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DATE: March 30, 2015

SUBJECT: Toxicological Assessment of SpaceX-4 (SpX-4) First Ingress Air Quality

SUMMARY: The T-value measured at first entry met acceptable limits and does not pose a concern for crew health.

One mini-grab sample container (m-GSC) was collected by crew members onboard ISS during first ingress into SpX-4 on September 23, 2014, 97 hours after late cargo loading and a pre-launch clean air purge.

Complete data tables of all measured concentrations and corresponding T-values based on 7-day and 180-day SMACs are enclosed. A summary of the analytical results is shown in Table 1. Recovery of the 3 surrogate standards from the mGSC was the following: 13C-acetone, 111%; fluorobenzene-d5, 108%; and chlorobenzene-d5, 89%. Initial sample pressure for the mGSC was 14.0 psia, indicating nominal sample collection. The sample was collected approximately 3 minutes after hatch opening.

Table 1. Analytical Summary of ISS results

Sample Location	Sample Date	NMVOCs ^a (mg/m ³)	Freon 218 (mg/m ³)	CO ₂ (mg/m ³)	Alcohols ^b (mg/m ³)	T-value ^c (units)
SpaceX-4 first ingress	9/23/2014	4.5	0.6	2600	3.2	0.1 (0.3)
<i>Guideline</i>		<25	---	<9300	<5	<3

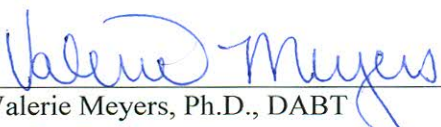
^aNon-methane volatile organic hydrocarbons, excluding Freon 218

^bIncludes acetone

^cBased on 7-d SMACs and calculated excluding CO₂; parentheses indicate value based on 180-day SMACs

Toxicological Evaluation of ISS Air Quality:

The CO₂ and Freon 218 levels measured in the SpX-4 first ingress sample indicate limited mixing with the ISS atmosphere prior to sample collection. Similar to previous SpaceX first ingress samples, the primary contributors to the T-value were carbon monoxide and trimethylsilanol. Perfluoro (2-methyl) pentane vapors, which originate from the heat-exchange fluid used by the Dragon vehicle, were not detected, indicating that steps taken to mitigate the leak have been successful.


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3/30/15
 Date

Enclosures Table 1: Analytical concentrations of compounds found in the first ingress m-GSC
 Table 2: T-values corresponding to analytical concentrations in Table 1, based on 7-day and 180-day SMACs

