INTERNAL CONTAMINATION ISSUES

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CONTAMINATION

EXTERNAL ISSUES

- WINDOWS
- MATERIAL DEGRADATION DUE TO MOLECULAR OXYGEN EXPOSURE
- HYPERGOLICS AND OTHER REACTANTS

INTERNAL ISSUES

- √ PARTICULATE
- √ ATMOSPHERIC
- BIOLOGICAL (BACTERIOLICAL)

√ DISCUSSED IN THIS SESSION

INTERNAL ATMOSPHERIC CONTAMINATION

Contaminants Found in Shuttle Orbiter Atmospheric Samples

Compound Identity	STS MISSION NUMBER														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Acetic Acid, n-Butyl Ester	X								X						
Acetic Acid, 2-Ethoxyethlyester	X														
Acetic Acid, Ethyl Ester						X	X								
C_4 Alkene						X									
Benzaldehyde		X													
Benzene	X	X	X		X	X									
Bromotrifluoromethane			X	X											
1-Butanal	X	X	X												
1-Butanol	X	X							X						
2-Butanone	X	X	X		X	X			X						
Butene					X										
n-Butylbenzene	X														
Carbon Dioxide							X								
Carbon Disulfide		X													
Carbon Monoxide	X	X	X		X	X	X	X	X						
Cyclohexane		X													
Decane		X													
Dichlorodifluoromethane				X											
1,1-Dichlorethene		X													
Dichloromethane	X	X	X		X	X	X		X						
1,2-Dimethylbenzene	X	X	X			X			X						
1,3-Dimethylbenzene	X	X	X		X	X	X		X						
1,4-Dimethylbenzene	X				X				X						
1,1-Dimethylethanol	X														
Ethanal	X	X	X		X	X	X		X						
Ethanol	X	X	X	X	X	X	X		X						
Ethylbenzene	X	X	X			X			X						
2-Ethylhexanal		X													
Ethyl 2-Propenyl Ether						X									
1-Heptanal	X														
Heptane		X	X												
2-Heptanone	X														
3-Heptanone	X														
Hexamethylcyclopentane		X													
Hexamethylcyclotrisiloxane	X					X			X						
1-Hexanal	X								X						
Hexane	X	X													

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Compound Identity	STS MISSION NUMBER														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hydrogen							X								
Indan		X													
C_7 Ketone						X									
Methane	X	X	X	X	X		X	X	X						
Methanol	X	X													
2-Methyl-1,3-Butadiene	X														
Methylcyclopentane	X	X				X									
Methylethylcyclopentane			X												
6-Methyl-2-Heptanone		X													
2-Methylpentane		X													
2-Methyl-1-Propanol		X													
2-Methyl-2-Propanol		X	X			X									
4-Methyl-2-Propantanone	X		X												
Napthalene		X													
Nonane		X													
Octane		X													
1-Pentanal	X	X	X												
Pentane		X	X						X						
1-Propanal	X	X	X			X			X						
1-Propanol						X									
2-Propanol	X		X		X	X			X						
2-Propanone	X	X	X	X	X	X	X	X	X						
Prophylbenzene	X	X													
Toluene	X	X	X		X	X	X		X						
1,1,1-Trichloroethane	X	X	X			X	X	X	X						
Trichloroethene		X	X				X	X							
Triochlorofluoromethane	X	X	X				X		X						
1,1,2-Trichloro-1,2,2-Triflourethane	X	X	X	X	X	X	X	X	X						
Trimethyl Silanol		X													
C_7-Aliphatic Hydrocarbons (1)*		X													
C_8-Aliphatic Hydrocarbons (7)		X													
C_9-Aliphatic Hydrocarbons (9)		X													
C_{10}-Aliphatic Hydrocarbons (8)		X													
C_{11}-Aliphatic Hydrocarbons (8)		X													
C_{12}-Aliphatic Hydrocarbons (8)		X													
C_{13}-Aliphatic Hydrocarbons (1)		X					X								
C_{14}-Aliphatic Hydrocarbons (13)		X													

Compound Identity	STS MISSION NUMBER														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C_8-Alkane (1)				X											
C_9-Alkane (5)				X		X									
C_{10}-Alkane (6)	X		X												
C_{11}-Alkane (5)	X		X												
C_{12}-Alkane (4)	X		X												
C_8-Olefinic Hydrocarbon (1)		X													
C_9-Olefinic Hydrocarbon (2)		X													
Silocone MW = 236									X						
Siloxane (3)					X										
Octamethylcyclotetrasiloxane						X			X						
C_3-Substituted Benzene (11)	X														
C_4-Substituted Benzene (6)	X														

BACKGROUND

PRESENT SYSTEM:

- WHOLE GAS SAMPLES
  - THREE TIMES DURING MISSION THE CYLINDER VALVE IS OPENED TO PERMIT THE INFLOW OF CABIN ATMOSPHERE INTO THE EVACUATED CYLINDER.
  - THE SAMPLE IS TRAPPED UPON CLOSING THE CYLINDER VALVE.
  - TOXICOLOGY LABORATORY PERFORMS ANALYSES AFTER THE FLIGHT.
- GAS CHROMATOGRAPHY
  - MASS SPECTROMETRY FOR COMPOUND IDENTIFICATION
  - GAS CHROMATOGRAPHY FOR QUANTIFICATION.

