

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

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# 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.

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# Toxicological Assessment of Air Contaminants

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## (Mir 19 Final Science Report)

### INTRODUCTION

#### Objectives

**O**UR PRIMARY OBJECTIVE was to assess whether the respirable air in Mir meets U.S. toxicological standards for air quality in spacecraft occupied by humans (1-3). This objective was accomplished by obtaining periodic 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 variations in the atmosphere so that future sampling protocols can be designed to detect important variations in pollutant concentrations. A final objective was to compare three methods of air sampling according to the pollutant concentrations found in samples taken at the same time on Mir.

#### Hypotheses

The amount of atmospheric contamination during the Mir 19 expedition 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 19.

The temporal variations in contamination levels during the Mir 19 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 methods of sampling air contaminants will provide comparable results except for contaminants that are known to be poorly retained by each method. No single air sampling method is capable of containing *and* preserving all important trace contaminants until the sampler reaches ground-based laboratories months after the acquisition of

sample. In order to optimize an archival sampling protocol for future international missions, it is essential that similarities and differences in methods be evaluated. The unknown atmosphere of the Mir offers an opportunity to compare two U.S. methods and a Russian method by concomitant acquisition of samples.

#### Background/History

The Mir station has been in operation for almost a decade and presents a unique opportunity to quantify air pollutants that have accumulated inside the spacecraft during this long existence. Russian toxicologists and analytical chemists sample air pollutants periodically inside the Mir using Tenax<sup>R</sup> sorbent traps; however, their ground-based, gas chromatography (GC) methods of quantifying pollutants are designed to quantify only a portion of the pollutants suspected to be present in Mir. Application of gas chromatography/mass spectrometry (GC/MS) methods to sample analysis facilitates the identification and quantification of many more contaminants than GC alone. A recent report compares various methods available to sample and analyze spacecraft air (4).

The NASA/JSC Toxicology Laboratory routinely applies sorbent and canister methods to recover air pollutants from the Shuttle atmosphere (5). After return to the JSC laboratory, these samples are subjected to 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 not measured formaldehyde in spacecraft air; however, there is a report that cosmonauts have gained sensitivity to formaldehyde during flights (6).

The NASA solid sorbent air sampler (SSAS) was used to obtain air contaminant samples during the Mir 17 expedition (7). 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 current SSAS, which is configured with Tenax sorbent, does not trap highly volatile compounds such as carbon monoxide and certain freons.

During Mir 18, the SSAS inlet was accidentally obstructed so that valid samples were not obtained; however, 12 samples were obtained using grab sample containers (GSCs). The GSC samples revealed a steady-state background of chemical contamination with an occasional contaminant spike such as that observed for freon 82 (8). In addition, personal and area samples were obtained for formaldehyde measurement during Mir 18. These samples suggested that the nominal concentration of formaldehyde exceeds both the U.S. and Russian limits for this irritant.

The hypotheses for the Mir 19 study were addressed by applying U.S. analytical methods to samples acquired according to a well defined temporal 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 safe to breathe. The T-value is defined for "n" contaminants in a toxicological effect group (*teg*) based on the measured concentration of each contaminant (C<sub>n</sub>) in the group and the spacecraft maximum allowable concentration (SMAC<sub>n</sub>) for each contaminant, as given below.

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

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<sup>-5</sup> torr or less. Each SSAS tube is cleaned with ultrapure nitrogen at 250 °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. The Russian AK-1 tubes are cleaned and repacked after each use. The Tenax GC sorbent is solvent rinsed and heat-treated at 300 °C before being packed into 150 mm X 5 mm inner diameter tubes. After packing, the tubes are heated again and purged with a stream of inert gas. 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.

**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 diaphragm 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. Samples using the AK-1 system are acquired when the cosmonaut uses a calibrated bellows pump to aspirate 500 ml of air through the tube, which has been inserted into the pump inlet. The tube remains sealed before and after sampling. 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 on the Soyuz vehicle or the Space Shuttle. Samplers returned via the Shuttle were maintained under strict chain-of-custody procedures used by NASA. The chain-of-custody for the samplers that returned through Russia was not as well established and there were some problems getting the samplers to Houston for analysis.

**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 assessment 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<sup>R</sup>-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<sup>R</sup> 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. IBMP AK-1 Sorbent System (Figure 3)

The AK-1 system consists of a hand-operated bellows pump of 0.1 L capacity (AN-3 aspirator) and a 150 mm X 5 mm (id) tube containing Tenax<sup>R</sup> sorbent. The tube is sealed on each end with teflon seals which are seated by screwing the end-caps onto each threaded end of the sorbent tube. The end caps are attached to the tube with nylon tethers.

### HW4. NASA Formaldehyde Badges (Figure 4)

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.

## Method/Protocol

### *Location of Air Sampling*

Instantaneous air samples using GSCs were obtained at the core module central post (CMCP) or core module post N1 (CMP N1) periodically throughout the expedition. One GSC collected early in the flight in the dining area

was lost due to a faulty valve. In addition, 24-hour integrated samples using the SSAS were obtained from the core module. Two instantaneous air samples were also obtained from the core module (presumably) using the Russian AK-1 sorbent system. Formaldehyde badges were worn for periods of 11.9 to 13.0 hours by a crewmembers on four days separated by 1 to 2 months. The badges were worn during waking hours and the duties of the cosmonauts took them to various modules and work areas within the Mir complex.

