

# STS 127 Return Samples: Assessment of Air Quality aboard the Shuttle (STS-127) and International Space Station (2J/A)

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 (<sup>13</sup>C-acetone, fluorobenzene, and chlorobenzene) from the 2 GSCs averaged 113, 96, and 110 %, respectively. Based on the end-of-mission sample, the Shuttle atmosphere was acceptable for human respiration. Note that Freon 218 was present in high concentration because it spread from the ISS atmosphere into the Shuttle during docked operations.

Table 1. Analytical Summary of Shuttle Samples

| Sample Location       | Date of Sample | NMVOCs <sup>a</sup> (mg/m <sup>3</sup> ) | Freon 218 (mg/m <sup>3</sup> ) | T Value <sup>b</sup> (units) | Alcohols (mg/m <sup>3</sup> ) | Formaldehyde (µg/m <sup>3</sup> ) |
|-----------------------|----------------|--|--------------------------------|------------------------------|-------------------------------|-----------------------------------|
| Preflight             | 7/13/09        | 0.3                                      | 0                              | 0.02                         | 0.10                          | --                                |
| Middeck (end mission) | 7/31/09        | 4  | 165                            | 0.19                         | 0.67                          | --                                |

<sup>a</sup> Non-methane volatile organic hydrocarbons, excluding Freon 218

<sup>b</sup> Calculated excluding CO<sub>2</sub>, formaldehyde, and siloxanes.

The toxicological assessment of 9 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 78, 90 and 75%, respectively. Two formaldehyde-badge lab controls averaged 98% recovery.

Table 2. Analytical Summary of ISS Results

| Module/Sample    | Approx. Date | NMVOCs <sup>a</sup> (mg/m <sup>3</sup> ) | Freon 218 (mg/m <sup>3</sup> ) | T Value <sup>b</sup> (units) | Alcohols (mg/m <sup>3</sup> ) | Formaldehyde (µg/m <sup>3</sup> ) |
|------------------|--------------|--|--------------------------------|------------------------------|-------------------------------|-----------------------------------|
| Lab              | 12/9/08      | --                                       | --                             | --                           | --                            | 29                                |
| SM               | 12/9/08      | --                                       | --                             | --                           | --                            | 27                                |
| Lab              | 1/13/09      | --                                       | --                             | --                           | --                            | 49                                |
| SM               | 1/13/09      | --                                       | --                             | --                           | --                            | 32                                |
| SM               | 4/9/09       | 6  | 220                            | 0.34                         | 4.5                           | 35                                |
| Lab              | 4/9/09       | 5  | 210                            | 0.27                         | 4.0                           | 25                                |
| Columbus         | 4/9/09       | 11                                       | 260                            | <b>4.91<sup>c</sup></b>      | 5.4                           | --                                |
| Lab              | 5/27/09      | 6  | 230                            | <b>3.60<sup>c</sup></b>      | 3.0                           | --                                |
| JEM              | 5/27/09      | 7  | 210                            | <b>4.91<sup>c</sup></b>      | 3.3                           | --                                |
| SM               | 5/27/09      | 6  | 200                            | <b>3.57<sup>c</sup></b>      | 3.1                           | --                                |
| SM               | 7/2/09       | 4  | 200                            | 0.87                         | 3.1                           | --                                |
| Lab              | 7/2/09       | 5  | 260                            | 0.87                         | 3.3                           | --                                |
| Lab              | 7/17/09      | 6  | 180                            | <b>2.58<sup>c</sup></b>      | 3.3                           | --                                |
| <i>Guideline</i> |              | <25                                      | <i>none</i>                    | <1.0                         | <5                            | <120                              |

<sup>a</sup> Non-methane volatile organic hydrocarbons, excluding Freon 218

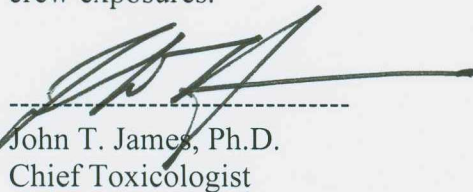
<sup>b</sup> Calculated excluding CO<sub>2</sub>, formaldehyde, and siloxanes.

<sup>c</sup> High T values are due to traces of propenal, an irritant

The bolded T values are problematic and difficult to interpret. The primary contributor to the elevated T values is acrolein (propenal), which is a primary irritant to the eyes and upper

airways. There were no crew reports of nasal or eye irritation during the times of these samples. Furthermore, no apparent source of acrolein could be identified. It is also perplexing that in the first set of three samples only one shows appreciable acrolein, yet in the next three simultaneous samples all show measurable acrolein. The sample on July 17 was taken in conjunction with operation of the Air Quality Monitor DTO, hence there was no contingency involved.

Other than the problem with traces of acrolein in the samples, the air quality was acceptable for respiration. The 24-hour SMAC for acrolein (0.08 mg/m<sup>3</sup>) is 4-fold higher than the 180-day SMAC (0.02 mg/m<sup>3</sup>) used to calculate the T values. The 24-hour SMAC allows only a slight risk of minimal irritation. Since the acrolein concentrations never exceeded the 24-hour limit, this may be why no irritation was reported by the crew. In any case, the acrolein concentrations are not sustained, but they do bear watching. Unfortunately, we are constrained to one-month intervals of sampling, which is patently inadequate to identify a source and characterize episodic crew exposures.



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Enclosures

Table 1A: Analytical concentrations of compounds found in the STS-127 GSCs

Table 1B: Analytical concentrations of compounds found in 2J/A GSCs

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

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