STS 128 Return Samples: Assessment of Air Quality aboard the Shuttle (STS-128) and International Space Station (17A)

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 GSCs averaged 110, 102, and 103 %, 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 (µg/m^3)
Preflight	8/28/09	0.2	0	0.01	0.1	--
Flight-deck (end mission)	9/11/09	6.0	130	0.24	0.9	--

[a] Non-methane volatile organic hydrocarbons, excluding Freon 218
[b] Calculated excluding CO_2, formaldehyde, and siloxanes.

The toxicological assessment of 8 GSCs and 6 pairs of formaldehyde badges from the ISS is shown in Table 2. The recoveries of the 3 standards (as listed above) from the GSCs averaged 89, 99 and 94%, respectively. Two formaldehyde-badge lab controls averaged 90% recovery.

Table 2. Analytical Summary of ISS Results

Module/Sample	Approx. Date	NMVOCs[a] (mg/m^3)	Freon 218 (mg/m^3)	T Value[b] (units)	Alcohols (mg/m^3)	Formaldehyde (µg/m^3)
Lab	5/28/09	--	--	--	--	35
SM	5/28/09	--	--	--	--	31
Lab	7/3/09	--	--	--	--	32
SM	7/3/09	--	--	--	--	22
SM	7/28/09	6.4	170	**3.3**[c]	3.3	21
Lab	7/28/09	3.6	150	0.3	2.6	27
Columbus	7/28/09	3.4	160	0.3	2.3	--
Lab	8/3/09	4.3	170	0.6	3.1	--
MPLM (first entry)	9/1/09	20	30	**2.0**	**9.4**	--
SM	9/3/09	5.6	190	0.9	4.0	--
Lab	9/3/09	3.6	180	0.3	2.7	--
JEM	9/3/09	3.7	170	0.3	2.7	--
Guideline		*<25*	*none*	*<1.0*	*<5*	*<120*

[a] Non-methane volatile organic hydrocarbons, excluding Freon 218
[b] Calculated excluding CO_2, formaldehyde, and siloxanes.
[c] High T value is due to traces of propenal, an irritant. Other aldehydes were also present in this sample.

The Freon 218 values suggest a steady state over the period of the sampling with new sources and minimal scrubbing in balance. The T-values are generally within acceptable range (<1); however, one value was elevated due primarily to trace amounts of propenal, a potent mucosal irritant. The crew has not reported any eye or upper airway irritation associated with the SM atmosphere from this time period, and the elevated T-value was

confined to a single module. The lack of time-resolution in sampling confounds our ability to identify a source.

The first-entry sample from the MPLM showed a high T-value, as expected, before the MPLM atmosphere was dispersed into the ISS atmosphere and the pollutants became highly diluted and scrubbed. The compounds with a T-value contribution greater than 0.1 included the following: 2-methyl furan, benzene, fluorotrimethylsilane, trimethylsilanol, and carbon monoxide. The large value for alcohols was primarily due to 2-propanol, which probably originated from ground-based "cleaning" of surfaces. The fact that there was 30 mg/m^3 Freon 218 in the MPLM sample proves that some mixing of the ISS atmosphere into the MPLM had occurred before the sample was acquired.