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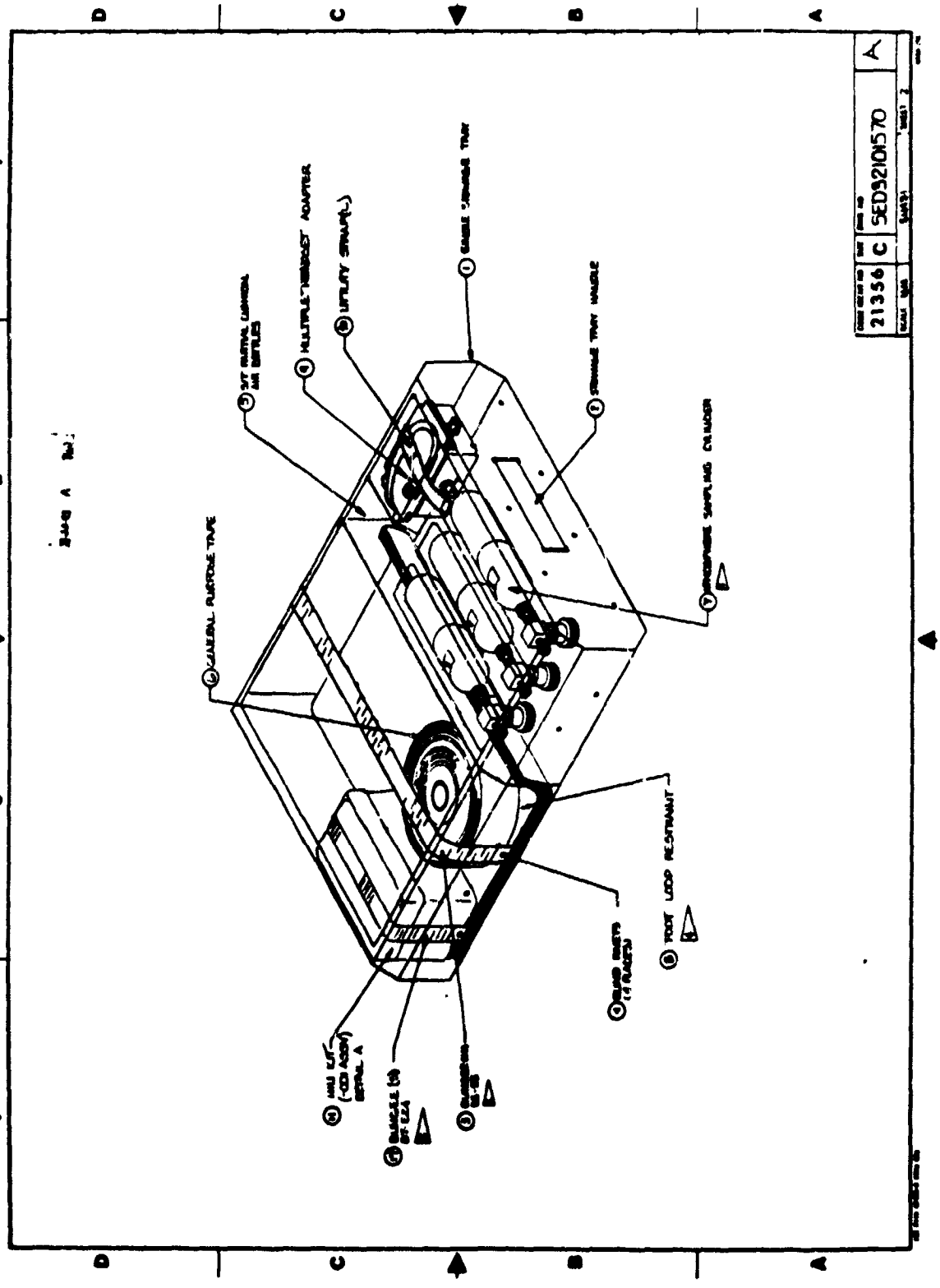

STS-2

- SYSTEMIC POISONS EXCEEDED LIMIT BY 1.22 TIMES (MAJOR CONSTITUENT TOLUENE)
- FOUR SAMPLE BOTTLE, TENAX ABSORBER, AND CHARCOAL SAMPLE ANALYSES USED FOR EVALUATION.
- SOURCE OF TOLUENE INTRODUCED DURING GROUND OPS.

