STS 132 Return Samples: Assessment of Air Quality aboard the Shuttle (STS-132) and International Space Station (ULF4)

Space Shuttle: The toxicological assessments of 2 grab sample canisters (GSCs) from the Shuttle are reported in Table 1. Analytical methods have not changed from earlier reports. The recoveries of the 3 surrogates (^{13}C-acetone, fluorobenzene, and chlorobenzene) from the 2 Shuttle GSCs averaged 93, 85%, and 88 %, respectively. Based on the end-of-mission sample, the Shuttle atmosphere was acceptable for human respiration.

Table 1. Analytical Summary of Shuttle Samples

Sample Location	Date of Sample	NMVOCs [a] (mg/m^3)	Freon 218 (mg/m^3)	T Value[b] (units)	Alcohols (mg/m^3)	Formaldehyde ($\mu g/m^3$)
Preflight	5/14/10	0.1	<0.025	0.01	0.06	--
Mid-deck (end of mission)	5/26/10	3.0	22[d]	0.18	0.89	--
Guideline		*25*	*none*	*1.0*	*none*[c]	*<120*

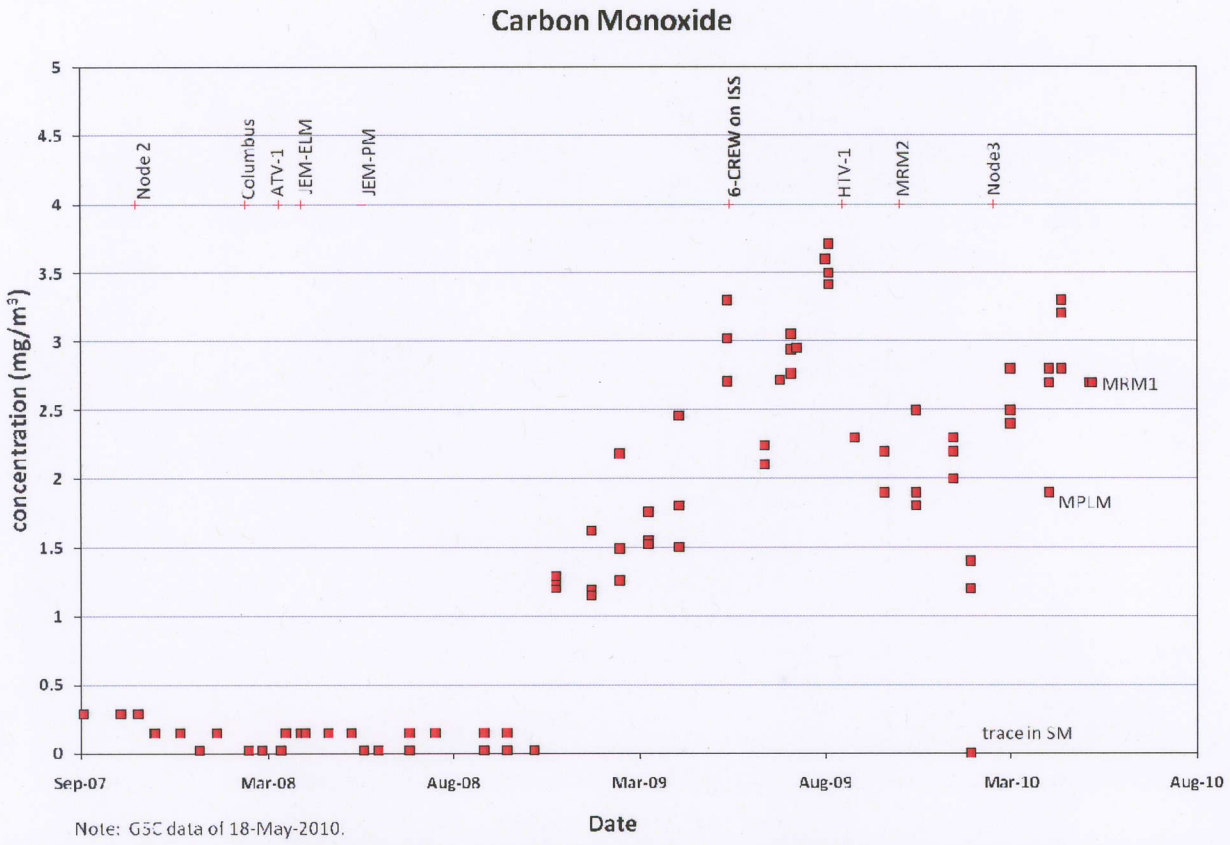
[a] Non-methane volatile organic hydrocarbons, excluding Freon 218
[b] Based on 7-day SMACs and calculated excluding CO_2, formaldehyde, and siloxanes.
[c] There is no guideline value because water is not recovered from humidity condensate on Shuttle as it is on ISS.
[d] This is residual from the ISS during docked phase.