John T. James, Ph.D.
Chief Toxicologist

Enclosures
Table 1A: Analytical concentrations of compounds found in the STS-128 GSCs
Table 1B: Analytical concentrations of compounds found in 17A 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-128 RETURN GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m3)		
	AA04735 Flight-Deck SN 1079 09/11/09 @ 14:24 GMT	AA04732 Preflight SN 1022 08/24/09 @ 20:22 EDT	AA04733 Preflight SN 1073 08/28/09 @ 19:00 EDT
TARGET COMPOUNDS (TO-14/POLAR)* **			
FREON12	<0.025	<0.025	<0.025
CHLOROMETHANE	0.036	<0.025	<0.025
FREON114	<0.025	<0.025	<0.025
METHANOL	0.17	0.036	TRACE
ACETALDEHYDE	0.15	0.032	TRACE
VINYLCHLORIDE	<0.025	<0.025	<0.025
BROMOMETHANE	<0.025	<0.025	<0.025
ETHANOL	0.47	TRACE	TRACE
CHLOROETHANE	<0.025	<0.025	<0.025
ACETONITRILE	TRACE	<0.025	<0.025
PROPENAL	<0.025	<0.025	<0.025
ACETONE	0.15	0.030	TRACE
PROPANAL	TRACE	TRACE	TRACE
ISOPROPANOL	0.050	TRACE	0.063
FREON11	<0.025	<0.025	<0.025
FURAN	<0.025	<0.025	<0.025
ACRYLONITRILE	<0.025	<0.025	<0.025
PENTANE	<0.025	<0.025	<0.025
2-METHYL-2-PROPANOL	TRACE	<0.025	<0.025
METHYLACETATE	<0.025	<0.025	<0.025
1,1-DICHLOROETHENE	<0.025	<0.025	<0.025
DICHLOROMETHANE	TRACE	<0.025	<0.025
3-CHLOROPROPENE	<0.025	<0.025	<0.025
FREON113	<0.025	<0.025	<0.025
N-PROPANOL	TRACE	<0.025	<0.025
1,1-DICHLOROETHANE	<0.025	<0.025	<0.025
BUTANAL	TRACE	<0.025	<0.025
2-BUTANONE	TRACE	<0.025	<0.025
CIS-1,2-DICHLOROETHENE	<0.025	<0.025	<0.025
2-METHYLFURAN	<0.025	<0.025	<0.025
ETHYLACETATE	<0.025	<0.025	<0.025
HEXANE	<0.025	<0.025	<0.025
CHLOROFORM	<0.025	<0.025	<0.025
2-BUTENAL	<0.025	<0.025	<0.025
1,2-DICHLOROETHANE	<0.025	<0.025	<0.025
1,1,1-TRICHLOROETHANE	<0.025	<0.025	<0.025
N-BUTANOL	TRACE	<0.025	<0.025
BENZENE	<0.025	<0.025	<0.025
CARBONTETRACHLORIDE	<0.025	<0.025	<0.025
2-PENTANONE	<0.025	<0.025	<0.025
2-METHYLHEXANE	<0.025	<0.025	<0.025
2,3-DIMETHYLPENTANE	<0.025	<0.025	<0.025
PENTANAL	TRACE	<0.025	<0.025
3-METHYLHEXANE	<0.025	<0.025	<0.025
1,2-DICHLOROPROPANE	<0.025	<0.025	<0.025
1,4-DIOXANE	<0.025	<0.025	<0.025
TRICHLOROETHENE	<0.025	<0.025	<0.025
2,5-DIMETHYLFURAN	<0.025	<0.025	<0.025
N-HEPTANE	<0.025	<0.025	<0.025
4-METHYL2-PENTANONE	<0.025	<0.025	<0.025
CIS-1,3-DICHLOROPROPENE	<0.025	<0.025	<0.025
2-PENTENAL	<0.025	<0.025	<0.025
TRANS-1,3-DICHLOROPROPENE	<0.025	<0.025	<0.025

1,1,2-TRICHLOROETHANE	<0.025	<0.025	<0.025
TOLUENE	TRACE	<0.025	<0.025
HEXANAL	TRACE	<0.025	<0.025
MESITYLOXIDE	<0.025	<0.025	<0.025
1,2-DIBROMOETHANE	<0.025	<0.025	<0.025
BUTYLACETATE	<0.025	<0.025	<0.025
OCTANE	<0.025	<0.025	<0.025
TETRACHLOROETHENE	<0.025	<0.025	<0.025
CHLOROBENZENE	<0.025	<0.025	<0.025
ETHYLBENZENE	<0.025	<0.025	<0.025
M/P-XYLENES	<0.025	<0.025	<0.025
2-HEPTANONE	<0.025	<0.025	<0.025
CYCLOHEXANONE	<0.025	<0.025	<0.025
HEPTANAL	TRACE	<0.025	<0.025
STYRENE	<0.025	<0.025	<0.025
1,1,2,2-TETRACHLOROETHANE	<0.025	<0.025	<0.025
O-XYLENE	<0.025	<0.025	<0.025
NONANE	<0.025	<0.025	<0.025
1,3,5-TRIMETHYLBENZENE	<0.025	<0.025	<0.025
1,2,4-TRIMETHYLBENZENE	<0.025	<0.025	<0.025
1,3-DICHLOROBENZENE	<0.025	<0.025	<0.025
1,4-DICHLOROBENZENE	<0.025	<0.025	<0.025
1,2-DICHLOROBENZENE	<0.025	<0.025	<0.025
1,2,4-TRICHLOROBENZENE	<0.025	<0.025	<0.025
HEXACHLORO-1,3-BUTADIENE	<0.025	<0.025	<0.025