### *Analysis of the NASA GSC Samples*

The NASA/JSC method of analyzing canister samples follows the U.S. Environmental Protection Agency's TO-14 method with modifications to handle spacecraft air samples. The JSC laboratory uses two sets of standards including TO-14 compounds and targeted polar compounds often found in spacecraft air. A special inlet system is designed to manage the high concentrations of water vapor and carbon dioxide characteristic of spacecraft samples. The method of tuning the mass spectrometer, verifying the tune, running system blanks, cleaning and proofing the canister, and data handling follow the TO-14 protocol. Measurements of carbon monoxide, hydrogen, and methane use packed-column GCs, each with a different detector to optimize the analysis. The quality of GC data is assured by analysis of blanks, generation of calibration curves, and data tracking with control charts. Calibration curves up to 440 ppb are performed on the GC/MS for all target compounds. Nontarget compounds present in high concentration are quantified based on an individual calibration curve spanning the range of concentrations found in the spacecraft samples.

### *Analysis of the NASA SSAS Tubes*

Analysis of SSAS tubes is similar to analysis of the GSCs with several modifications. The air flow through each tube is measured before and after flight to determine the volume of spacecraft air sampled during the sampling period on orbit. The SSAS tubes are also cleaned and proofed before flight. After flight, the tubes are desorbed into canisters, the canister pressures are measured, and the analysis is conducted according to the GC/MS method described above for GSCs.

### *Analysis of the IMBP AK-1 Tubes*

The sorbent tubes were prepared at IMBP according to their standard methods (4). During Mir 19, the cosmonauts obtained pollutant samples by pumping 500 ml of air through each sample tube. Selected tubes were sent to JSC where they were heated to 200 °C and desorbed into canisters by passing ultra-pure nitrogen at 10.1 ml/min for 20 min through the tubes. The canister

pressure was measured and the analyses were completed by following the GC/MS method for canisters.

#### *Analysis of NASA Formaldehyde Badges*

Before flight, selected badges from a common lot were used to determine the formaldehyde uptake rate at low concentrations. After exposure on orbit for a specific period of time, the badges were returned to JSC. Exposed badges, as well as negative and positive control badges, were analyzed by aqueous extraction of formaldehyde from the badges and quantification by a chromotropic acid colorimetric procedure. The atmospheric concentration was calculated from the known uptake rate of the badges and the time of exposure on orbit.

## RESULTS

### List of Pre-, In-, and Postflight Anomalies

There were problems in only two instances. The three earliest GSCs were returned from Mir 19 expedition via the Soyuz, which landed in Russia. Considerable delay occurred in getting these samples out of Russia and delivered to Houston. The second problem encountered was that the earliest GSC used for sampling in the dining area was lost due to a valve leak, which was discovered during in-processing in the JSC Toxicology Laboratory.

### Quality and Completeness of Data

The analytical data met all quality control criteria established in the JSC Toxicology Laboratory with the exception that recoveries of surrogate compounds from the SSAS tubes were slightly below the acceptance range of 75 to 125 %. Specifically, the recoveries of fluorobenzene ranged from 60 to 75 % and the recoveries of bromofluoromethane ranged from 54 to 65 %. A comparison of results on five marker compounds from the SSAS and GSCs samples taken at the same time suggests that the low SSAS recoveries were due to underdosed tubes when the surrogates were added rather than analytical errors leading to loss of surrogate. As shown in Table 8, the concentrations of the marker compounds in the GSCs averaged 87% of the concentrations calculated from the SSAS data. The marker compounds were selected based on the following criteria: no retention losses in the SSAS, significant concentrations were measured ( $>0.10 \text{ mg/m}^3$ ) by both methods, and the contaminant is normally present at a fairly consistent concentration. The last criteria was needed to ensure that the instantaneous GSC method and the time-integrated SSAS method can be compared.

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**Table 3.** Analytical Results of Mir 19 AK-1 Air Samples- Concentrations

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**Table 5.** Analytical Results of Mir 19 SSAS Air Samples- T-Value

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**Figure 2.** NASA Solid sorbent air sampler

**Figure 3.** IBMP AK-1 Sorbent System

**Figure 4.** NASA Formaldehyde Badges

## DISCUSSION

### *Are U.S. Toxicological Standards for Spacecraft Air Quality Met?*

The GSC data shown in table 8 suggest that U.S. toxicological standards were met during Mir 19. The only toxicological group standard that was exceeded was for irritants in the second sample taken on 11/13. This sample showed a low, but measurable, concentration ( $0.06 \text{ mg/m}^3$ ) of acrolein (propenal). The SMAC for this irritant is so low ( $0.03 \text{ mg/m}^3$ ) that for this single sample the 180-d SMAC was exceeded. A single T value above the acceptance level of 1.0 does not suggest poor air quality when all other values were well below 1.0. The sample was paired with one taken 2 minutes earlier and the earlier sample was similar except that it showed significantly less acrolein, furan, and carbon monoxide. All three contaminants are known to be associated with pyrolysis of organic materials.

