



STS 129 Return Samples: Assessment of Air Quality aboard the Shuttle (STS-129) and International Space Station (ULF3)

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 (¹³C-acetone, fluorobenzene, and chlorobenzene) from the 2 GSCs averaged 109, 101, and 101 %, 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 | 11/16/099 | 0.2 | 0 | 0.05 | 0.1 | -- |
| Mid-deck (end mission) | 11/27/09 | 3.2 | 61 | 0.16 | 0.8 | -- |

^a Non-methane volatile organic hydrocarbons, excluding Freon 218

^b Based on 7-day SMACs and calculated excluding CO₂, formaldehyde, and siloxanes.

International Space Station: The toxicological assessment of 5 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 81, 87 and 55%, respectively. The low recovery of chlorobenzene was due to analytical interference from high levels of Freon 218. Results of two GSC samples (9/29/and 10/28) were not reported due to problems with overall surrogate recoveries. Three positive formaldehyde-badge controls averaged 101% 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 | 9/4/09 | -- | -- | -- | -- | 21 |
| SM | 9/4/09 | -- | -- | -- | -- | 20 |
| HTV [first entry] | 9/18/09 | 22 | 15 | 3.2 | 7.0 | -- |
| Lab | 9/29/09 | 4 | 164 | 0.4 | 1.9 | 25 |
| SM | 9/29/09 | 4 | 158 | 0.3 | 1.9 | 21 |
| Lab | 10/28/09 | 6 | 159 | 1.0 ^c | 3.5 | 35 |
| SM | 10/28/09 | 6 | 164 | 0.4 | 3.6 | 20 |
| <i>Guideline</i> | | <25 | <i>none</i> | <1.0 | <5 | <120 |

^a Non-methane volatile organic hydrocarbons, excluding Freon 218

^b Based on 180-d SMACs and calculated excluding CO₂, formaldehyde, and siloxanes.

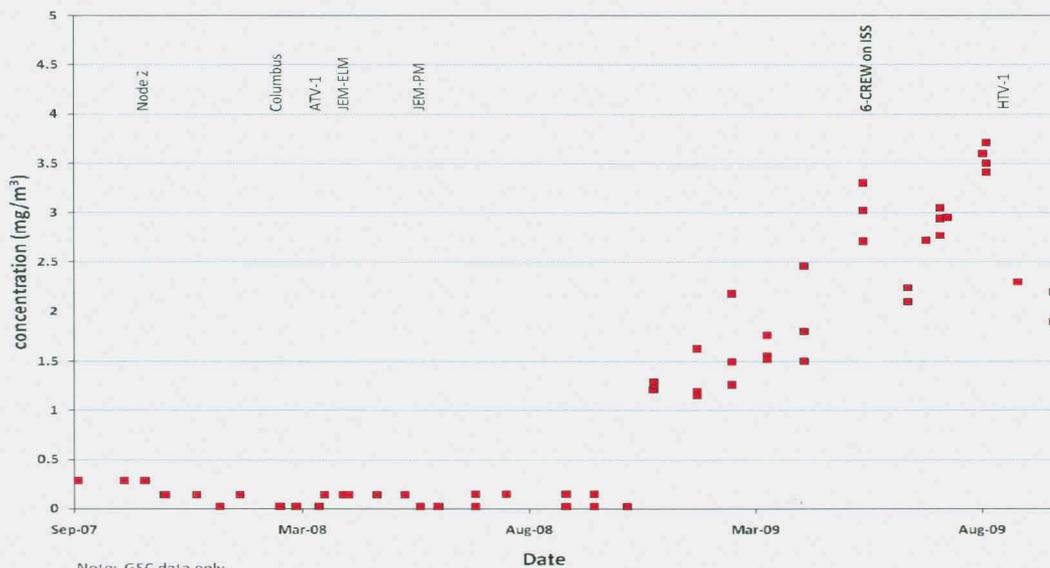
^c Higher T value is due to traces of propenal, an irritant.

HTV First Entry: Upon first entry into the HTV the crew noted a strong odor that was characterized as “new car smell” or somewhat like formaldehyde. Two crewmembers reported mild headaches after working in the area of the HTV for a period of time; this situation persisted for 2-3 days. The odors seemed to be strongest in the area of box foam and investigation is continuing as to the precise source. There is no specific compound in the analytical results that

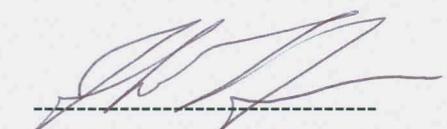
could have produced the odors reported; however, compounds can often be smelled at extremely low concentrations, well below analytical detection limits. Furthermore, the simple presence of odors can elicit mild headaches in many individuals.

Carbon Monoxide Accumulation aboard ISS: Over the past few months the nominal concentrations of CO have been increasing gradually (see figure below). The results from samples returned on this flight indicate that the concentrations have dropped somewhat; however, they have not returned to pre-October 2008 levels. In any case, these changes are well below the 180-day SMAC of CO, which is 17 mg/m^3 . There is no threat to crew health.

Carbon Monoxide



General Observations about ISS Air Quality: This is a very limited set of samples on which to base 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 propanal have not recurred. None-the-less, we must still be vigilant when dealing with nominal atmospheres in ISS. Unmanned modules require special attention when the crew first enters.



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Enclosures

Table 1A: Analytical concentrations of compounds found in the STS-129 GSCs

Table 1B: Analytical concentrations of compounds found in ULF3 GSCs

Table 2A: T-values of the compounds in table 1A

Table 2B: T-values of the compounds in table 1B