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

NON-TARGET COMPOUNDS			
OCTAFLUOROPROPANE**	130	<0.025	<0.025
BROMOTRIFLUOROMETHANE+	**1.8**	<0.025	<0.025
DIFLUOROCHLOROMETHANE	<0.025	TRACE	0.027
CARBONYLSULFIDE	<0.025	<0.025	<0.025
1-BUTENE	<0.025	<0.025	<0.025
ISOPRENE	0.056	<0.025	<0.025
HEXAMETHYLCYCLOTRISILOXANE	*	*	*
DECAMETHYLCYCLOPENTASILOXANE	*	*	*

TOTAL ALCOHOLS PLUS ACETONE	**0.86**	**0.091**	**0.10**

TARGET COMPOUNDS (GC)* **			
CARBON MONOXIDE	6.50	TRACE	TRACE
METHANE	56	<1.6	<1.6
HYDROGEN	17	<0.41	<0.41
CARBON DIOXIDE	5300	TRACE	TRACE

TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	**130**	**0.15**	**0.15**

TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS) MINUS OCTAFLUOROPROPANE	**6.0**	**0.15**	**0.15**

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

+Corrected for Mass 69

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

TRACE: Amount detected is sufficient for compound identification only.

** Measurements are calibrated by one-point calibration

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

TABLE 1B
ANALYTICAL RESULTS OF
17A RETURN GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m3)							
	AA04736 S/N 1106 Mid-SM 07/28/09 @16:40 GMT	AA04737 S/N 1035 Mid-LAB 07/28/09 @ 16:45 GMT	AA04738 S/N 1040 Mid-COLUMBUS 07/28/09 @ 16:50 GMT	AA04739 S/N 1042 LAB 08/03/09 @ 15:35 GMT	AA04740 S/N 1052 MPLM 09/01/09 @ 04:00 GMT	AA04741 S/N 1085 SM 09/03/09 @ 21:28 GMT	AA04742 S/N 1071 LAB 09/03/09 @ 21:32 GMT	AA04743 S/N 1076 JEM 09/03/09 @ 21:40 GMT
TARGET COMPOUNDS (TO-14/POLAR)* **								
FREON12	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CHLOROMETHANE	TRACE	<0.025	TRACE	TRACE	TRACE	TRACE	<0.025	<0.025
FREON114	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
***METHANOL ** **	***0.70***	0.25	0.26	0.38	0.30	0.27	0.23	0.23
ACETALDEHYDE	0.82	0.052	0.079	0.11	0.11	0.23	0.060	0.061
VINYLCHLORIDE	<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
ETHANOL *	**1.9**	**1.9**	**1.6**	**2.0**	**1.3**	**3.1**	**1.9**	**1.9**
CHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
ACETONITRILE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
PROPENAL	0.05	<0.025	<0.025	<0.025	<0.025	TRACE	<0.025	<0.025
ACETONE	0.43	0.24	0.27	0.33	0.85	0.34	0.25	0.26
PROPANAL	0.29	<0.025	TRACE	TRACE	0.039	0.061	<0.025	TRACE
ISOPROPANOL*	0.11	0.10	0.11	0.19	**6.7**	0.21	0.20	0.24
FREON11	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
FURAN	<0.025	<0.025	<0.025	TRACE	<0.025	<0.025	<0.025	<0.025
ACRYLONITRILE	TRACE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
PENTANE	TRACE	<0.025	TRACE	<0.025	0.036	<0.025	<0.025	<0.025
2-METHYL-2-PROPANOL	TRACE	<0.025	<0.025	<0.025	0.054	<0.025	<0.025	<0.025
METHYLACETATE	TRACE	<0.025	<0.025	TRACE	TRACE	<0.025	<0.025	<0.025
1,1-DICHLOROETHENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
DICHLOROMETHANE	TRACE	TRACE	TRACE	TRACE	0.094	TRACE	TRACE	TRACE
3-CHLOROPROPENE	<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
N-PROPANOL	0.064	0.053	0.061	0.058	0.034	0.043	0.041	0.045
1,1-DICHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
BUTANAL	0.17	<0.025	<0.025	TRACE	0.03	0.046	<0.025	TRACE
2-BUTANONE	0.15	TRACE	TRACE	0.026	0.41	0.047	TRACE	0.025
CIS-1,2-DICHLOROETHENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2-METHYLFURAN	TRACE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
ETHYLACETATE	0.028	0.025	TRACE	0.059	0.21	0.042	0.032	0.030
HEXANE	<0.025	<0.025	<0.025	<0.025	0.11	<0.025	<0.025	<0.025
CHLOROFORM	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2-BUTENAL	0.083	<0.025	<0.025	TRACE	0.026	0.032	<0.025	<0.025
1,2-DICHLOROETHANE	TRACE	TRACE	<0.025	TRACE	0.051	TRACE	<0.025	<0.025
1,1,1-TRICHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
N-BUTANOL	0.088	0.059	0.056	0.11	0.20	0.075	0.048	0.057
BENZENE	TRACE	<0.025	<0.025	<0.025	TRACE	<0.025	<0.025	<0.025
CARBONTETRACHLORIDE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2-PENTANONE	0.095	<0.025	<0.025	<0.025	<0.025	TRACE	<0.025	<0.025
2-METHYLHEXANE	<0.025	<0.025	<0.025	TRACE	0.034	<0.025	<0.025	<0.025
2,3-DIMETHYLPENTANE	<0.025	<0.025	<0.025	TRACE	0.036	<0.025	<0.025	<0.025
PENTANAL	0.12	<0.025	<0.025	TRACE	TRACE	0.042	<0.025	<0.025
3-METHYLHEXANE	TRACE	<0.025	<0.025	TRACE	0.054	<0.025	<0.025	<0.025
1,2-DICHLOROPROPANE	<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
TRICHLOROETHENE	<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
N-HEPTANE	<0.025	<0.025	<0.025	<0.025	TRACE	<0.025	<0.025	<0.025
4-METHYL2-PENTANONE	<0.025	<0.025	<0.025	<0.025	0.035	<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
2-PENTENAL	TRACE	<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
1,1,2-TRICHLOROETHANE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
TOLUENE	TRACE	TRACE	TRACE	0.028	0.22	TRACE	TRACE	TRACE