International Space Station: The toxicological assessment of 7 GSCs from the ISS is shown in Table 2. The recoveries of the 3 standards (as listed above) from the GSCs averaged 78, 96 and 90%, respectively. Recovery from formaldehyde control badges ranged from 90 to 112%.

Table 2. Analytical Summary of ISS Results

Module/Sample	Approx. Date of Sample	NMVOCs[a] (mg/m^3)	Freon 218 (mg/m^3)	T Value[b] (units)	Alcohols (mg/m^3)	Formaldehyde ($\mu g/m^3$)
JEM	4/20/10	5.3	64	**1.07**[c]	3.3	--
Lab	4/20/10	4.9	65	0.36	3.6	35
SM	4/20/10	7.5	60	0.38	**6.0**[c]	46
SM	5/18/10	6.0	48	**1.08**[c]	3.9	--
Lab	5/18/10	5.7	47	0.34	4.1	--
Columbus	5/18/10	5.7	54	0.96[c]	3.6	--
MRM1 (first entry)	5/20/10	17	39[d]	1.70	8.1	--
Guideline		*<25*	*none*	*<1.0*	*<5*	*<120*

[a] Non-methane volatile organic hydrocarbons, excluding Freon 218
[b] Based on 180-d SMACs and calculated excluding CO_2, formaldehyde, and siloxanes.
[c] Higher T value is due to traces of propenal, a mucosal irritant. High alcohol is due to methanol.
[d] The relatively high value for Freon 218 suggests that capture of the first-entry sample was delayed, allowing diffusion from the ISS into the atmosphere of the newly-opened module.



Carbon Monoxide Accumulation aboard ISS: From late 2008 the nominal concentrations of CO had been increasing gradually (see figure above). The results from samples returned on this flight indicate that the CO concentrations, after dropping in late 2009, have cycled upward. In any case, these changes are well below the 180-day SMAC for CO, which is17 mg/m^3. There is no threat to crew health. The source of the additional CO is unknown.

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. Past observations of sporadic elevations of propenal have recurred, but at a lower level. We must continue to be vigilant when dealing with nominal atmospheres in ISS. New, unmanned modules, such as the MRM1, require special attention when the crew first enters.

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Enclosures

Table 1A: Analytical concentrations of compounds found in the STS-132 GSCs
Table 1B: Analytical concentrations of compounds found in ULF4 GSCs
Table 2A: T-values of the compounds in table 1A
Table 2B: T-values of the compounds in table 1B

TABLE 1A
ANALYTICAL RESULTS OF
STS-132 GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m3)	
	AA04917 MIDDDECK SN 1101 05/26/10 @ 07:38 GMT	AA04909 PRE-FLIGHT SN 1039 05/14/10 @12:57 EDT
TARGET COMPOUNDS (TO-14/POLAR)* **		
FREON12	<0.025	<0.025
CHLOROMETHANE	0.029	<0.025
FREON114	<0.025	<0.025
METHANOL	0.18	TRACE
ACETALDEHYDE	0.17	TRACE
VINYLCHLORIDE	<0.025	<0.025
BROMOMETHANE	<0.025	<0.025
ETHANOL	0.45	TRACE
CHLOROETHANE	<0.025	<0.025
ACETONITRILE	TRACE	TRACE
PROPENAL	<0.025	<0.025
ACETONE	0.19	0.028
PROPANAL	0.054	TRACE
ISOPROPANOL	0.063	TRACE
FREON11	<0.025	<0.025
FURAN	<0.025	<0.025
ACRYLONITRILE	<0.025	<0.025
PENTANE	TRACE	TRACE
2-METHYL-2-PROPANOL	TRACE	<0.025
METHYLACETATE	<0.025	<0.025
1,1-DICHLOROETHENE	<0.025	<0.025
DICHLOROMETHANE	<0.025	<0.025
3-CHLOROPROPENE	<0.025	<0.025
FREON113	<0.025	<0.025
N-PROPANOL	TRACE	<0.025
1,1-DICHLOROETHANE	<0.025	<0.025
BUTANAL	TRACE	<0.025
2-BUTANONE	0.045	<0.025
CIS-1,2-DICHLOROETHENE	<0.025	<0.025
2-METHYLFURAN	<0.025	<0.025
ETHYLACETATE	<0.025	<0.025
HEXANE	<0.025	<0.025
CHLOROFORM	<0.025	<0.025
2-BUTENAL	<0.025	<0.025
1,2-DICHLOROETHANE	<0.025	<0.025
1,1,1-TRICHLOROETHANE	<0.025	<0.025
N-BUTANOL	<0.025	<0.025
BENZENE	<0.025	<0.025
CARBONTETRACHLORIDE	<0.025	<0.025
2-PENTANONE	<0.025	<0.025

