Shuttle-Mir Science Program
Phase 1A Research
Postflight Science Report

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Contents

SECTION 4: HYGIENE, SANITATION AND RADIATION REPORTS 4-1

SECTION 5: BEHAVIOR AND PERFORMANCE REPORTS........ 5-1

SECTION 6: FUNDAMENTAL BIOLOGY REPORTS........ 6-1

SECTION 7: MICROGRAVITY........ 7-1

Introduction

The Shuttle-Mir Science Program, also known as the Phase 1A program, was developed as a result of a joint agreement between the United States and the Russian Federation which initiated a cooperative human space flight program. The program consisted of two long duration missions, Mir 18 and Mir 19, and one Shuttle docking mission, Spacelab-Mir (SL-M) STS-71.

The Mir 18 mission began with the launch of the Soyuz TM21 on March 14, 1995, carrying two Russian cosmonauts, Mission Commander Lieutenant Colonel Vladimir N. Dezhurov and Flight Engineer Gennady M. Strekalov, Ph.D., and U.S. Astronaut, Mission Specialist Norman E. Thagard, M.D. The Soyuz TM21 docked with the Mir on March 16, 1995. After a 116 day stay in space, most of it on the Russian Space Station Mir, the Mir 18 crew landed at Kennedy Space Center on July 7, 1995. The STS-71 crew consisted of Commander Captain Robert L. “Hoot” Gibson, Pilot Lieutenant Colonel Charles J. Precourt, Mission Specialist Ellen S. Baker, M.D., Mission Specialist Gregory J. Harbaugh and Mission Specialist Bonnie J. Dunbar, Ph.D. The SL-M mission also provided return transportation for the Mir 18 crew and transportation for the Mir 19 crew to the Mir.

The Mir 19 mission continued the joint science program and began with the launch of U.S. Space Shuttle Atlantis carrying two Russian cosmonauts, Mission Commander Colonel Anatoly Y. Solovyev and Flight Engineer Nikolai M. Budarin, to the space station Mir. Mir 19 was concluded on September 11, 1995, with the landing of Soyuz TM21 in Russia.

The Shuttle-Mir science program used the U.S. Space Shuttle and the Russian Space Station Mir capabilities to conduct joint research activities in space. Seven research areas encompassing 28 investigations were conducted on Mir and/or the Shuttle. The overall objectives of the Shuttle-Mir missions were to obtain engineering and operational experience in conducting research on an orbital space station; to conduct specific investigations in medical support, life sciences, fundamental biology, microgravity sciences, Earth observations, and life support technology; and to characterize the environment relative to microgravity and life sciences research on Mir to better understand past and future investigations. Included in this report are the final science reports from the investigations performed on Mir 18, STS-71, and/or Mir 19.

Section 4: Hygiene, Sanitation and Radiation Reports

Toxicological Assessment of Air Contaminants

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(Mir 18 Final Science Report)

INTRODUCTION

Objectives

OUR OBJECTIVE WAS to assess whether the air in Mir meets U.S. toxicological standards for air quality in spacecraft occupied by humans (1-3). This objective was accomplished by obtaining valid samples of the Mir atmosphere, analyzing those samples in a ground-based laboratory, and applying toxicological assessment methods for mixtures to the analytical results. In addition to this general assessment of Mir air, we wanted to quantify temporal and spatial variations inside the spacecraft.

Hypotheses

The amount of atmospheric contamination during the Mir 18 expedition will be greater than typically found on Shuttle, but will meet U.S. toxicological standards for mixtures of contaminants. The induced environment of human spacecraft contains chemical contaminants from many sources and crew exposures will be continuous to those pollutants that remain in the air during a mission. It is essential that sources of pollution be controlled and that the air revitalization system operate to remove contaminants to specified standards. Testing of this hypothesis will show whether source control and air revitalization were adequate during Mir 18.

The temporal variations in contamination levels during the Mir 18 expedition will be small. Air sampling must be done at intervals that allow toxicologists to assess the normal levels of pollutants *and* the periodic excursions associated with planned and unplanned events. The variability in contaminant levels will determine the frequency with which sampling needs to be conducted

The spatial variations in contaminant levels will be small when measured from various points within the Mir Space Station. A well designed spacecraft will contain few "dead volumes" where air movement is low and pollutants can accumulate. Since the crew's duties take them to every module, it is important to know whether their exposure to pollutants depends on their specific location within the Mir.

Background/History

The Mir station has been in operation for almost a decade and presents a unique opportunity for quantification of air pollutants that have accumulated inside the spacecraft during this long existence. Russian toxicologists and analytical chemists measure air pollutants periodically inside the Mir using AK-1 sorbent traps; however, their multi-gas chromatography method of quantifying pollutants can identify and quantify only a portion of the pollutants suspected to be present. Interest in the Mir atmosphere was heightened by reports from their experts that benzene may have been present in quantities averaging above 1 mg/m^3 during Mir 10 (the U.S. standard for benzene is 0.2 mg/m^3).

The NASA/JSC Toxicology Laboratory routinely applies sorbent and canister methods to recover air pollutants from the Shuttle atmosphere (4). After return to the laboratory, these samples are subjected to gas chromatography (GC) and mass spectrometry (MS) by state-of-the-art methods under rigid quality control. In addition, a method for trapping and analyzing formaldehyde has recently been adapted for measurement of concentrations in the Shuttle. To our knowledge, the Russians have never measured formaldehyde in spacecraft air; however, there is a report that cosmonauts have gained sensitivity to formaldehyde during flights (5).

The NASA solid sorbent air sampler (SSAS) was used to obtain air contaminant samples during the Mir 17 expedition (6). Seven samples, each collected during 24 hour periods, were acquired at intervals of 3 to 4 days during the mission. The results indicated that the air met U.S. standards for the contaminants trapped; however, the SSAS does not trap highly volatile compounds such as carbon monoxide and certain freons.