HEXANAL	0.091	<0.025	<0.025	<0.025	<0.025	0.029	<0.025	<0.025
MESITYLOXIDE	<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
BUTYLACETATE	<0.025	<0.025	<0.025	TRACE	0.030	<0.025	<0.025	<0.025
TETRACHLOROETHENE	<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
ETHYLBENZENE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
M/P-XYLENES	<0.025	<0.025	<0.025	TRACE	TRACE	<0.025	<0.025	<0.025
2-HEPTANONE	TRACE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CYCLOHEXANONE	0.044	TRACE	TRACE	0.036	0.44	0.042	0.038	0.062
HEPTANAL	0.068	<0.025	<0.025	<0.025	TRACE	0.026	<0.025	<0.025
STYRENE	<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
O-XYLENE	TRACE	TRACE	<0.025	0.041	<0.025	0.028	TRACE	TRACE
1,3,5-TRIMETHYLBENZENE	<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
1,3-DICHLOROBENZENE	<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
1,2-DICHLOROBENZENE	<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
HEXACHLORO-1,3-BUTADIENE	<0.025	<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	<0.025
ETHYLENE OXIDE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
CARBON DISULFIDE	TRACE	<0.025	<0.025	TRACE	0.037	TRACE	TRACE	TRACE
2-METHYL-2-PROPENAL	TRACE	<0.025	<0.025	<0.025	TRACE	<0.025	<0.025	<0.025
3-BUTEN-2-ONE	<0.025	<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	<0.025
DIMETHYLDISULFIDE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
OCTAMETHYLCYCLOTETRASILOXANE	##	##	##	##	##	##	##	##