TABLE 1
ANALYTICAL RESULTS OF
SPACEX-4 RETURN GSC AIR SAMPLE

CHEMICAL CONTAMINANT	CONCENTRATION (mg/M ³)
	AA05825 SN 2082 SPACEX-4 INGRESS 9/23/14 @ 17:55 GMT
TARGET COMPOUNDS (TO-15)	
FREON12	<0.025
CHLOROMETHANE	TRACE
FREON114	<0.025
METHANOL	0.37
ACETALDEHYDE	0.14
VINYLCHLORIDE	<0.025
BROMOMETHANE	<0.025
ETHANOL *	2.3
CHLOROETHANE	<0.025
ACETONITRILE	<0.025
PROPENAL	<0.025
ACETONE	0.15
PROPANAL	TRACE
ISOPROPANOL	0.27
FREON11	<0.025
FURAN	<0.025
ACRYLONITRILE	<0.025
PENTANE	<0.025
2-METHYL-2-PROPANOL	<0.025
METHYLACETATE	<0.025
1,1-DICHLOROETHENE	<0.025
DICHLOROMETHANE	TRACE
3-CHLOROPROPENE	<0.025
FREON113	<0.025
N-PROPANOL	TRACE
1,1-DICHLOROETHANE	<0.025
BUTANAL	<0.025
2-BUTANONE	TRACE
CIS-1,2-DICHLOROETHENE	<0.025
2-METHYLFURAN	<0.025
ETHYLACETATE	TRACE
HEXANE	<0.025
CHLOROFORM	<0.025
2-BUTENAL	<0.025
1,2-DICHLOROETHANE	<0.025
1,1,1-TRICHLOROETHANE	<0.025
N-BUTANOL	0.084
BENZENE	<0.025
CARBONTETRACHLORIDE	<0.025
2-PENTANONE	<0.025
2-METHYLHEXANE	<0.025
2,3-DIMETHYLPENTANE	<0.025
PENTANAL	<0.025
3-METHYLHEXANE	<0.025
1,2-DICHLOROPROPANE	<0.025
1,4-DIOXANE	<0.025
TRICHLOROETHENE	<0.025
2,5-DIMETHYLFURAN	<0.025
N-HEPTANE	<0.025
4-METHYL2-PENTANONE	<0.025
CIS-1,3-DICHLOROPROPENE	<0.025
2-PENTENAL	<0.025
TRANS-1,3-DICHLOROPROPENE	<0.025
1,1,2-TRICHLOROETHANE	<0.025
TOLUENE	0.032
HEXANAL	<0.025
MESITYLOXIDE	<0.025
1,2-DIBROMOETHANE	<0.025
BUTYLACETATE	TRACE
OCTANE	<0.025
TETRACHLOROETHENE	<0.025
CHLOROBENZENE	<0.025
ETHYLBENZENE	TRACE
M/P-XYLENES	<0.050
2-HEPTANONE	<0.025
CYCLOHEXANONE	<0.025
HEPTANAL	<0.025
STYRENE	<0.025
1,1,2,2-TETRACHLOROETHANE	<0.025
O-XYLENE	TRACE
NONANE	<0.025
1,3,5-TRIMETHYLBENZENE	<0.025
1,2,4-TRIMETHYLBENZENE	<0.025
1,3-DICHLOROBENZENE	<0.025
1,4-DICHLOROBENZENE	<0.025
1,2-DICHLOROBENZENE	<0.025
1,2,4-TRICHLOROBENZENE	<0.050
HEXACHLORO-1,3-BUTADIENE	<0.075

TABLE 1
ANALYTICAL RESULTS OF
SPACEX-4 RETURN GSC AIR SAMPLE

CHEMICAL CONTAMINANT	CONCENTRATION (mg/M ³)
	AA05825 SN 2082 SPACEX-4 INGRESS 9/23/14 @ 17:55 GMT
SPECIAL INTEREST COMPOUNDS **	
1,3-BUTADIENE &	<0.050
ETHYLENE OXIDE	<0.050
2-METHYL-2-PROPENAL	<0.050
3-BUTEN-2-ONE	<0.050
2-ETHOXYETHANOL	<0.050
DIMETHYL DISULFIDE	<0.050
OCTAFLUOROPROPANE &	0.63
PERFLUORO-2-METHYLPENTANE &	<0.050
CARBONYL SULFIDE &	<0.025
ISOBUTANE &	<0.025
2-METHYL-1-PROPENE &	<0.025
DIMETHYL SULFIDE &	<0.025
CARBON DISULFIDE &	<0.025
TRIMETHYLSILANOL &	0.046
OCTAMETHYLCYCLOTETRASILOXANE &	<0.075
DECAMETHYLCYCLOPENTASILOXANE &	<0.15
HEXAMETHYLCYCLOTRISILOXANE %	0.63
NON-TARGET COMPOUNDS **	
PROPENE &	<0.050
PROPANE &	<0.050
BUTANE &	<0.050
ISOPRENE &	<0.050
1,1,1,2-TETRAFLUOROETHANE	0.35
TOTAL ALCOHOLS PLUS ACETONE	3.2
TARGET COMPOUNDS (GC)	
CARBON MONOXIDE	2.6
METHANE	6.7
HYDROGEN	2.2
CARBON DIOXIDE	2600
TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	5.1
TOTAL CONCENTRATION - OFP (NON-METHANE HYDROCARBONS)	4.5

* GC/FID data results are in bold

** Quantified using "B" response factor except where noted

& Quantified using a multi-point calibration

% Response factor generated from an internal study

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

TRACE: Amount detected is sufficient for compound identification only.