The hypotheses were addressed by applying the U.S. analytical methods to samples acquired according to a well defined temporal and spatial sampling protocol. Once the analytical data were obtained, the toxicological assessment was performed for mixtures. According to this method, contaminants are placed into categories based on their toxicological effect (e.g. irritant, neurotoxicant, carcinogen, etc). In each toxicological category the T value must not exceed 1 for the air to be considered fully suitable. The T-value is defined for "n" contaminants in a toxicological effect group (*teg*) based on the measured concentration of each contaminant (Cn) in the group and the spacecraft maximum allowable concentration (SMACn) for each contaminant, as given below.

$T(teg) = C1/SMAC1 + C2/SMAC2 + ...Cn/SMACn$

The SMACs in the above equation must be selected for the time of exposure of the crew. Typically, for Mir expeditions the appropriate SMACs are those for 180 days of exposure.

METHODS/SCIENCE OPERATIONS

Functional Objectives

FO1. Provide cleaned and proofed air samplers.

Grab sample canisters are subjected to several steps in preparation for launch. A high vacuum manifold is used to test each canister valve and fitting for leaks, then each is cleaned and proofed to <5 ppb for each contaminant quantified by GC/MS. Finally, each canister is evacuated to a pressure of 10^{-5} torr or less. Each SSAS tube is cleaned with ultrapure nitrogen at 250 ^{o}C and proofed to <5 ppb for each GC/MS analyte. The SSAS is dosed with fluorobenzene and bromofluoromethane to assess the recovery of compounds sampled during the flight. The flow through each tube is measured in triplicate using a small volume of clean, humidified air. Preparation of the formaldehyde badges includes quantification of their uptake rate by comparison with an impinger method and dosing 2 positive control badges which serve as trip surrogates. All sampling devices were delivered to the Mir on 2/15/95 by a Russian *Progress* resupply vehicle.

FO2. Sample air using protocols provided.

Instantaneous air samples are taken by the GSC when the valve is opened by the crewmember. SSAS samples are taken over periods of about 24 hours by electronic pulsing of a diaphram pump to draw air through one of the sorbent tubes, which is selected by a crewmember according to protocol. Each of the seven sampling tubes is used for only one sampling session and the instrument is off most of the flight. The start and stop times are recorded on the instrument by a crewmember. Formaldehyde badges, after removal of the face covering, are attached to the cosmonaut's uniform with velcro and the badge is worn for approximately 12 hours while the cosmonaut is active. When the sample period ends, the badge is removed and resealed until it reaches the JSC laboratory.

FO3. Return samplers to NASA/JSC Toxicology Laboratory.

Air samplers were returned by the Space Shuttle on STS-71. Samplers returned via the Shuttle were maintained under strict chain-of-custody procedures used by NASA.

FO4. Analyze samples according to standard operating procedures for targeted compounds.

Details of the analytical procedures are given in part D below for each of the samplers.

FO5. Assess the toxicological acceptability of air based on the analytical data.

Toxicological assesment of air quality was based on grouping compounds found in the air into toxicological effect categories and assuming that the potential for adverse effects from each member of a group was additive to other members in proportion to the SMAC of each (see equation above). Only compounds whose concentration reached at least 1/100 of their long term SMAC were considered. This mathematical paradigm may be precise; however, it is founded on an assumption of additivity of similar toxic effects, which has never been proven for the vast majority of toxic chemicals. The assumption of additivity is reasonable as long as the compounds are grouped appropriately and the concentrations of each are only a small fraction of the SMAC.

Hardware Items

HW1. NASA Grab sample canisters (Figure 1)

The NASA/JSC canisters are purchased from Scientific Instrumentation Specialists, Moscow, Idaho with a special modification to include a clutched-closure valve and a clutch handle retainer. Once the canister is received at JSC, the tether is added to prevent loss of the dust cap. Each canister weighs 0.5 kg and retains a volume of 358 ml. The interior surfaces are SUMMA^{R}-treated to minimize retention of compounds on the walls.

HW2. NASA Solid sorbent air sampler (Figure 2)

The SSAS (U.S. Patent 4,584,887, dated April 29, 1986) consists of two subassemblies and a cylindrical outer case (see figure). The unit contains 8 sorbent tubes, one of which (position 8) is used as a parking position between acquisition of spacecraft samples on one of the other 7 tubes. Each tube is 1/4 inch, glass-lined, stainless steel packed with 0.5 gm of Tenax^{R} sorbent. The pump assembly is battery powered (4 alkaline C cells) and can be set to draw from 0.5 to 3.0 liters of air through a sample tube over a 24-hour sampling period. The entire unit weighs approximately 2.3 kg. A recent modification to the inlet screen provides a 5-fold increase in the inlet area to minimize chances for obstruction of the inlet.

HW3. NASA Formaldehyde Badges (Figure 3)

The formaldehyde badges, which rely on passive diffusion, were purchased from Air Quality Research who markets them to the industrial hygiene community. When received at JSC, the frame of each badge is modified to a 2 1/2 inch square and marked for NASA's applications. Each lot is tested for uptake of formaldehyde and background response. Once exposed to air, the dry collector converts formaldehyde to a stable product. The diffusion rate is controlled by a permeable membrane between the collector and the sample atmosphere.

Methods/Protocol

Air samples were obtained at the central control post periodically throughout the expedition as instantaneous samples using GSCs and 24-hour integrated samples using the SSAS. Late in the mission, five GSCs were taken in a 30 minute time span from attached modules to assess spatial variations. Formaldehyde badges were worn for periods of 11.5 to 13.2 hours by a crewmember on nine days separated by 1 to 2 weeks.

The GSCs contents were analyzed by gas chromatography for highly volatile compounds such as carbon monoxide and by GC/MS for identification and quantification of approximately 80 targeted compounds and an unknown number of non-target compounds. The SSAS contents were to be desorbed into a canister in the lab and GC/MS analysis completed; however, the SASS inlet was obstructed to the point where the sample volume was highly uncertain. Analysis of the SSAS samples was not completed. The formaldehyde badges were analyzed by a chromatrophic acid procedure. All analyses were conducted according to SOPs and under rigid quality control.

RESULTS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

None

Inflight Anomalies

None

Postflight Anomalies

When the SSAS was returned to the NASA/JSC Toxicology Laboratory, it was found that the inlet was obstructed by a "milky" material. The flows had been reduced to approximately 1/3 their preflight values. Since the time when the obstruction occurred was unknown, the volume sampled by the SSAS could not be measured with sufficient precision to meet quality control criteria; hence, the data were not available in reportable form.