NON-TARGET COMPOUNDS								
OCTAFLUOROPROPANE++	170	150	160	170	30	190	180	170
SULFURHEXAFLUORIDE	0.035	0.030	0.033	0.038	<0.025	0.029	0.031	0.028
1,1,1,2-TETRAFLUOROETHANE	0.075	0.077	0.074	0.12	3.0	0.33	0.29	0.29
BROMOTRIFLUOROMETHANE+	0.54	0.47	0.53	0.16	<0.025	0.18	0.18	0.14
CHLORODIFLUOROMETHANE	<0.025	<0.025	<0.025	<0.025	0.092	<0.025	<0.025	<0.025
CARBONYLSULFIDE	TRACE	<0.025	TRACE	TRACE	0.084	TRACE	TRACE	TRACE
FLUOROTRIMETHYLSILANE	<0.025	TRACE	<0.025	TRACE	0.18	<0.025	<0.025	<0.025
1,1-DICHLORO-1-FLUOROETHANE	<0.025	<0.025	<0.025	<0.025	0.18	<0.025	<0.025	<0.025
ISOPRENE	0.092	0.081	0.080	0.11	TRACE	0.072	0.053	0.055
TRIMETHYLSILANOL	0.11	0.15	0.15	0.31	4.2	0.17	0.14	0.21
C8-ALKANE	<0.025	<0.025	<0.025	<0.025	0.069	<0.025	<0.025	<0.025
HEXAMETHYLCYCLOTRISILOXANE	##	##	##	##	##	##	##	##
ACETICACID,2-METHOXYPROPYLESTER	<0.025	<0.025	<0.025	<0.025	0.13	<0.025	<0.025	<0.025
BENZALDEHYDE	0.055	<0.025	<0.025	TRACE	TRACE	0.079	<0.025	<0.025
C8-ALDEHYDE	TRACE	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
DECAMETHYLCYCLOPENTASILOXANE	##	##	##	##	##	##	##	##

TOTAL ALCOHOLS PLUS ACETONE	**3.3**	**2.6**	**2.3**	**3.1**	**9.4**	**4.0**	**2.7**	**2.7**

TARGET COMPOUNDS (GC)* **								
CARBON MONOXIDE	3.1	2.8	2.9	3.0	3.6	3.7	3.5	3.4
METHANE	18	18	18	19	TRACE	20	20	20
HYDROGEN	3.8	3.8	3.9	3.1	< 0.41	4.4	4.3	4.6
CARBON DIOXIDE	8700	8300	9400	8700	1600	8400	7500	8700

TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	**180**	**150**	**160**	**170**	**50**	**200**	**180**	**170**

TOTAL CONCENTRATION - OFP (NON-METHANE HYDROCARBONS)	**6.4**	**3.6**	**3.4**	**4.3**	**20**	**5.6**	**3.6**	**3.7**

*** FROM GC/FID RESULTS**

*****FROM GC RESULTS; MeOH Conc.=GC MeOH Conc.-(2* GC/MS ACETALDEHYDE Conc.)***

+ CORRECTED FOR MASS 69

++ Measurements are calibrated by single-point calibration.

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.

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

TABLE 2A
ANALYTICAL RESULTS OF
STS-128 RETURN GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (7-d SMAC)		
	AA04735 Flight-Deck SN 1079 09/11/09 @ 14:24 GMT	AA04732 Preflight SN 1022 08/24/09 @ 20:22 EDT	AA04733 Preflight SN 1073 08/28/09 @ 19:00 EDT
TARGET COMPOUNDS (TO-14/POLAR)			
FREON12	ND	ND	ND
CHLOROMETHANE	0.00089	ND	ND
FREON114	ND	ND	ND
METHANOL	0.01895	0.00401	0.00139
ACETALDEHYDE	0.03647	0.00808	0.00313
VINYLCHLORIDE	ND	ND	ND
BROMOMETHANE	ND	ND	ND
ETHANOL	0.00024	0.00001	0.00001
CHLOROETHANE	ND	ND	ND
ACETONITRILE	0.00187	ND	ND
PROPENAL	0.00000	ND	ND
ACETONE	0.00284	0.00058	0.00024
PROPANAL	0.00087	0.00087	0.00087
ISOPROPANOL	0.00033	0.00008	0.00042
FREON11	ND	ND	ND
FURAN	ND	ND	ND
ACRYLONITRILE	ND	ND	ND
PENTANE	ND	ND	ND
2-METHYL-2-PROPANOL	0.00008	ND	ND
METHYLACETATE	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND
DICHLOROMETHANE	0.00025	ND	ND
3-CHLOROPROPENE	ND	ND	ND
FREON113	ND	ND	ND
N-PROPANOL	0.00013	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND
BUTANAL	0.00071	ND	ND
2-BUTANONE	0.00042	ND	ND
CIS-1,2-DICHLOROETHENE	ND	ND	ND
2-METHYLFURAN	ND	ND	ND
ETHYLACETATE	ND	ND	ND
HEXANE	ND	ND	ND
CHLOROFORM	ND	ND	ND
2-BUTENAL	ND	ND	ND
1,2-DICHLOROETHANE	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND
N-BUTANOL	0.00016	ND	ND
BENZENE	ND	ND	ND
CARBONTETRACHLORIDE	ND	ND	ND
2-PENTANONE	ND	ND	ND