2-METHYLHEXANE	<0.025	<0.025
2,3-DIMETHYLPENTANE	<0.025	<0.025
PENTANAL	TRACE	<0.025
3-METHYLHEXANE	<0.025	<0.025
1,2-DICHLOROPROPANE	<0.025	<0.025
1,4-DIOXANE	<0.025	<0.025
TRICHLOROETHENE	<0.025	<0.025
2,5-DIMETHYLFURAN	<0.025	<0.025
N-HEPTANE	<0.025	<0.025
4-METHYL2-PENTANONE	<0.025	<0.025
CIS-1,3-DICHLOROPROPENE	<0.025	<0.025
2-PENTENAL	<0.025	<0.025
TRANS-1,3-DICHLOROPROPENE	<0.025	<0.025
1,1,2-TRICHLOROETHANE	<0.025	<0.025
TOLUENE	<0.025	<0.025
HEXANAL	<0.025	<0.025
MESITYLOXIDE	<0.025	<0.025
1,2-DIBROMOETHANE	<0.025	<0.025
BUTYLACETATE	<0.025	<0.025
OCTANE	<0.025	<0.025
TETRACHLOROETHENE	<0.025	<0.025
CHLOROBENZENE	<0.025	<0.025
ETHYLBENZENE	<0.025	<0.025
M/P-XYLENES	<0.025	<0.025
2-HEPTANONE	<0.025	<0.025
CYCLOHEXANONE	<0.025	<0.025
HEPTANAL	<0.025	<0.025
STYRENE	<0.025	<0.025
1,1,2,2-TETRACHLOROETHANE	<0.025	<0.025
O-XYLENE	<0.025	<0.025
NONANE	<0.025	<0.025
1,3,5-TRIMETHYLBENZENE	<0.025	<0.025
1,2,4-TRIMETHYLBENZENE	<0.025	<0.025
1,3-DICHLOROBENZENE	<0.025	<0.025
1,4-DICHLOROBENZENE	<0.025	<0.025
1,2-DICHLOROBENZENE	<0.025	<0.025
1,2,4-TRICHLOROBENZENE	<0.025	<0.025
HEXACHLORO-1,3-BUTADIENE	<0.025	<0.025

TARGET COMPOUNDS (TOXIC)		
1,3-BUTADIENE	<0.025	<0.025
ETHYLENE OXIDE	<0.025	<0.025
CARBON DISULFIDE	<0.025	<0.025
2-METHYL-2-PROPENAL	<0.025	<0.025
3-BUTEN-2-ONE	<0.025	<0.025
2-ETHOXYETHANOL	<0.025	<0.025
DIMETHYLDISULFIDE	<0.025	<0.025
OCTAMETHYLCYCLOTETRASILOXANE	*	*