Completeness/Quality of Data

Except as noted above, the data were substantially complete and of extremely high quality. In some of the canister samples perfluoropropane, a non-targeted contaminant, could not be measured accurately because the sample was depleted by the time a modified GC/MS method was developed and standards purchased for developing a calibration curve.

Tables, Figures, and Graphs Index

DISCUSSION

Are U.S. Toxicological Standards Met for Mir 18?

The toxicological assessment of air quality during Mir 18 shows that U.S. standards were met for all toxicologiccal categories except mucosal (eye, throat, and upper airways) irritants. The T-value for this category was 1.57, which is slightly above the acceptability limit of 1.0. Formaldehyde contributed 1.2 units of this value. Since the formaldehyde SMAC was set to reduce the risk of mucosal irritation to less than 1/100 (7), it is unlikely that any members of such a small crew experienced any mucosal irritation as a result of formaldehyde exposure.

Are Temporal Variations in the Concentrations of Air Pollutants Small?

For most contaminants, the measured concentrations were reasonably consistent, that is there were not large temporal variations. The GSC sample taken on 6/4/95 did show a large "spike" (32 mg/m^3) of perfluoro-dimethylcyclohexanes (Freon 82) into the air. The concentration of Freon 82 decayed slowly over the next few weeks, reaching a concentration of 3.5 mg/m^3 on 6/29/95.

Are Spatial Variations in the Concentrations of Air Pollutants Small?

The spatial variations were small in the five samples taken from various modules on 6/12/95 between 1700 and 1730.

Conclusion

The Mir atmosphere is very close to meeting U.S. standards for mixtures of contaminants. Formaldehyde does appear to be above desirable concentrations; however, the consequences of prolonged exposure to low formaldehyde concentrations is a risk of mucosal irritation slightly above 1/100. Temporal variations can be important as shown by the Freon 82 spike; however, it appears that spatial variations are small.

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4. James, JT, TF Limero, HJ Leano, JF Boyd, and PA Covington. (1994) Volatile organic contaminants found in the habitable environment of the Space Shuttle: STS-26 to STS-55. Aviat. Space Environ. Med. 65:851-7
5. Peto, PG (1981) Results of Soviet-Hungarian Space Research. East Europe Report No. 699, 3 April 1981. pp 4-12
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TABLE 1. AIR SAMPLING SESSIONS

Mission	Scheduled Sample	Scheduled Day	Actual Day	Actual Date	Actual Subjects	Samples/ Parameters
Using the Solid Sorbent Air Sampler						
Mir 18	Tube 1	MD 5	MD 5	20 Mar	n/a	Integrated/ GC-MS for VOCs
	Tube 2	MD 13	MD 14	29 Mar	n/a	Same
	Tube 3	MD 25	MD 25	9 Apr	n/a	Same
	Tube 4	MD 45	MD 45	29 Apr	n/a	Same
	Tube 5	MD 60	MD 60	14 May	n/a	Same
	Tube 6	MD 73	MD 73	28 May	n/a	Same
	Tube 7	MD 82	MD 80	3 Jun	n/a	Same
STS-71	Tube 1	FD 1	FD 1	27 Jun	n/a	Integrated/GC-MS for VOCs
	Tube 2	FD 2	FD 2	28 Jun	n/a	Same
	Tube 3	FD 4	FD 4	30 Jun	n/a	Same
	Tube 4	FD 5	FD 5	1 Jul	n/a	Same
	Tube 5	FD 6	FD 6	2 Jul	n/a	Same
	Tube 6	FD 7	FD 7	3 Jul	n/a	Same
	Tube 7	FD 8	FD 8	4 Jul	n/a	Same
Using Grab Sample Containers						
Mir 18	1	MD 6	MD 6	21 Mar	n/a	Grab/ GC-MS for VOCs
	2	MD 14	MD 14	29 Mar	n/a	Same
	3	MD 26	MD 26	10 Apr	n/a	Same
	4	MD 46	MD 46	30 Apr	n/a	Same
	5	MD 61	MD 61	15 May	n/a	Same
	6	MD 74	MD 74	29 May	n/a	Same
	7	MD 82	MD 81	4 Jun	n/a	Same
	8	MD 109	MD 89	12 Jun	n/a	Same
	9	MD 109	MD 89	12 Jun	n/a	Same
	10	MD 109	MD 89	12 Jun	n/a	Same
	11	MD 109	MD 89	12 Jun	n/a	Same
	12	MD 109	MD 106	29 Jun	n/a	Same
STS-71	1	FD 1	FD 1	27 Jun	n/a	Grab/ GC-MS for VOCs
	2	FD 2	FD 2	28 Jun	n/a	Same
	3	FD 3	FD 3	29 Jun	n/a	Same
	4	FD 6	FD 6	2 Jul	n/a	Same
	5	FD 7	FD 7	3 Jul	n/a	Same
	6	FD 7	FD 7	3 Jul	n/a	Same
Using the Formaldehyde Monitors						
Mir 18	1	MD 6	MD 6	22 Mar	Subject1	Formaldehyde
	2	MD 14	MD 14	29 Mar	Subject1	Same
	3	MD 26	MD 26	10 Apr	Subject1	Same
	4	MD 37	MD 37	21 Apr	Subject1	Same
	5	MD 46	MD 46	30 Apr	Subject1	Same
	6	MD 57	MD 56	10 May	Subject1	Same
	7	MD 68	MD 69	23 May	Subject1	Same
	8	MD 79	MD 89	12 Jun	Subject1	Same
	9	MD 97	MD 97	20 Jun	Subject1	Same