2-METHYLHEXANE	ND	ND	ND
2,3-DIMETHYLPENTANE	ND	ND	ND
PENTANAL	0.00059	ND	ND
3-METHYLHEXANE	ND	ND	ND
1,2-DICHLOROPROPANE	ND	ND	ND
1,4-DIOXANE	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND
2,5-DIMETHYLFURAN	ND	ND	ND
N-HEPTANE	ND	ND	ND
4-METHYL2-PENTANONE	ND	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND	ND
2-PENTENAL	ND	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND	ND
TOLUENE	0.00021	ND	ND
HEXANAL	0.00051	ND	ND
MESITYLOXIDE	ND	ND	ND
1,2-DIBROMOETHANE	ND	ND	ND
BUTYLACETATE	ND	ND	ND
OCTANE	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND
CHLOROBENZENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
M/P-XYLENES	ND	ND	ND
2-HEPTANONE	ND	ND	ND
CYCLOHEXANONE	ND	ND	ND
HEPTANAL	0.00045	ND	ND
STYRENE	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND
O-XYLENE	ND	ND	ND
NONANE	ND	ND	ND
1,3,5-TRIMETHYLBENZENE	ND	ND	ND
1,2,4-TRIMETHYLBENZENE	ND	ND	ND
1,3-DICHLOROBENZENE	ND	ND	ND
1,4-DICHLOROBENZENE	ND	ND	ND
1,2-DICHLOROBENZENE	ND	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND	ND
HEXACHLORO-1,3-BUTADIENE	ND	ND	ND

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

NON-TARGET COMPOUNDS			
OCTAFLUOROPROPANE	0.00149	ND	ND
BROMOTRIFLUOROMETHANE+	**0.00016**	ND	ND

DIFLUOROCHLOROMETHANE	ND	0.00000	0.00001
CARBONYLSULFIDE	ND	ND	ND
1-BUTENE	ND	ND	ND
ISOPRENE	0.00930	ND	ND
HEXAMETHYLCYCLOTRISILOXANE	*	*	*
DECAMETHYLCYCLOPENTASILOXANE	*	*	*

TARGET COMPOUNDS (GC)			
CARBON MONOXIDE	0.10299	0.00454	0.00454
METHANE	0.01590	0.00000	0.00000
HYDROGEN	0.05094	0.00000	0.00000
CARBON DIOXIDE	0.40682	0.01538	0.01538

