 @ 10:20 GMT
TARGET COMPOUNDS (TO-14/POLAR)							
FREON12	ND	ND	ND	ND	ND	ND	ND
CHLOROMETHANE	ND	ND	ND	ND	ND	ND	ND
FREON114	ND	ND	ND	ND	ND	ND	ND
METHANOL	0.00507	0.00703	0.00580	0.00490	0.00439	0.00421	0.00616
ACETALDEHYDE	0.08205	0.06097	0.06348	0.07344	0.05175	0.06341	0.12102
VINYLCHELORIDE	ND	ND	ND	ND	ND	ND	ND
BROMOMETHANE	ND	ND	ND	ND	ND	ND	ND
ETHANOL	0.00226	0.00226	0.00217	0.00264	0.00170	0.00151	0.00264
CHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
ACETONITRILE	ND	ND	ND	ND	ND	ND	ND
PROPENAL	ND	ND	ND	ND	ND	ND	ND
ACETONE	0.00559	0.00548	0.00552	0.00738	0.00722	0.00765	0.00691
PROPANAL	0.00227	0.00227	0.00227	0.00227	ND	0.00227	0.00227
ISOPROPANOL	0.00353	0.00435	0.00356	0.00629	0.00375	0.00455	0.00288
FREON11	ND	ND	ND	ND	ND	ND	ND
FURAN	ND	ND	ND	ND	ND	ND	ND
ACRYLONITRILE	ND	ND	ND	ND	ND	ND	ND
PENTANE	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-PROPANOL	ND	ND	ND	ND	ND	ND	ND
METHYLACETATE	0.00021	0.00021	0.00021	0.00043	ND	0.00021	0.00132
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND
DICHLOROMETHANE	ND	ND	ND	ND	ND	ND	ND
3-CHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND
FREON113	ND	ND	ND	ND	ND	ND	ND
N-PROPANOL	0.00026	0.00026	0.00054	0.00058	ND	0.00057	0.00054
1,1-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
BUTANAL	ND	ND	ND	ND	ND	0.00192	ND
2-BUTANONE	0.00083	0.00083	0.00083	0.00083	ND	0.00083	0.00083
CIS-1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND
2-METHYLFURAN	ND	ND	ND	ND	ND	ND	ND
ETHYLACETATE	0.00039	0.00037	0.00036	0.00061	ND	0.00050	0.00437
HEXANE	ND	ND	ND	ND	ND	ND	ND
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND
2-BUTENAL	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROETHANE	0.01563	0.01563	0.01563	0.01563	ND	0.01563	0.01563
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
N-BUTANOL	0.00291	0.00255	0.00252	0.00271	0.00823	0.00273	0.00280
BENZENE	ND	ND	ND	ND	ND	ND	ND

CARBON TETRACHLORIDE	ND	ND	ND	ND	ND	ND	ND
2-PENTANONE	ND	ND	ND	ND	ND	ND	ND
2-METHYLHEXANE	ND	ND	ND	ND	ND	0.00936	ND
2,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	0.00644	ND
PENTANAL	ND	ND	ND	ND	ND	ND	ND
3-METHYLHEXANE	ND	ND	ND	0.00208	ND	0.01429	ND
1,2-DICHLOROPROPANE	ND	ND	ND	ND	ND	ND	ND
1,4-DIOXANE	ND	ND	ND	ND	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLFURAN	ND	ND	ND	ND	ND	ND	ND
N-HEPTANE	ND	ND	ND	ND	ND	0.00579	ND
4-METHYL-2-PENTANONE	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND
2-PENTENAL	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
TOLUENE	0.00167	0.00167	0.00167	0.00364	ND	0.00541	0.00391
HEXANAL	ND	ND	ND	ND	ND	ND	ND
MESITYLOXIDE	ND	ND	ND	ND	ND	ND	ND
1,2-DIBROMOETHANE	ND	ND	ND	ND	ND	ND	ND
BUTYLACETATE	ND	ND	ND	ND	ND	ND	ND
OCTANE	ND	ND	ND	ND	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND	ND	ND	ND	ND
CHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND
M/P-XYLENES	ND	ND	ND	ND	ND	0.00068	ND
2-HEPTANONE	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANONE	ND	ND	ND	ND	ND	ND	ND
HEPTANAL	ND	ND	ND	ND	ND	ND	ND
STYRENE	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
O-XYLENE	0.00170	0.00172	0.00206	0.00208	ND	0.00319	0.00257
NONANE	ND	ND	ND	ND	ND	ND	ND
1,3,5-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND
1,3-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND
1,4-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND
HEXACHLORO-1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND

SPECIAL INTEREST COMPOUNDS							
1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND
ETHYLENE OXIDE	ND	ND	ND	ND	ND	ND	ND
CARBON DISULFIDE	ND	ND	ND	ND	ND	ND	ND
2-METHYL-2-PROPENAL	ND	ND	ND	ND	ND	ND	ND
3-BUTEN-2-ONE	ND	ND	ND	ND	ND	ND	ND
2-ETHOXYETHANOL	ND	ND	ND	ND	ND	ND	ND
DIMETHYLDISULFIDE	ND	ND	ND	ND	ND	ND	ND
TRIMETHYLSILANOL	0.04352	0.04754	0.03927	0.05644	0.03457	0.04379	0.04275

HEXAMETHYLCYCLOTRILOXANE	0.10401	0.10561	0.10033	0.10751	0.08958	0.09515	0.08240
OCTAMETHYLCYCLOTETRAILOXANE	0.00998	0.01026	0.01051	0.01346	0.01057	0.00945	0.00871
DECAMETHYLCYCLOPENTASILOXANE	0.07179	0.07677	0.07859	0.07294	0.06523	0.06213	0.04624

NON-TARGET COMPOUNDS

OCTAFLUOROPROPANE	0.00037	0.00041	0.00038	0.00041	0.00036	0.00036	0.00037
SULFURHEXAFLUORIDE	0.00009	0.00010	ND	0.00009	ND	0.00008	0.00012
1,1,1,2-TETRAFLUOROETHANE	0.00048	0.00024	ND	0.00061	0.00053	0.00064	0.01081
PERFLUORO-2-METHYLPENTANE	ND	ND	ND	ND	ND	ND	0.00030
FORMALDEHYDE	ND	ND	ND	ND	ND	ND	ND
PROPENE	ND	ND	ND	ND	ND	ND	ND
CHLORODIFLUOROMETHANE	ND	ND	ND	ND	ND	ND	ND
CARBONYLSULFIDE	ND	ND	ND	ND	ND	ND	ND
ISOBUTANE	ND	ND	ND	ND	ND	0.00064	ND
1-BUTENE	0.00005	0.00005	ND	0.00005	0.00005	0.00005	0.00005
1,3-DIOXOLANE	0.00069	0.00069	ND	0.00143	0.00069	0.00069	0.00240
2-METHYL-1,3-BUTADIENE	0.01907	0.01824	ND	0.03396	0.03273	0.02753	0.02514
BUTYL ETHER	ND	ND	ND	ND	ND	ND	ND
PROPANOIC ACID, PENTYLESTER	ND	ND	ND	ND	ND	ND	ND
C11-ALKANE	ND	ND	ND	ND	ND	ND	ND
2-ETHYL-1-HEXANOL	0.00246	0.00247	ND	0.00264	0.00240	0.00237	0.00246
C6-ALKENE	ND	ND	ND	ND	ND	ND	ND
C4-SUBSTITUTED BENZENE	ND	ND	ND	ND	ND	ND	ND
LIMONENE	0.00022	0.00022	ND	0.00053	0.00086	0.00076	0.00095
C11-ALKANE	ND	ND	ND	ND	ND	ND	ND
C11-ALKANE	ND	ND	ND	ND	ND	ND	ND
C11-ALKANE	ND	ND	ND	ND	ND	ND	ND
C11-ALKANE	ND	ND	ND	ND	ND	ND	ND

TARGET COMPOUNDS (GC)

CARBON MONOXIDE	0.00749	0.00749	0.00752	0.07419	0.09321	0.09054	0.00752
METHANE	0.00347	0.00345	0.00348	0.00347	0.00453	0.00442	0.00299
HYDROGEN	0.01031	0.01076	0.01056	0.01178	0.01483	0.01420	0.01335
CARBON DIOXIDE	0.28851	0.27912	0.27880	0.56884	0.48443	0.45541	0.43745

TOTAL T-VALUE	0.68688	0.66902	0.63606	1.07385	0.91162	0.95935	0.85788
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TOTAL T-VALUE - OFP	0.68650	0.66861	0.63568	1.07345	0.91126	0.95899	0.85751
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ND : Value is less than the laboratory report detection limit.

OFP: Octafluoropropane

Note: Number of decimal places in T-Values do not represent significant figures of measurements.