TABLE 2. ANALYTICAL RESULTS OF MIR 18 CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	AIR CONCENTRATION (mg/m3)											
	AA01081 CORE 3/21/95 9:35	AA01082 CORE 3/29/95 13:05	AA01083 CORE 4/10/95 11:00	AA01084 CORE 4/30/95 15:15	AA01085 CORE 5/15/95 10:00	AA01086 CORE 6/4/95 18:00	AA01087 KVANT 6/12/95 17:00	AA01088 KVANT II 6/12/95 17:10	AA01089 KRISTALL 6/12/95 17:15	AA01090 SPEKTER 6/12/95 17:20	AA01091 SOYUZ 6/12/95 17:30	AA01092 CORE 6/29/95 11:35
TARGET COMPOUNDS (TO-14/POLAR)												
DICHLORODIFLUOROMETHANE	1.3	0.91	0.95	1.1	0.90	0.42	0.81	1.1	1.3	1.5	1.3	1.1
CHLOROMETHANE	* < 0.050	0.07	0.06	0.07	TRACE	TRACE	TRACE	0.06	0.06	0.08	0.06	0.06
1,1-DICHLORO-1,2,2,2-TETRAFLUOROETHANE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
ACETALDEHYDE	0.31	0.21	0.18	0.24	0.20	0.25	0.28	0.30	0.30	0.24	0.33	0.20
METHANOL	0.13	0.13	0.14	0.28	0.35	0.28	0.27	0.34	0.32	0.34	0.39	0.22
VINYL CHLORIDE	< 0.050	TRACE	TRACE	TRACE	< 0.050	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
BROMOMETHANE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
ETHANOL **	4.1	0.88	2.5	2.0	0.67	2.4	2.2	1.4	1.1	1.5	1.9	0.60
CHLOROETHANE	0.05	0.05	< 0.050	0.12	TRACE	0.11	0.17	0.14	0.14	0.15	0.14	0.07
PROPENAL	# TRACE	TRACE	TRACE	TRACE	0.02	TRACE	TRACE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
ACETONE	0.48	0.87	0.56	0.72	0.39	0.62	0.67	0.67	0.71	0.67	0.71	0.84
PROPANAL	0.09	0.08	0.06	0.09	0.08	0.07	0.09	0.08	0.07	0.06	0.08	0.06
ISOPROPANOL	0.05	0.85	0.27	0.92	0.09	0.16	0.25	0.23	0.23	0.24	0.25	1.5
TRICHLOROFLUOROMETHANE	0.11	0.18	0.17	0.89	0.22	1.0	0.86	0.83	0.82	0.83	0.82	0.52
ACRYLONITRILE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	TRACE	< 0.050	< 0.050	< 0.050
2-METHYL-2-PROPANOL	< 0.050	< 0.050	TRACE	TRACE	TRACE	TRACE	TRACE	< 0.050	< 0.050	< 0.050	TRACE	TRACE
METHYL ACETATE	< 0.050	< 0.050	< 0.050	0.06	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,1-DICHLOROETHENE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
DICHLOROMETHANE	0.06	0.05	0.05	0.06	TRACE	0.05	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,1,2-TRICHLORO-1,1,2-TRIFLUOROETHANE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.51	0.19	0.19	0.18	0.19	0.18	TRACE
N-PROPANOL	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,1-DICHLOROETHANE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
BUTANAL	0.06	0.06	TRACE	0.06	0.05	TRACE	0.07	0.06	TRACE	TRACE	0.06	TRACE
2-BUTANONE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,2-DICHLOROETHENE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-METHYLFURAN	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
ETHYL ACETATE	TRACE	TRACE	TRACE	0.15	0.09	0.35	0.10	0.09	0.07	0.11	0.11	TRACE
CHLOROFORM	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-BUTENAL	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	TRACE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
1,2-DICHLOROETHANE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,1,1-TRICHLOROETHANE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
N-BUTANOL	0.12	0.16	0.13	0.14	0.12	0.27	0.23	0.21	0.18	0.21	0.22	0.09
1,1-DICHLOROPROPENE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
BENZENE	TRACE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
CARBON TETRACHLORIDE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-PENTANONE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
PENTANAL	0.07	0.06	TRACE	0.06	0.07	0.06	0.07	0.06	0.05	TRACE	0.06	TRACE
1,2-DICHLOROPROPANE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050

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CHEMICAL CONTAMINANT	AIR CONCENTRATION (mg/m3)											
	AA01081 CORE 3/21/95 9:35	AA01082 CORE 3/29/95 13:05	AA01083 CORE 4/10/95 11:00	AA01084 CORE 4/30/95 15:15	AA01085 CORE 5/15/95 10:00	AA01086 CORE 6/4/95 18:00	AA01087 KVANT 6/12/95 17:00	AA01088 KVANT II 6/12/95 17:10	AA01089 KRISTALL 6/12/95 17:15	AA01090 SPEKTER 6/12/95 17:20	AA01091 SOYUZ 6/12/95 17:30	AA01092 CORE 6/29/95 11:35
TARGET COMPOUNDS (TO-14/POLAR) contd.												
TRICHLOROETHENE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
2,5-DIMETHYLFURAN	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
CIS-1,3-DICHLOROPROPENE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-PENTENAL	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TRANS-1,3-DICHLOROPROPENE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
1,1,2-TRICHLOROETHANE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TOLUENE	0.14	0.12	0.10	0.13	0.09	0.25	0.19	0.21	0.19	0.20	0.19	0.11
HEXANAL	TRACE	TRACE	TRACE	TRACE	0.07	0.06	0.07	TRACE	TRACE	TRACE	0.05	TRACE
MESITYL OXIDE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
1,2-DIBROMOETHANE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
BUTYL ACETATE	TRACE	TRACE	TRACE	TRACE	TRACE	0.06	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
TETRACHLOROETHENE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
CHLOROBENZENE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
ETHYL BENZENE	TRACE	TRACE	TRACE	TRACE	TRACE	0.07	0.06	0.06	0.06	0.07	0.06	TRACE
M- + P-XYLENES	0.12	0.16	0.14	0.18	0.15	0.27	0.26	0.26	0.24	0.27	0.24	0.17
2-HEPTANONE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
CYCLOHEXANONE	TRACE	TRACE	TRACE	TRACE	TRACE	0.05	0.05	0.05	TRACE	0.06	TRACE	TRACE
HEPTANAL	0.06	0.06	0.06	0.07	0.10	0.07	0.07	TRACE	0.06	TRACE	TRACE	TRACE
STYRENE	< 0.050	< 0.050	< 0.050	TRACE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
1,1,2,2-TETRACHLOROETHANE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
O-XYLENE	0.10	0.13	0.13	0.15	0.13	0.22	0.21	0.21	0.19	0.21	0.19	0.15
1,3,5-TRIMETHYLBENZENE	< 0.050	< 0.050	TRACE	TRACE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
1,2,4-TRIMETHYLBENZENE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,3-DICHLOROBENZENE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
1,4-DICHLOROBENZENE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,2-DICHLOROBENZENE	< 0.050	TRACE	TRACE	TRACE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
1,2,4-TRICHLOROBENZENE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
HEXACHLORO-1,3-BUTADIENE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TARGET COMPOUNDS (TOXIC)												
1,3-BUTADIENE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
ETHYLENE OXIDE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
FURAN	< 0.050	TRACE	< 0.050	TRACE	0.12	0.06	TRACE	TRACE	TRACE	TRACE	TRACE	< 0.050
CHLOROPROPENES	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
CARBON DISULFIDE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	< 0.050
2-METHYL-2-PROPENAL	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
3-BUTEN-2-ONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
DIMETHYLDISULFIDE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
OCTAMETHYLCYCLOTETRASILOXANE	1.7	2.5	2.1	2.5	1.9	2.4	2.7	2.8	2.3	2.7	2.2	1.9