TOTAL T-VALUE	**0.65355**	**0.03355**	**0.02599**

TOTAL T-VALUE MINUS OCTAFLUOROPROPANE	**0.65205**	**0.03355**	**0.02599**

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

+Corrected for Mass 69

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
17A RETURN GRAB SAMPLE CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)							
	AA04736 S/N 1106 Mid-SM 07/28/09 @16:40 GMT	AA04737 S/N 1035 Mid-LAB 07/28/09 @ 16:45 GMT	AA04738 S/N 1040 Mid-COLUMBUS 07/28/09 @ 16:50 GMT	AA04739 S/N 1042 LAB 08/03/09 @ 15:35 GMT	AA04740 S/N 1052 MPLM 09/01/09 @ 04:00 GMT	AA04741 S/N 1085 SM 09/03/09 @ 21:28 GMT	AA04742 S/N 1071 LAB 09/03/09 @ 21:32 GMT	AA04743 S/N 1076 JEM 09/03/09 @ 21:40 GMT
TARGET COMPOUNDS (TO-14/POLAR)								
FREON12	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROMETHANE	0.00030	ND	0.00030	0.00030	0.00030	0.00030	ND	ND
FREON114	ND	ND	ND	ND	ND	ND	ND	ND
METHANOL **	***0.00773***	0.00280	0.00286	0.00419	0.00333	0.00295	0.00259	0.00250
ACETALDEHYDE	0.20472	0.01312	0.01965	0.02528	0.02776	0.05713	0.01506	0.01514
VINYLCHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND
BROMOMETHANE	ND	ND	ND	ND	ND	ND	ND	ND
ETHANOL *	**0.00095**	**0.00097**	**0.00078**	**0.00100**	**0.00065**	**0.00154**	**0.00094**	**0.00093**
CHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
ACETONITRILE	0.00187	0.00187	0.00187	0.00187	0.00187	0.00187	0.00187	0.00187
PROPENAL	2.47563	ND	ND	ND	ND	0.44699	ND	ND
ACETONE	0.00827	0.00461	0.00513	0.00626	0.01635	0.00656	0.00484	0.00499
PROPANAL	0.02595	ND	0.00114	0.00114	0.00359	0.00551	ND	0.00114
ISOPROPANOL	0.00072	0.00068	0.00071	0.00126	0.04473	0.00138	0.00134	0.00161
FREON11	ND	ND	ND	ND	ND	ND	ND	ND
FURAN	ND	ND	ND	0.17857	ND	ND	ND	ND
ACRYLONITRILE	0.00446	ND	ND	ND	ND	ND	ND	ND
PENTANE	0.00139	ND	0.00139	ND	0.00399	ND	ND	ND
2-METHYL-2-PROPANOL	0.00010	ND	ND	ND	0.00045	ND	ND	ND
METHYLACETATE	0.00010	ND	ND	0.00010	0.00010	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND
DICHLOROMETHANE	0.00125	0.00125	0.00125	0.00125	0.00941	0.00125	0.00125	0.00125
3-CHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND
FREON113	ND	ND	ND	ND	ND	ND	ND	ND
N-PROPANOL	0.00065	0.00054	0.00063	0.00059	0.00035	0.00044	0.00042	0.00046
1,1-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
BUTANAL	0.01296	ND	ND	0.00096	0.00195	0.00357	ND	0.00096
2-BUTANONE	0.00488	0.00042	0.00042	0.00087	0.01368	0.00155	0.00042	0.00084
CIS-1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLFURAN	0.09615	ND	ND	ND	ND	ND	ND	ND
ETHYLACETATE	0.00015	0.00014	0.00007	0.00033	0.00118	0.00023	0.00018	0.00017
HEXANE	ND	ND	ND	ND	0.01040	ND	ND	ND
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTENAL	0.04879	ND	ND	0.00735	0.01548	0.01888	ND	ND
1,2-DICHLOROETHANE	0.00781	0.00781	ND	0.00781	0.03207	0.00781	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
N-BUTANOL	0.00219	0.00147	0.00140	0.00274	0.00501	0.00188	0.00121	0.00142
BENZENE	0.06250	ND	ND	ND	0.06250	ND	ND	ND
CARBONTETRACHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND
2-PENTANONE	0.00135	ND	ND	ND	ND	0.00018	ND	ND
2-METHYLHEXANE	ND	ND	ND	0.00104	0.00287	ND	ND	ND
2,3-DIMETHYLPENTANE	ND	ND	ND	0.00104	0.00304	ND	ND	ND
PENTANAL	0.00751	ND	ND	0.00078	0.00078	0.00264	ND	ND
3-METHYLHEXANE	0.00104	ND	ND	0.00104	0.00451	ND	ND	ND
1,2-DICHLOROPROPANE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DIOXANE	ND	ND	ND	ND	ND	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLFURAN	ND	ND	ND	ND	ND	ND	ND	ND
N-HEPTANE	ND	ND	ND	ND	0.00104	ND	ND	ND
4-METHYL2-PENTANONE	ND	ND	ND	ND	0.00025	ND	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND
2-PENTENAL	0.00595	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
TOLUENE	0.00083	0.00083	0.00083	0.00189	0.01480	0.00083	0.00083	0.00083
HEXANAL	0.00506	ND	ND	ND	ND	0.00159	ND	ND
MESITYLOXIDE	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DIBROMOETHANE	ND	ND	ND	ND	ND	ND	ND	ND
BUTYLACETATE	ND	ND	ND	0.00007	0.00016	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
M/P-XYLENES	ND	ND	ND	0.00034	0.00034	ND	ND	ND
2-HEPTANONE	0.00054	ND	ND	ND	ND	ND	ND	ND
CYCLOHEXANONE	0.00073	0.00021	0.00021	0.00059	0.00730	0.00070	0.00063	0.00104

