

STS 124 Return Samples: Assessment of Air Quality aboard the Shuttle (STS-124) and International Space Station (1J)

The toxicological assessment of 2 grab sample canisters (GSCs) from the Shuttle is reported in Table 1. Analytical methods have not changed from earlier reports. The recoveries of the 3 surrogates (¹³C-acetone, fluorobenzene, and chlorobenzene) from the GSCs were 99, 103, and 96%. The presence of Freon 218 from the ISS atmosphere is obvious in the 6/14 sample.

Table 1: Analytical Summary of Shuttle Samples

Sample Location	Date of Sample	NMVOCs ^a (mg/m ³)	T Value ^b (units)	Alcohols (mg/m ³)	Freon 218 (mg/m ³)	Formaldehyde (µg/m ³)
Flight deck (preflight)	5/31/08	0	0.45	0.09	0	--
Mid-deck (end of mission)	6/14/08	4	0.50	0.7	230	--

^a Non-methane volatile organic hydrocarbons with Freon 218 removed

^b Calculated excluding CO₂, formaldehyde, and siloxanes. The main contribution to both samples was a trace of propenal.

The toxicological assessment of 13 GSCs and 8 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 99, 103 and 92%, respectively. Recoveries from 3 positive-control formaldehyde badges ranged from 101 to 113%.

Table 2: Analytical Summary of ISS Results

Module/Sample	Approx . Date	NMVOCs ^a (mg/m ³)	T Value ^b (units)	Alcohols (mg/m ³)	Freon 218 (mg/m ³)	Formaldehyde (µg/m ³)
Lab (FMK)	2/25/08	--	--	--	--	37
SM (FMK)	2/25/08	--	--	--	--	34
Col	3/19/08	5	0.39	4.3	41	--
Lab	3/19/08	6	0.17	4.5	36	40
SM	3/19/08	6	0.38	4.8	36	35
ATV Vestibule	4/03/08	7	0.68	4.5	6	--
ATV (first entry)	4/03/08	16	0.94	4.9	4	--
SM	4/07/08	8	1.41	4.9	34	35
Lab	4/07/08	5	0.25	4.2	34	40
JLP	4/07/08	7	1.49	4.4	38	--
SM (F218 leak)	4/30/08	2	0.20	4.4	630	--
Lab	5/22/08	12	0.32	4.9	620	30
JLP	5/22/08	4	0.43	5.9	660	--
SM	5/22/08	3	0.24	5.5	590	28
JPM (first entry)	6/04/08	110 ^c	0.77	9.4	70	--
<i>Guideline</i>		<25	<1.0	<5	<i>none</i>	<120

^a Non-methane volatile organic hydrocarbons without F218 added into the total.

^b Calculated excluding CO₂, formaldehyde, and siloxanes.

^c Butane and iso-butane were the primary components of this high value.

T Values above 1.0: The SM and JLP samples on April 7 showed T values well above 1.0. In both cases a small amount of propenal (acrolein) in the samples contributed 0.8 T units. The source of this mucosal irritant is unknown. When combined with the T values from other irritants (primarily other aldehydes, including formaldehyde), the T_{irritants} were 1.3 and 1.4 for the SM and JLP, respectively. These are well above the level we would like to find and suggest that the crew had some risk of very slight upper airway irritation or eye irritation. The crew did not report airway or eye irritation.

Freon 218 values: This volatile compound was accidentally released from the SM air conditioning system. Evidence of this release is obvious in the data of Table 2. From 3/19 to 4/07 the concentration was relatively unchanged (34-41 mg/m³ in all modules). Much lower values were observed as the crew entered and sampled the ATV vestibule and then the ATV itself. The leak occurred on 4/30, and we found that the concentration of Freon 218 (620-660 mg/m³) had not decreased more than 20 days later (5/22). As expected, some of the Freon entered the JLP before a pristine, first-entry sample could be obtained.

The Butanes in JPM: The finding of butane (43 mg/m³) and iso-butane (52 mg/m³) in the first-entry sample of the JPM was totally unexpected. The primary compound identified with offgassing during the ground test was trimethylsilanol (TMS). The on-orbit sample showed TMS and other common offgas products (several light alcohols, ethyl acetate, and C7-alkanes), but the 4-carbon alkanes were unexpected. These highly-volatile compounds are sometimes used in mixtures with propane as heat-exchange fluids, but no such source has been identified in the JPM. They are of no toxicological significance at these concentrations.

John T. James, Ph.D.
Chief Toxicologist

Enclosures

Table 1A: [Analytical concentrations of compounds found in the STS-124 GSCs](#)

Table 1B: [Analytical concentrations of compounds found in 1J GSCs](#)

Table 2A: [T-values of the compounds in table 1A](#)

Table 2B: [T-values of the compounds in table 1B](#)