TABLE 2. ANALYTICAL RESULTS OF MIR 18 CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	AIR CONCENTRATION (mg/m3)											
	AA01081 CORE 3/21/95 9:35	AA01082 CORE 3/29/95 13:05	AA01083 CORE 4/10/95 11:00	AA01084 CORE 4/30/95 15:15	AA01085 CORE 5/15/95 10:00	AA01086 CORE 6/4/95 18:00	AA01087 KVANT 6/12/95 17:00	AA01088 KVANT II 6/12/95 17:10	AA01089 KRISTALL 6/12/95 17:15	AA01090 SPEKTER 6/12/95 17:20	AA01091 SOYUZ 6/12/95 17:30	AA01092 CORE 6/29/95 11:35
NON-TARGET COMPOUNDS												
PERFLUOROPROPANE ***	^ NS	NS	44	23	20	NS	36	37	NS	48	29	29
CHLORODIFLUOROMETHANE	& BL	BL	BL	BL	BL	0.09	0.09	0.10	0.10	0.10	0.11	0.07
1-CHLORO-1,1-DIFLUOROETHANE	0.49	0.53	0.51	0.67	0.68	0.53	0.44	0.45	0.44	0.46	0.46	0.27
C4-ALKENE	BL	BL	BL	0.10	BL	0.08	BL	BL	BL	BL	0.09	BL
PERFLUORODIMETHYLCYCLOHEXANES ****	1.0	1.2	0.82	1.7	0.85	32	7.6	7.8	8.0	8.3	8.2	3.5
C5-ALKANE	0.04	0.06	0.05	0.08	0.02	0.04	0.05	0.05	0.07	0.06	0.05	0.04
2-METHYL-1,3-BUTADIENE	BL	0.09	0.07	0.10	BL	BL	0.10	0.08	0.11	0.09	0.10	BL
C7-ALKANES	0.06	0.06	BL	0.14	BL	1.1	0.30	0.33	0.31	0.34	0.32	0.05
OXYGENATED HYDROCARBON (MW ≥ 114)	BL	BL	BL	0.08	0.10	BL	BL	BL	BL	BL	BL	BL
HEXAMETHYLCYCLOTRISILOXANE	1.8	2.4	2.1	2.2	1.6	2.2	2.0	2.1	1.7	2.1	1.4	1.6
BENZALDEHYDE	0.25	0.12	0.10	0.14	BL	0.15	0.17	0.09	BL	BL	0.11	BL
OCTANAL	BL	0.14	0.20	BL	0.28	0.23	0.19	BL	0.23	0.13	BL	BL
C8-ALCOHOL	BL	BL	0.78	BL	BL	BL	BL	BL	BL	BL	BL	BL
C11-ALKANE	BL	BL	BL	BL	0.12	0.21	BL	BL	BL	0.14	BL	BL
LIMONENE	0.28	0.29	0.27	0.48	0.69	0.38	0.36	0.36	0.34	0.35	0.36	0.24
NONANAL	BL	BL	0.20	BL	0.27	0.22	BL	BL	0.23	BL	BL	BL
DIPHENYLAMINE	BL	BL	BL	BL	BL	0.11	BL	BL	BL	BL	BL	BL
DECAMETHYLCYCLOPENTASILOXANE	BL	BL	0.41	BL	BL	BL	BL	BL	0.37	0.44	BL	BL
TARGET COMPOUNDS (GC)												
CARBON MONOXIDE	1.3	TRACE	1.6	TRACE	1.3	3.1	1.6	1.7	1.5	1.3	1.3	TRACE
METHANE	1800	1700	1700	1400	1700	1200	1300	1200	1000	1000	960	1300
HYDROGEN	6.2	9.2	10	14	17	12	14	11	9.5	10	12	11
TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)	13	12	57	39	30	47	57	58	21	70	50	42

* < : Value is less than the laboratory report detection limit.
**: Ethanol concentrations exceed the calibration curve concentration range, with the exception of samples AA01085 and AA01092.
TRACE: Amount detected is sufficient for compound identification only.
Calculations are based on one-half of the laboratory report detection limit (1.1 mg/m3 for CO; 3.3 mg/m3 for CH4; 0.41 mg/m3 for H2).
& BL: Area below the search routine limit (<20% of the fluorobenzene peak area).
***: Compound was re-analyzed based on the calibration performed on 10/13-16/95.
^ NS: No sample available.
****: Quantitations based on a 4-point calibration performed on 9/19/-22/95.