HEPTANAL	0.00324	ND	ND	ND	0.00060	0.00125	ND	ND
STYRENE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
O-XYLENE	0.00034	0.00034	ND	0.00110	ND	0.00076	0.00034	0.00034
1,3,5-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIMETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXACHLORO-1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND

TARGET COMPOUNDS (TOXIC)								
1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLENE OXIDE	ND	ND	ND	ND	ND	ND	ND	ND
CARBON DISULFIDE	0.00078	ND	ND	0.00078	0.00230	0.00078	0.00078	0.00078
2-METHYL-2-PROPENAL	0.00735	ND	ND	ND	0.00735	ND	ND	ND
3-BUTEN-2-ONE	ND	ND	ND	ND	ND	ND	ND	ND
2-ETHOXYETHANOL	ND	ND	ND	ND	ND	ND	ND	ND
DIMETHYLDISULFIDE	ND	ND	ND	ND	ND	ND	ND	ND
OCTAMETHYLCYCLOTETRASILOXANE	##	##	##	##	##	##	##	##

NON-TARGET COMPOUNDS								
OCTAFLUOROPROPANE++	0.00205	0.00180	0.00193	0.00204	0.00039	0.00222	0.00213	0.00199
SULFURHEXAFLUORIDE	0.00003	0.00002	0.00003	0.00003	ND	0.00002	0.00003	0.00002
1,1,1,2-TETRAFLUOROETHANE	0.00075	0.00077	0.00074	0.00119	0.02988	0.00330	0.00295	0.00287
BROMOTRIFLUOROMETHANE+	0.00005	0.00004	0.00005	0.00001	ND	0.00002	0.00002	0.00001
CHLORODIFLUOROMETHANE	ND	ND	ND	ND	0.00003	ND	ND	ND
CARBONYLSULFIDE	0.00104	ND	0.00104	0.00104	0.00699	0.00104	0.00104	0.00104
FLUOROTRIMETHYLSILANE	ND	0.02500	ND	0.02500	0.36642	ND	ND	ND
1,1-DICHLORO-1-FLUOROETHANE	ND	ND	ND	ND	0.00122	ND	ND	ND
ISOPRENE	0.03077	0.02696	0.02652	0.03619	0.00417	0.02404	0.01776	0.01850
TRIMETHYLSILANOL	0.02857	0.03638	0.03777	0.07832	1.04858	0.04164	0.03572	0.05302
C8-ALKANE	ND	ND	ND	ND	0.00534	ND	ND	ND
HEXAMETHYLCYCLOTRISILOXANE	##	##	##	##	##	##	##	##
ACETICACID,2-METHOXYPROPYLESTER	ND	ND	ND	ND	0.04307	ND	ND	ND
BENZALDEHYDE	0.00032	ND	ND	0.00007	0.00007	0.00046	ND	ND
C8-ALDEHYDE	0.00052	ND	ND	ND	ND	ND	ND	ND
DECAMETHYLCYCLOPENTASILOXANE	##	##	##	##	##	##	##	##

TARGET COMPOUNDS (GC)								
CARBON MONOXIDE	0.17923	0.16318	0.17301	0.17372	0.21166	0.21813	0.20583	0.20039
METHANE	0.00523	0.00503	0.00517	0.00535	0.00023	0.00571	0.00565	0.00569
HYDROGEN	0.01105	0.01107	0.01134	0.00920	0.00000	0.01300	0.01277	0.01359
CARBON DIOXIDE	0.67202	0.64181	0.72249	0.67026	0.12399	0.64714	0.57428	0.67108

TOTAL T-VALUE	**3.93592**	**0.94913**	**1.01872**	**1.25298**	**2.14251**	**1.52529**	**0.89087**	**1.00447**

TOTAL T-VALUE - OFP	**3.93388**	**0.94733**	**1.01679**	**1.25095**	**2.14212**	**1.52307**	**0.88874**	**1.00248**

*** FROM GC/FID RESULTS**

*****FROM GC RESULTS; MeOH Conc.=GC MeOH Conc.-(2* GC/MS ACETALDEHYDE Conc.)***

+ CORRECTED FOR MASS 69

++ Measurements are calibrated by single-point calibration.

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

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.