NON-TARGET COMPOUNDS		
OCTAFLUOROPROPANE**	22	<0.025
SULFURHEXAFLUORIDE	0.17	<0.025

BROMOTRIFLUOROMETHANE	1.6	<0.025
HEXAMETHYLCYCLOTRISILOXANE	*	*
DECAMETHYLCYCLOPENTASILOXANE	*	*

TOTAL ALCOHOLS PLUS ACETONE	**0.89**	**0.065**

TARGET COMPOUNDS (GC)* **		
CARBON MONOXIDE	4.8	< 0.57
METHANE	46	< 1.6
HYDROGEN	12	< 0.41
CARBON DIOXIDE	3500	TRACE

TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	**25**	**0.12**

TOTAL CONCENTRATION MINUS OFP (NON-METHANE HYDROCARBONS)	**3.0**	**0.12**

***Present, subject to large, random variability, therefore not quantifiable**

** Measurements are calibrated by one-point calibration

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

TRACE: Amount detected is sufficient for compound identification only.

*** Measurements are calibrated by multi-point initial calibration and verified by mid-point continuing calibration.

TABLE 1B
ANALYTICAL RESULTS OF
ULF4 RETURN GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m3)						
	AA04918 S/N 1096 JEM 4/20/10 @ 13:41 GMT	**AA04919 S/N 1077 LAB 04/20/10 @ 13:43 GMT**	**AA04920 S/N 1070 SM 04/20/10 @ 14:08 GMT**	**AA04921 S/N 1105 SM 05/18/10 @ 14:30 GMT**	**AA04922 S/N 1109 LAB 05/18/10 @ 14:35 GMT**	**AA04923 S/N 1110 COLUMBUS 05/18/10 @ 14:40 GMT**	**AA04924 S/N 1085 MRM1 5/20/10 @ 10:53 GMT**
TARGET COMPOUNDS (TO-14/POLAR)+++							
FREON12	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CHLOROMETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	TRACE
FREON114	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
METHANOL *#	0.35	0.34	***2.7***	0.38	0.37	0.43	0.51
ACETALDEHYDE	0.25	0.066	0.088	0.38	0.16	0.29	0.35
VINYLCHLORIDE	<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
ETHANOL *	**2.4**	**2.9**	**2.9**	**3.0**	**3.1**	**2.5**	**5.2**
CHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
ACETONITRILE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
PROPENAL	TRACE	<0.025	<0.025	TRACE	<0.025	TRACE	TRACE
ACETONE	0.30	0.19	0.21	0.29	0.25	0.31	0.92
PROPANAL	0.087	TRACE	TRACE	0.11	0.043	0.085	0.086
ISOPROPANOL *	0.13	0.13	0.12	0.12	0.14	0.16	**1.2**
FREON11	<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
ACRYLONITRILE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
PENTANE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
2-METHYL-2-PROPANOL	<0.025	<0.025	<0.025	TRACE	<0.025	TRACE	TRACE
METHYLACETATE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	0.028
1,1-DICHLOROETHENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
DICHLOROMETHANE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
3-CHLOROPROPENE	<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
N-PROPANOL	0.039	0.034	0.032	0.033	0.092	0.112	0.033
1,1-DICHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
BUTANAL	0.047	<0.025	<0.025	0.060	TRACE	0.048	0.040
2-BUTANONE	0.058	TRACE	TRACE	0.064	0.026	0.040	0.032
CIS-1,2-DICHLOROETHENE	<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
ETHYLACETATE	0.037	0.040	0.039	0.041	0.035	0.032	0.13
HEXANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	TRACE
CHLOROFORM	<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
1,2-DICHLOROETHANE	TRACE	0.025	0.031	TRACE	TRACE	TRACE	0.052
1,1,1-TRICHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
N-BUTANOL	0.072	0.068	0.075	0.070	0.11	0.099	0.19
BENZENE	<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
2-PENTANONE	0.028	<0.025	<0.025	0.036	TRACE	TRACE	TRACE
2-METHYLHEXANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.10
2,3-DIMETHYLPENTANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.10
PENTANAL	0.037	<0.025	<0.025	0.026	TRACE	0.030	0.028
3-METHYLHEXANE	TRACE	<0.025	TRACE	TRACE	<0.025	<0.025	0.15
1,2-DICHLOROPROPANE	<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
TRICHLOROETHENE	<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
N-HEPTANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.044
4-METHYL2-PENTANONE	<0.025	<0.025	<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
2-PENTENAL	<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
1,1,2-TRICHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
TOLUENE	<0.025	<0.025	TRACE	<0.025	<0.025	<0.025	0.11
HEXANAL	0.031	<0.025	<0.025	TRACE	TRACE	0.026	TRACE
MESITYLOXIDE	<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
BUTYLACETATE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.12
OCTANE	<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
CHLOROBENZENE	<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
M/P-XYLENES	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	TRACE
2-HEPTANONE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CYCLOHEXANONE	0.047	0.028	0.027	0.035	0.034	0.038	0.14
HEPTANAL	0.040	<0.025	<0.025	TRACE	TRACE	0.026	TRACE
STYRENE	<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
O-XYLENE	TRACE	TRACE	TRACE	0.036	0.032	0.030	1.8
NONANE	<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
1,2,4-TRIMETHYLBENZENE	<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
1,4-DICHLOROBENZENE	<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
1,2,4-TRICHLOROBENZENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
HEXACHLORO-1,3-BUTADIENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025