TABLE 3. ANALYTICAL RESULTS OF MIR 18 CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUES											
	AA01081 CORE 3/21/95 9:35	AA01082 CORE 3/29/95 13:05	AA01083 CORE 4/10/95 11:00	AA01084 CORE 4/30/95 15:15	AA01085 CORE 5/15/95 10:00	AA01086 CORE 6/4/95 18:00	AA01087 KVANT 6/12/95 17:00	AA01088 KVANT II 6/12/95 17:10	AA01089 KRISTALL 6/12/95 17:15	AA01090 SPEKTER 6/12/95 17:20	AA01091 SOYUZ 6/12/95 17:30	AA01092 CORE 6/29/95 11:35
TARGET COMPOUNDS (TO-14/POLAR)												
DICHLORODIFLUOROMETHANE	0.00271	0.00186	0.00193	0.00228	0.00183	0.00085	0.00165	0.00226	0.00274	0.00315	0.00271	0.00229
CHLOROMETHANE	ND	0.00160	0.00145	0.00174	0.00061	0.00061	0.00061	0.00153	0.00156	0.00202	0.00150	0.00149
1,1-DICHLORO-1,2,2,2-TETRAFLUOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ACETALDEHYDE	0.07804	0.05324	0.04427	0.06104	0.04981	0.06243	0.06879	0.07388	0.07471	0.06029	0.08142	0.04953
METHANOL	0.01459	0.01399	0.01512	0.03111	0.03899	0.03067	0.02946	0.03772	0.03592	0.03737	0.04300	0.02448
VINYL CHLORIDE	ND	0.00833	0.00833	0.00833	ND	0.00833	0.00833	0.00833	0.00833	0.00833	0.00833	0.00833
BROMOMETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHANOL	0.00206	0.00044	0.00123	0.00101	0.00034	0.00122	0.00112	0.00068	0.00055	0.00073	0.00095	0.00030
CHLOROETHANE	0.00020	0.00021	ND	0.00048	0.00010	0.00041	0.00064	0.00054	0.00054	0.00058	0.00055	0.00027
PROPENAL	0.33333	0.33333	0.33333	0.33333	0.71071	0.33333	0.33333	ND	ND	ND	ND	ND
ACETONE	0.00953	0.01741	0.01121	0.01446	0.00771	0.01239	0.01334	0.01339	0.01419	0.01337	0.01426	0.01675
PROPANAL	0.00091	0.00081	0.00062	0.00095	0.00081	0.00069	0.00099	0.00084	0.00073	0.00060	0.00084	0.00067
ISOPROPANOL	0.00034	0.00567	0.00183	0.00616	0.00060	0.00109	0.00164	0.00155	0.00152	0.00159	0.00165	0.01021
TRICHLOROFLUOROMETHANE	0.00019	0.00032	0.00031	0.00158	0.00038	0.00181	0.00154	0.00148	0.00147	0.00148	0.00147	0.00093
ACRYLONITRILE	ND	ND	ND	ND	ND	ND	ND	ND	0.00893	ND	ND	ND
2-METHYL-2-PROPANOL	ND	ND	0.00021	0.00021	0.00021	0.00021	0.00021	ND	ND	ND	0.00021	0.00021
METHYL ACETATE	ND	ND	ND	0.00050	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DICHLOROMETHANE	0.00569	0.00546	0.00507	0.00611	0.00250	0.00519	0.00250	0.00250	0.00250	0.00250	0.00250	0.00250
1,1,2-TRICHLORO-1,1,2-TRIFLUOROETHANE	ND	ND	ND	ND	ND	0.00126	0.00046	0.00047	0.00045	0.00048	0.00046	0.00006
N-PROPANOL	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026	0.00026
1,1-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BUTANAL	0.00053	0.00046	0.00021	0.00049	0.00043	0.00021	0.00054	0.00047	0.00021	0.00021	0.00051	0.00021
2-BUTANONE	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083
1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-METHYLFURAN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHYL ACETATE	0.00014	0.00014	0.00014	0.00082	0.00050	0.00194	0.00055	0.00052	0.00040	0.00062	0.00061	0.00014
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-BUTENAL	ND	ND	ND	ND	ND	0.00021	ND	ND	ND	ND	ND	ND
1,2-DICHLOROETHANE	0.02500	0.02500	0.02500	0.02500	0.02500	0.02500	0.02500	0.02500	0.02500	0.02500	0.02500	0.02500
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-BUTANOL	0.00295	0.00399	0.00326	0.00357	0.00305	0.00685	0.00574	0.00531	0.00443	0.00521	0.00539	0.00221
1,1-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BENZENE	0.12500	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBON TETRACHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-PENTANONE	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036
PENTANAL	0.00060	0.00052	0.00023	0.00052	0.00060	0.00051	0.00062	0.00054	0.00050	0.00023	0.00054	0.00023
1,2-DICHLOROPROPANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3. ANALYTICAL RESULTS OF MIR 18 CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUES											
	AA01081 CORE 3/21/95 9:35	AA01082 CORE 3/29/95 13:05	AA01083 CORE 4/10/95 11:00	AA01084 CORE 4/30/95 15:15	AA01085 CORE 5/15/95 10:00	AA01086 CORE 6/4/95 18:00	AA01087 KVANT 6/12/95 17:00	AA01088 KVANT II 6/12/95 17:10	AA01089 KRISTALL 6/12/95 17:15	AA01090 SPEKTER 6/12/95 17:20	AA01091 SOYUZ 6/12/95 17:30	AA01092 CORE 6/29/95 11:35
TARGET COMPOUNDS (TO-14/POLAR) contd.												
TRICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,5-DIMETHYLFURAN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-PENTENAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TOLUENE	0.00235	0.00194	0.00169	0.00209	0.00154	0.00419	0.00318	0.00348	0.00310	0.00339	0.00312	0.00183
HEXANAL	0.00510	0.00510	0.00510	0.00510	0.01406	0.01226	0.01451	0.00510	0.00510	0.00510	0.01027	0.00510
MESITYL OXIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DIBROMOETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BUTYL ACETATE	0.00013	0.00013	0.00013	0.00013	0.00013	0.00032	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013
TETRACHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROBENZENE	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054
ETHYL BENZENE	0.00019	0.00019	0.00019	0.00019	0.00019	0.00053	0.00050	0.00049	0.00046	0.00051	0.00045	0.00019
M- + P-XYLENES	0.00053	0.00075	0.00066	0.00083	0.00068	0.00124	0.00120	0.00119	0.00107	0.00121	0.00107	0.00077
2-HEPTANONE	0.00109	0.00109	0.00109	0.00109	0.00109	0.00109	0.00109	0.00109	0.00109	0.00109	0.00109	0.00109
CYCLOHEXANONE	0.00042	0.00042	0.00042	0.00042	0.00042	0.00089	0.00087	0.00091	0.00042	0.00093	0.00042	0.00042
HEPTANAL	0.01096	0.01056	0.01116	0.01198	0.01789	0.01200	0.01308	0.00446	0.01098	0.00446	0.00446	0.00446
STYRENE	ND	ND	ND	0.00058	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
O-XYLENE	0.00044	0.00057	0.00057	0.00070	0.00058	0.00098	0.00097	0.00097	0.00087	0.00098	0.00088	0.00067
1,3,5-TRIMETHYLBENZENE	ND	ND	0.00167	0.00167	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRIMETHYLBENZENE	0.00167	0.00167	0.00167	0.00167	0.00167	0.00167	0.00167	0.00167	0.00167	0.00167	0.00167	0.00167
1,3-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DICHLOROBENZENE	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083	0.00083
1,2-DICHLOROBENZENE	ND	0.00083	0.00083	0.00083	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HEXACHLORO-1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TARGET COMPOUNDS (TOXIC)												
1,3-BUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLENE OXIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FURAN	ND	0.22727	ND	0.22727	1.12497	0.55955	0.22727	0.22727	0.22727	0.22727	0.22727	ND
CHLOROPROPENES	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CARBON DISULFIDE	0.00156	0.00156	0.00156	0.00156	0.00156	0.00156	0.00156	0.00156	0.00156	0.00156	0.00156	ND
2-METHYL-2-PROPENAL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-BUTEN-2-ONE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DIMETHYLDISULFIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTAMETHYLCYCLOTETRASILOXANE	0.01124	0.01687	0.01424	0.01691	0.01261	0.01592	0.01827	0.01853	0.01549	0.01773	0.01497	0.01291