OFP - Octafluoropropane

TABLE 2
T-VALUES FOR SPACEX-4 INGRESS GSC AIR SAMPLE

CHEMICAL CONTAMINANT	AA05825 SN 2082 SPACEX-4 INGRESS 9/23/14 @ 17:55 GMT	
	(7-d SMAC)	(180-d SMAC)
TARGET COMPOUNDS (TO-15)		
FREON12	ND	ND
CHLOROMETHANE	0.00030	0.00030
FREON114	ND	ND
METHANOL	0.00416	0.00416
ACETALDEHYDE	0.03496	0.03496
VINYLCHLORIDE	ND	ND
BROMOMETHANE	ND	ND
ETHANOL	0.00115	0.00115
CHLOROETHANE	ND	ND
ACETONITRILE	ND	ND
PROPENAL	ND	ND
ACETONE	0.00295	0.00295
PROPANAL	0.00114	0.00114
ISOPROPANOL	0.00180	0.00180
FREON11	ND	ND
FURAN	ND	ND
ACRYLONITRILE	ND	ND
PENTANE	ND	ND
2-METHYL-2-PROPANOL	ND	ND
METHYLACETATE	ND	ND
1,1-DICHLOROETHENE	ND	ND
DICHLOROMETHANE	0.00026	0.00125
3-CHLOROPROPENE	ND	ND
FREON113	ND	ND
N-PROPANOL	0.00013	0.00013
1,1-DICHLOROETHANE	ND	ND
BUTANAL	ND	ND
2-BUTANONE	0.00042	0.00042
CIS-1,2-DICHLOROETHENE	ND	ND
2-METHYLFURAN	ND	ND
ETHYLACETATE	0.00007	0.00007
HEXANE	ND	ND
CHLOROFORM	ND	ND
2-BUTENAL	ND	ND
1,2-DICHLOROETHANE	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND
N-BUTANOL	0.00104	0.00209
BENZENE	ND	ND
CARBONTETRACHLORIDE	ND	ND
2-PENTANONE	ND	ND
2-METHYLHEXANE	ND	ND
2,3-DIMETHYLPENTANE	ND	ND
PENTANAL	ND	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	0.00215	0.00215
HEXANAL	ND	ND
MESITYLOXIDE	ND	ND
1,2-DIBROMOETHANE	ND	ND
BUTYLACETATE	0.00007	0.00007
OCTANE	ND	ND
TETRACHLOROETHENE	ND	ND
CHLOROBENZENE	ND	ND
ETHYLBENZENE	0.00010	0.00025
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	0.00017	0.00034
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

TABLE 2
T-VALUES FOR SPACEX-4 INGRESS GSC AIR SAMPLE

CHEMICAL CONTAMINANT	AA05825 SN 2082 SPACEX-4 INGRESS 9/23/14 @ 17:55 GMT	
	(7-d SMAC)	(180-d SMAC)
SPECIAL INTEREST COMPOUNDS **		
1,3-BUTADIENE &	ND	ND
ETHYLENE OXIDE	ND	ND
2-METHYL-2-PROPENAL	ND	ND
3-BUTEN-2-ONE	ND	ND
2-ETHOXYETHANOL	ND	ND
DIMETHYL DISULFIDE	ND	ND
OCTAFLUOROPROPANE &	0.00001	0.00001
PERFLUORO-2-METHYLPENTANE &	ND	ND
CARBONYL SULFIDE &	ND	ND
ISOBUTANE &	ND	ND
2-METHYL-1-PROPENE &	ND	ND
DIMETHYL SULFIDE &	ND	ND
CARBON DISULFIDE &	ND	ND
TRIMETHYLSILANOL &	0.01152	0.01152
OCTAMETHYLCYCLOTETRAILOXANE &	ND	ND
DECAMETHYLCYCLOPENTASILOXANE &	ND	ND
HEXAMETHYLCYCLOTRISILOXANE %	0.00699	0.06994
NON-TARGET COMPOUNDS **		
PROPENE &	ND	ND
PROPANE &	ND	ND
BUTANE &	ND	ND
ISOPRENE &	ND	ND
1,1,1,2-TETRAFLUOROETHANE	0.00339	0.00339
TARGET COMPOUNDS (GC)		
CARBON MONOXIDE	0.04196	0.15551
METHANE	0.00191	0.00191
HYDROGEN	0.00631	0.00631
CARBON DIOXIDE	0.20031	0.20031
TOTAL T-VALUE	0.32326	0.50212
TOTAL T-VALUE - CO2	0.12295	0.30181

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.