TARGET COMPOUNDS (TOXIC)++++							
1,3-BUTADIENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
ETHYLENE OXIDE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CARBON DISULFIDE	<0.025	TRACE	TRACE	<0.025	<0.025	<0.025	<0.025
2-METHYL-2-PROPENAL	TRACE	<0.025	<0.025	TRACE	TRACE	TRACE	0.032
3-BUTEN-2-ONE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2-ETHOXYETHANOL	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
DIMETHYLDISULFIDE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
OCTAMETHYLCYCLOTETRASILOXANE	##	##	##	##	##	##	##

NON-TARGET COMPOUNDS++++							
OCTAFLUOROPROPANE++	64	65	60	48	47	54	39
SULFURHEXAFLUORIDE	0.26	0.18	0.27	0.31	0.31	0.35	0.24
1,1,1,2-TERTRAFLUOROETHANE	0.27	0.28	0.28	0.16	0.17	0.19	0.14
BROMOTRIFLUOROMETHANE **	0.065	0.045	0.065	0.23	0.23	0.27	0.25
FORMALDEHYDE	0.035	0.055	0.033	0.10	0.066	0.058	0.035
CHLORODIFLUOROMETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	TRACE	<0.025
PROPENE	0.027	<0.025	<0.025	TRACE	TRACE	TRACE	0.54
CARBONYLSULFIDE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	0.040
ISOPRENE	0.12	0.12	0.13	0.11	0.099	0.088	0.10
TRIMETHYLSILANOL	0.29	0.24	0.24	0.18	0.16	0.21	2.2
2-METHYLPROPANENITRILE (ISOBUTYRONITRILE)	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.043
CARBONICACIDDIMETHYLESTER	0.034	0.034	0.032	0.030	0.028	0.031	0.078
2-METHYL-1-PROPANOL	TRACE	TRACE	TRACE	<0.025	TRACE	<0.025	0.74
HEXAMETHYLCYCLOTRISILOXANE	##	##	##	##	##	##	##
C12-ALKANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.19
DECAMETHYLTETRASILOXANE	0.11	0.086	0.096	<0.025	0.12	0.090	0.13
C4-SUBSTITUTEDBENZENE	<0.025	<0.025	<0.025	<0.025	TRACE	<0.025	<0.025
LIMONENE	0.080	0.096	0.11	0.13	0.10	0.087	0.088
C12-ALKANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.21
C12-ALKANE	TRACE	<0.025	<0.025	TRACE	0.027	0.026	0.32
DECAMETHYLCYCLOPENTASILOXANE	##	##	##	##	##	##	##

TOTAL ALCOHOLS PLUS ACETONE	**3.3**	**3.6**	**6.0**	**3.9**	**4.1**	**3.6**	**8.1**

TARGET COMPOUNDS (GC)+++							
CARBON MONOXIDE	3.3	3.2	2.8	2.2	2.7	2.7	2.7
METHANE	17	18	18	18	17	17	16
HYDROGEN	4.6	4.4	4.7	4.3	4.2	4.4	3.8
CARBON DIOXIDE	7300	7600	7900	7000	6600	5900	6700

TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	**69**	**70**	**68**	**55**	**53**	**60**	**56**