TABLE 3. ANALYTICAL RESULTS OF MIR 18 CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUES											
	AA01081 CORE 3/21/95 9:35	AA01082 CORE 3/29/95 13:05	AA01083 CORE 4/10/95 11:00	AA01084 CORE 4/30/95 15:15	AA01085 CORE 5/15/95 10:00	AA01086 CORE 6/4/95 18:00	AA01087 KVANT 6/12/95 17:00	AA01088 KVANT II 6/12/95 17:10	AA01089 KRISTALL 6/12/95 17:15	AA01090 SPEKTER 6/12/95 17:20	AA01091 SOYUZ 6/12/95 17:30	AA01092 CORE 6/29/95 11:35
NON-TARGET COMPOUNDS												
PERFLUOROPROPANE	NS	NS	0.22644	0.11967	0.10567	NS	0.18697	0.19085	NS	0.25209	0.15172	0.15311
CHLORODIFLUOROMETHANE	BL	BL	BL	BL	BL	0.00026	0.00026	0.00030	0.00029	0.00030	0.00031	0.00019
1-CHLORO-1,1-DIFLUOROETHANE	0.00491	0.00535	0.00511	0.00670	0.00685	0.00529	0.00443	0.00448	0.00445	0.00456	0.00459	0.00271
C4-ALKENE	BL	BL	BL	0.00022	BL	0.00018	BL	BL	BL	BL	0.00019	BL
PERFLUORODIMETHYLCYCLOHEXANES	0.00247	0.00288	0.00200	0.00423	0.00208	0.07841	0.01864	0.01919	0.01944	0.02027	0.02001	0.00847
C5-ALKANE	0.00013	0.00020	0.00016	0.00026	0.00007	0.00015	0.00018	0.00018	0.00025	0.00018	0.00018	0.00014
2-METHYL-1,3-BUTADIENE	BL	0.00016	0.00012	0.00018	BL	BL	0.00018	0.00015	0.00020	0.00016	0.00018	BL
C7-ALKANES	0.00031	0.00032	BL	0.00070	BL	0.00536	0.00151	0.00163	0.00154	0.00171	0.00160	0.00027
OXYGENATED HYDROCARBON (MW ≥ 114)	BL	BL	BL	0.27915	0.32575	BL	BL	BL	BL	BL	BL	BL
HEXAMETHYLCYCLOTRISILOXANE	0.00793	0.01032	0.00932	0.00954	0.00689	0.00965	0.00876	0.00916	0.00723	0.00920	0.00590	0.00681
BENZALDEHYDE	0.00143	0.00070	0.00057	0.00082	BL	0.00084	0.00097	0.00049	BL	BL	0.00064	BL
OCTANAL	BL	0.00532	0.00786	BL	0.01077	0.00870	0.00745	BL	0.00876	0.00508	BL	BL
C8-ALCOHOL	BL	BL	0.01474	BL	BL	BL	BL	BL	BL	BL	BL	BL
C11-ALKANE	BL	BL	BL	BL	0.00253	0.00441	BL	BL	BL	0.00288	BL	BL
LIMONENE	0.00050	0.00051	0.00049	0.00085	0.00123	0.00069	0.00064	0.00064	0.00061	0.00063	0.00064	0.00043
NONANAL	BL	BL	0.00699	BL	0.00917	0.00761	BL	BL	0.00796	BL	BL	BL
DIPHENYLAMINE	BL	BL	BL	BL	BL	0.05500	BL	BL	BL	BL	BL	BL
DECAMETHYLCYCLOPENTASILOXANE	BL	BL	0.00214	BL	BL	BL	BL	BL	0.00196	0.00234	BL	BL
TARGET COMPOUNDS (GC)												
CARBON MONOXIDE	0.10997	0.05000	0.13585	0.05000	0.11322	0.26876	0.14194	0.17422	0.15049	0.13146	0.12957	0.05000
METHANE	0.50317	0.49751	0.49877	0.40390	0.49094	0.34354	0.36761	0.34168	0.28535	0.29898	0.27637	0.37489
HYDROGEN	0.01846	0.02719	0.03038	0.04081	0.04912	0.03422	0.04075	0.03164	0.02818	0.03082	0.03611	0.03188
TOTAL T-VALUE	1.28958	1.34504	1.43851	1.69257	3.14890	1.93354	1.56470	1.22150	0.97363	1.19345	1.09030	0.80701

ND : Not detected.
NS: No sample available.
BL: Area below the search routine limit (<20% of the fluorobenzene peak area); T-Value not calculated.