PHYSIOLOGICAL EFFECTS GROUP	SPACECRAFT MAXIMUM ALLOWABLE CONCENTRATION (SMAC) PERCENT
IRRITANTS	11.3%
CNS DEPRESSANTS	22.2%
SYSTEMIC POISONS	122.3% *
ASPHYXIANTS	6.6%

STS-3

- ANALYSIS OF 4 BOTTLES AND CHARCOAL SAMPLES SHOWED METHANE AND HALON 1301.
- FIRE SUPPRESSION HALON BOTTLE RELEASED BEFORE ENTRY PER FLIGHT RULE (SMOKE DETECTOR FAILURE).
- LEVEL WOULD EXCEED SMAC - FLIGHT RULE CHANGE TO USE OXYGEN MASK EACH TIME BOTTLE FIRED.

STS-4

- ONLY ONE BOTTLE - INADEQUATE FOR ASSESSMENT
- FIRST USE OF ATCO (AMBIENT TEMP CATALYTIC OXIDIZER)
- 100% CHARCOAL USED IN A CANISTER FOR SCRUBBING
- FREON 12 INTRODUCED WITH FIRST USE OF VPC (VAPOR PHASE COMPRESSION) FREEZER.
- BALLOONING OF INSULATION BLANKET OCCURRED.
- ODOR NOTED WHEN AIRLOCK OPENED. (UNKNOWN)
- ANALYSIS OF THE ONE SAMPLE BOTTLE SHOWED: FREON 12, HALON 1301, FREON 113 (TF), METHANE.

STS-5

- INCREASE IN CREW SIZE TO 4
- ODOR AGAIN NOTED WHEN AIRLOCK OPENED (UNKNOWN)
- ODOR NOTICED NEAR ONE OF THE LOCKERS (UNKNOWN)

STS-6

- o CREW SIZE OF 4
- o CREW REPORTED THAT THEY WERE SUBJECTED TO HEADACHES DURING THE FLIGHT
- o AIR SAMPLES #3 AND #4 WERE COLLECTED AT THE SAME TIME
- o CREW REPORTED AN ODOR NEAR THE MLR
    - o CREW TURNED OFF MLR EXPERIMENT
    - o POST LANDING, THE ODOR WAS TRACED TO A BURNT WIRE INSULATION FROM A SHORT IN A WIRE HARNESS IN THE HUMIDITY SEPARATOR.
- o DUE TO BURNT WIRE, CHARCOAL "SCRUBBERS" ARE BEING ANALYZED FOR POSSIBLE DECOMPOSITION PRODUCTS.

STS-7

- CABIN PRESSURE CHANGE FROM 14.7 TO 10.2 PSI AND OXYGEN CONTENT INCREASED FROM 20.9% TO 26 TO 28%. MATERIALS WERE NOT CERTIFIED AT THE HIGHER 02 CONTENT.
- INCREASE IN CREW SIZE TO 5
- NO SAMPLES TAKEN WHEN CABIN WAS AT 10.2 PSI.

CONCERNS:

- o INSUFFICIENT SAMPLE BOTTLES TO PROVIDE THE NECESSARY DATA TO MAKE AN ADEQUATE ASSESSMENT OF THE CABIN ATMOSPHERE THROUGHOUT THE MISSION.
- o USE OF SAMPLE BOTTLES FOR QUALIFICATION/VERIFICATION FOR NEW EQUIPMENT OR CHANGES IN OPERATING CONDITIONS.
- o IF THE CREW CAPABILITY WERE TO BE DEGRADED (PHYSICALLY OR MENTALLY DURING THE FLIGHT) ADEQUATE POST FLIGHT DATA WOULD NOT BE AVAILABLE TO MAKE AN ASSESSMENT OF THE CAUSE AND INITIATION OF CORRECTIVE ACTION WOULD BE DIFFICULT.

- o NO CONTROL ON CARRY-ON ITEMS. FIRST EXPOSURE TO CABIN ENVIRONMENT IS DURING FLIGHT WITHOUT PRIOR EVALUATION OR REAL TIME MONITORING.
- o HALON 1301 LEAK/DISCHARGE COULD EXCEED SMAC LEVEL UNRECOGNIZED.
- o SYNERGISTIC EFFECTS OF CABIN CONTENTS IS UNKNOWN.
- o ABUSE OF $LiOH$ CANNISTERS MAY CREATE A SINGLE POINT FAILURE, WHICH COULD RELEASE CORROSIVE/TOXIC MATERIAL.
- o UNDER CURRENT SITUATIONS, MISSIONS MUST BE ABORTED IF THE DONNING OF MASKS IS REQUIRED.

CONCERNS: CONT'D

- o CABIN ATMOSPHERE CANNOT READILY BE ALTERED. CANNOT VENT TO VACUUM.
- o SPACELAB DATA - TBD