TOTAL CONCENTRATION - OFP (NON-METHANE HYDROCARBONS)	**5.4**	**5.0**	**7.6**	**6.1**	**5.9**	**5.8**	**17**

*** FROM GC/FID RESULTS**
****CORRECTED FOR ION 69**
 # FROM GC RESULTS; MeOH Conc.=GC MeOH Conc.-(2* GC/MS ACETALDEHYDE Conc.)
Present, subject to large, random variability, therefore not quantifiable
++ Measurements are calibrated by single-point calibration.
+++ Measurements are calibrated by multi-point initial calibration and verified by mid-point continuing calibration.
++++ Book B-values are used for quantitation. B-values are referenced in the book "Compilation of Mass Spectral Data" by A. Cornu and R. Massot, 1966
< : Value is less than the laboratory report detection limit.
TRACE: Amount detected is sufficient for compound identification only.

TABLE 2A
ANALYTICAL RESULTS OF
STS-132 GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (7-d SMAC)	
	AA04917 MIDDDECK SN 1101 05/26/10 @ 07:38 GMT	AA04909 PRE-FLIGHT SN 1039 05/14/10 @12:57 EDT
TARGET COMPOUNDS (TO-14/POLAR)		
FREON12	ND	ND
CHLOROMETHANE	0.00070	ND
FREON114	ND	ND
METHANOL	0.00197	0.00014
ACETALDEHYDE	0.04224	0.00313
VINYLCHLORIDE	ND	ND
BROMOMETHANE	ND	ND
ETHANOL	0.00022	0.00001
CHLOROETHANE	ND	ND
ACETONITRILE	0.00187	0.00187
PROPENAL	ND	ND
ACETONE	0.00373	0.00054
PROPANAL	0.00493	0.00114
ISOPROPANOL	0.00042	0.00008
FREON11	ND	ND
FURAN	ND	ND
ACRYLONITRILE	ND	ND
PENTANE	0.00007	0.00007
2-METHYL-2-PROPANOL	0.00008	ND
METHYLACETATE	ND	ND
1,1-DICHLOROETHENE	ND	ND
DICHLOROMETHANE	ND	ND
3-CHLOROPROPENE	ND	ND
FREON113	ND	ND
N-PROPANOL	0.00013	ND
1,1-DICHLOROETHANE	ND	ND
BUTANAL	0.00096	ND
2-BUTANONE	0.00150	ND
CIS-1,2-DICHLOROETHENE	ND	ND
2-METHYLFURAN	ND	ND
ETHYLACETATE	ND	ND
HEXANE	ND	ND
CHLOROFORM	ND	ND
2-BUTENAL	ND	ND
1,2-DICHLOROETHANE	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND
N-BUTANOL	ND	ND
BENZENE	ND	ND
CARBONTETRACHLORIDE	ND	ND
2-PENTANONE	ND	ND

2-METHYLHEXANE	ND	ND
2,3-DIMETHYLPENTANE	ND	ND
PENTANAL	0.00078	ND
3-METHYLHEXANE	ND	ND
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	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND
2-PENTENAL	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND
TOLUENE	ND	ND
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	ND	ND
2-HEPTANONE	ND	ND
CYCLOHEXANONE	ND	ND
HEPTANAL	ND	ND
STYRENE	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND
O-XYLENE	ND	ND
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

TARGET COMPOUNDS (TOXIC)		
1,3-BUTADIENE	ND	ND
ETHYLENE OXIDE	ND	ND
CARBON DISULFIDE	ND	ND
2-METHYL-2-PROPENAL	ND	ND
3-BUTEN-2-ONE	ND	ND
2-ETHOXYETHANOL	ND	ND
DIMETHYLDISULFIDE	ND	ND
OCTAMETHYLCYCLOTETRASILOXANE	*	*

NON-TARGET COMPOUNDS		
OCTAFLUOROPROPANE**	0.00026	ND
SULFURHEXAFLUORIDE	0.00014	ND

BROMOTRIFLUOROMETHANE	0.00014	ND
HEXAMETHYLCYCLOTRISILOXANE	*	*
DECAMETHYLCYCLOPENTASILOXANE	*	*

TARGET COMPOUNDS (GC)		
CARBON MONOXIDE	0.07609	0.00000
METHANE	0.01303	0.00000
HYDROGEN	0.03524	0.00000
CARBON DIOXIDE	0.26705	0.01538