TABLE 4. MIR 18 FORMALDEHYDE RESULTS

Date	Start Time	Formaldehyde Concentration (mg/m3)
22 Mar 95	1800	0.059
29 Mar 95	1110	0.076
10 Apr 95	1045	0.04
21 Apr 95	1045	0.044
30 Apr 95	1145	0.059
10 May 95	1310	0.065
23 May 95	1020	0.059
12 Jun 95	1025	0.056
20 Jun 95	945	0.068

Recovery from positive controls = 99 and 92 %

TABLE 5. MIR 18 TOXICOLOGICAL ASSESSMENT

Toxic Effect Group (teg)	Contaminant	Concentration/SMAC	T(teg) Range & Average
irritants	acetaldehyde	0.044 - 0.081	(1.26 - 1.99) 1.57
	propenal	n.d. - 0.711	
	hexanal	0.005 - 0.014	
	heptanal	0.004 - 0.018	
	formaldehyde	0.800 - 1.520	
Neurotoxicants	methanol	0.014 - 0.043	(0.09 - 0.31) 0.15
	acetone	0.008 - 0.017	
	carbon monoxide	0.050 - 0.269	
Carcinogens	1,2-dichloroethane	0.025	(0.02 - 1.15) 0.32
	furan	n.d. - 1.125	
Cardiotoxicants	Freon 82	0.002 - 0.078	(0.11 - 0.36) 0.22
	carbon monoxide	0.050 - 0.269	
	Freon 218	n.s. - 0.252	
"Explosives"	methane	0.28 - 0.50	(0.37 - 0.54) 0.46
	hydrogen	0.03 - 0.05	

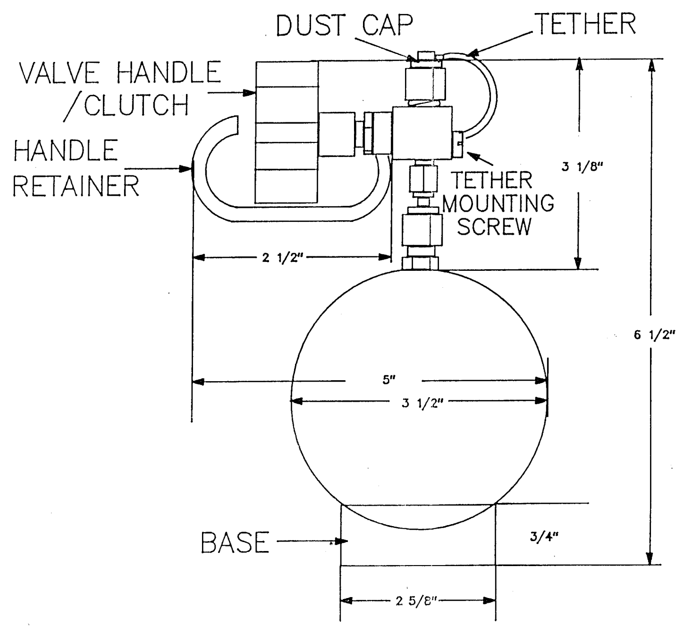

Figure 1. NASA Grab sample canisters

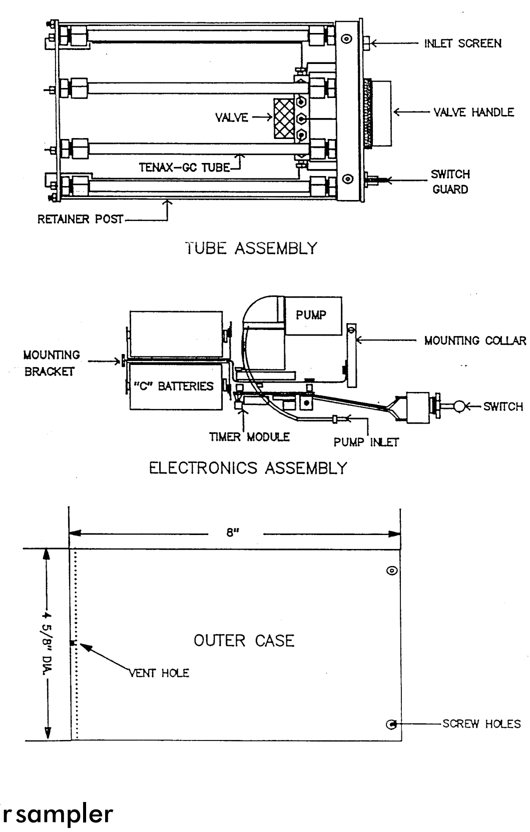

Figure 2. NASA Solid sorbent air sampler

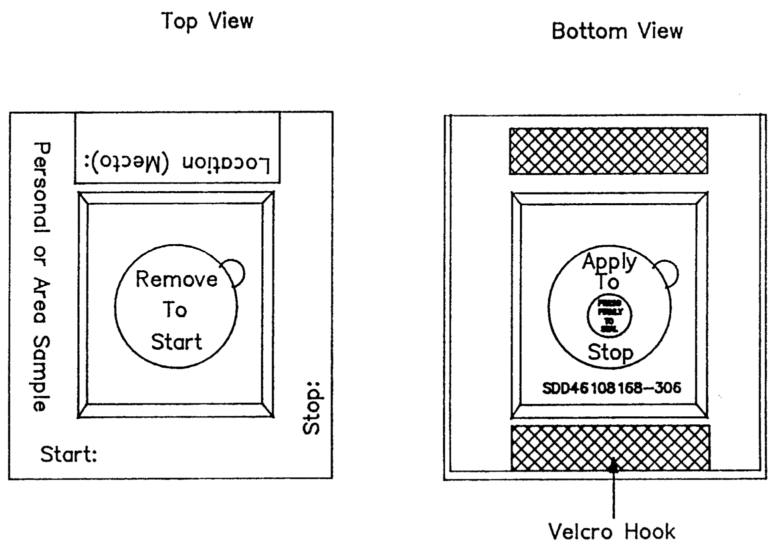

Figure3. NASA Formaldehyde Badges