TOTAL T-VALUE	**0.45155**	**0.02234**

***Present, but not included in total T-Value**

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
ULF4 RETURN GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)						
	AA04918 S/N 1096 JEM 4/20/10 @ 13:41 GMT	**AA04919 S/N 1077 LAB 04/20/10 @ 13:43 GMT**	**AA04920 S/N 1070 SM 04/20/10 @ 14:08 GMT**	**AA04921 S/N 1105 SM 05/18/10 @ 14:30 GMT**	**AA04922 S/N 1109 LAB 05/18/10 @ 14:35 GMT**	**AA04923 S/N 1110 COLUMBUS 05/18/10 @ 14:40 GMT**	**AA04924 S/N 1085 MRM1 5/20/10 @ 10:53 GMT**
TARGET COMPOUNDS (TO-14/POLAR)							
FREON12	ND	ND	ND	ND	ND	ND	ND
CHLOROMETHANE	ND	ND	ND	ND	ND	ND	0.00030
FREON114	ND	ND	ND	ND	ND	ND	ND
METHANOL *#	0.00391	0.00374	***0.02975***	0.00422	0.00412	0.00477	0.00571
ACETALDEHYDE	0.06373	0.01647	0.02188	0.09541	0.04013	0.07237	0.08835
VINYLCHLORIDE	ND	ND	ND	ND	ND	ND	ND
BROMOMETHANE	ND	ND	ND	ND	ND	ND	ND
ETHANOL *	**0.00121**	**0.00143**	**0.00144**	**0.00149**	**0.00154**	**0.00126**	**0.00262**
CHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
ACETONITRILE	0.00187	0.00187	0.00187	0.00187	0.00187	0.00187	0.00187
PROPENAL	0.62500	ND	ND	0.69111	ND	0.56618	0.62500
ACETONE	0.00571	0.00357	0.00395	0.00560	0.00487	0.00590	0.01761
PROPANAL	0.00789	0.00114	0.00114	0.01020	0.00390	0.00776	0.00786
ISOPROPANOL *	0.00090	0.00084	0.00077	0.00082	0.00095	0.00106	**0.00821**
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	0.00139	0.00139	0.00139	0.00139	0.00139	0.00139	0.00139
2-METHYL-2-PROPANOL	ND	ND	ND	0.00010	ND	0.00010	0.00010
METHYLACETATE	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00023
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND
DICHLOROMETHANE	0.00125	0.00125	0.00125	0.00125	0.00125	0.00125	0.00125
3-CHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND
FREON113	ND	ND	ND	ND	ND	ND	ND
N-PROPANOL	0.00039	0.00034	0.00032	0.00034	0.00094	0.00114	0.00033
1,1-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
BUTANAL	0.00363	ND	ND	0.00464	0.00096	0.00370	0.00305
2-BUTANONE	0.00193	0.00042	0.00042	0.00214	0.00088	0.00134	0.00108
CIS-1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND
2-METHYLFURAN	ND	ND	ND	ND	ND	ND	ND
ETHYLACETATE	0.00021	0.00022	0.00021	0.00023	0.00019	0.00018	0.00071
HEXANE	ND	ND	ND	ND	ND	ND	0.00114
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND
2-BUTENAL	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROETHANE	0.00781	0.01583	0.01935	0.00781	0.00781	0.00781	0.03270
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
N-BUTANOL	0.00181	0.00169	0.00187	0.00174	0.00270	0.00248	0.00463
BENZENE	ND	ND	ND	ND	ND	ND	ND
CARBONTETRACHLORIDE	ND	ND	ND	ND	ND	ND	ND
2-PENTANONE	0.00040	ND	ND	0.00051	0.00018	0.00018	0.00018
2-METHYLHEXANE	ND	ND	ND	ND	ND	ND	0.00833
2,3-DIMETHYLPENTANE	ND	ND	ND	ND	ND	ND	0.00847
PENTANAL	0.00233	ND	ND	0.00161	0.00078	0.00186	0.00176
3-METHYLHEXANE	0.00104	ND	0.00104	0.00104	ND	ND	0.01259
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	ND	0.00368
4-METHYL2-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	ND	ND	0.00083	ND	ND	ND	0.00715
HEXANAL	0.00170	ND	ND	0.00069	0.00069	0.00144	0.00069

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	0.00063
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	ND	0.00034
2-HEPTANONE	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANONE	0.00078	0.00047	0.00046	0.00059	0.00057	0.00064	0.00232
HEPTANAL	0.00193	ND	ND	0.00060	0.00060	0.00124	0.00060
STYRENE	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
O-XYLENE	0.00034	0.00034	0.00034	0.00096	0.00088	0.00080	0.04887
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

TARGET COMPOUNDS (TOXIC)							
1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND
ETHYLENE OXIDE	ND	ND	ND	ND	ND	ND	ND
CARBON DISULFIDE	ND	0.00078	0.00078	ND	ND	ND	ND
2-METHYL-2-PROPENAL	0.00735	ND	ND	0.00735	0.00735	0.00735	0.01870
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
OCTAMETHYLCYCLOTETRASILOXANE	##	##	##	##	##	##	##

NON-TARGET COMPOUNDS							
OCTAFLUOROPROPANE++	0.00076	0.00076	0.00071	0.00057	0.00056	0.00064	0.00046
SULFURHEXAFLUORIDE	0.00022	0.00015	0.00023	0.00026	0.00026	0.00029	0.00020
1,1,1,2-TERTRAFLUOROETHANE	0.00264	0.00266	0.00268	0.00156	0.00162	0.00178	0.00135
BROMOTRIFLUOROMETHANE **	0.00001	0.00000	0.00001	0.00002	0.00002	0.00002	0.00002
FORMALDEHYDE	0.29113	0.45693	0.27568	0.83677	0.55406	0.47964	0.28763
CHLORODIFLUOROMETHANE	ND	ND	ND	ND	ND	0.00000	ND
PROPENE	0.00003	ND	ND	0.00001	0.00001	0.00001	0.00063
CARBONYLSULFIDE	0.00104	0.00104	0.00104	0.00104	0.00104	0.00104	0.00329
ISOPRENE	0.03945	0.04095	0.04464	0.03634	0.03311	0.02927	0.03328
TRIMETHYLSILANOL	0.07142	0.06095	0.06010	0.04472	0.04104	0.05175	0.55206
2-METHYLPROPANENITRILE (ISOBUTYRONITRILE)	ND	ND	ND	ND	ND	ND	0.00586
CARBONICACIDDIMETHYLESTER	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00003
2-METHYL-1-PROPANOL	0.00010	0.00010	0.00010	ND	0.00010	ND	0.00610
HEXAMETHYLCYCLOTRISILOXANE	##	##	##	##	##	##	##
C12-ALKANE	ND	ND	ND	ND	ND	ND	0.00361
DECAMETHYLTETRASILOXANE	0.00071	0.00054	0.00060	ND	0.00073	0.00057	0.00082
C4-SUBSTITUTEDBENZENE	ND	ND	ND	ND	0.00089	ND	ND
LIMONENE	0.00070	0.00084	0.00094	0.00115	0.00087	0.00076	0.00076
C12-ALKANE	ND	ND	ND	ND	ND	ND	0.00401
C12-ALKANE	0.00024	ND	ND	0.00024	0.00052	0.00050	0.00610
DECAMETHYLCYCLOPENTASILOXANE	##	##	##	##	##	##	##

TARGET COMPOUNDS (GC)							
CARBON MONOXIDE	0.19452	0.18988	0.16291	0.13086	0.15669	0.15975	0.15859
METHANE	0.00496	0.00503	0.00508	0.00511	0.00495	0.00495	0.00452
HYDROGEN	0.01343	0.01303	0.01368	0.01276	0.01222	0.01281	0.01127
CARBON DIOXIDE	0.56050	0.58768	0.60686	0.53749	0.50590	0.45327	0.51848

TOTAL T-VALUE	**1.92648**	**1.41245**	**1.26443**	**2.45274**	**1.39927**	**1.89123**	**2.51753**

TOTAL T-VALUE - OFP	**1.92572**	**1.41169**	**1.26372**	**2.45217**	**1.39871**	**1.89060**	**2.51706**

*** FROM GC/FID RESULTS**

Present, subject to large, random variability, therefore not quantifiable

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

TRACE: Amount detected is sufficient for compound identification only.