The pollutant concentrations measured from the SSAS showed total T values less than 1.0, so there was no need to calculate T values for each type of toxicant. The AK-1 data were not considered representative of the Mir atmosphere since the tubes may not have been completely sealed after sampling.

According to a protocol signed recently in Houston, formaldehyde concentrations based on the badge method will be considered reference data until further confirmation of the method is developed; however, all ground-based test data indicate that the method is valid. The measurements taken during Mir 19 suggest that formaldehyde exposures consistently exceed both the Russian and U.S. limits of  $0.05 \text{ mg/m}^3$ . The measurements also suggest that the cosmonauts may be exposed to relatively high concentrations at certain times. Although some experiments conducted in the general time frame of the formaldehyde measurements involved handing this fixative, we could not specifically correlate cosmonaut activity with the high measurements. Additional studies are needed to confirm the validity of the badge method and identify the source of the formaldehyde contamination.

#### *Are the Temporal Variations in the Concentrations of Air Pollutants Small?*

With only a few exceptions, the concentrations of individual contaminants do not vary more than 2 to 3 fold in samples taken with the GSCs. For example, some of the ranges of the major contaminants are as follows:

- chloromethane: 0.07 to 0.11
- acetaldehyde: 0.15 to 0.32
- methanol: 0.14 to 0.41
- acetone: 0.24 to 0.67
- trichlorofluoromethane: 0.23 to 0.58
- n-butanol: 0.14 to 0.36
- toluene: 0.08 to 0.19
- m&p-xylenes: 0.14 to 0.24
- o-xylene: 0.12 to 0.23
- methane: 520 to 690
- hydrogen: 11 to 27

Major trace contaminants that show greater than a 3-fold variation include dichlorodifluoromethane, ethanol, isopropanol, octamethylcyclotetrasiloxane, perfluorodimethylcyclohexanes, hexamethylcyclotrisiloxane, limonene, and carbon monoxide. Some of these variations are due to periodic use of these chemicals for utility purposes such as hand cleaning (ethanol), lens cleaning (isopropanol), and personal hygiene (siloxanes). Others are

probably associated with the opening of newly delivered modules or experiment startup (freons) or with food consumption (limonene). The reason for variability in carbon monoxide concentrations is unclear.

The 24-hour, time-integrated samples obtained by the SSAS tended to smooth some of the variability in the trace contaminant concentrations. For example, except for a single outlier value for each contaminant, the following ranges were found: dichlorodifluoromethane, 1.5 to 2.7; ethanol, 0.7 to 1.3; isopropanol, 0.17 to 0.47; and hexamethylcyclotrisiloxane, 0.25 to 0.60. All concentrations of octamethylcyclotetrasiloxane fell within the range of 0.49 to  $0.93 \text{ mg/m}^3$ . Perfluorodimethylcyclohexanes and limonene still showed some variability even in the integrated samples.

The results using the AK-1 tubes (Table 3) were not useful in understanding the temporal variations in contaminant concentration because only 2 samples were available for analysis. Furthermore, the concentrations appeared to be comparable for some contaminants (e.g. acetone, trichlorofluoromethane, dichloromethane, 2-butanone, benzene, and decamethylcyclopentasiloxane), whereas, some varied over orders of magnitude (e.g. acetaldehyde and propenal).

#### *Are the Methods of Sampling Comparable?*

The sampling methods show important differences, but most differences can be understood in terms of limitations in the trapping efficiency of tenax for volatile compounds. As shown in part III.B (above), the concentrations determined on 5 marker contaminants from 3 sampling sessions appear to be comparable when the GSC and SSAS methods are compared. A comparison of those marker compounds from AK-1 results is shown in Table 9.

These results suggest that the AK-1 sampling method does not give comparable results to the GSC or SSAS methods. It must be emphasized that these are very limited data and there is a number of possible explanations for these differences that may not involve inherent differences in the methods. Although the samples were paired for the purposes of comparison, even a few minutes difference in sample times could result in some variation in the atmosphere sampled. The AK-1 tubes were not verified clean by the JSC laboratory that did the final analysis, but it seems unlikely that such large differences could be due to residual contamination. The most likely possibility seems to be that the seals on the ends of the AK-1 tubes may have leaked, permitting air contaminants from Mir and other locations to concentrate on the sorbent during transport and storage. The Russians have noted this sort of difficulty in the past.

Before concluding that there are significant differences in the AK-1 sampling method, ground-based sampling of

*known* atmospheres should be conducted using well defined mixtures of contaminants selected to simulate many of those found in spacecraft air. The JSC Toxicology Laboratory routinely uses a "Shuttle mixture" to test and evaluate new techniques for air sampling and analysis.

### Conclusions

Data from the NASA GSCs and SSAS show that the air quality during Mir 19 meets U.S. standards for spacecraft; however, reference data from formaldehyde badges indicates that sources of formaldehyde may need to be identified and controlled.

The concentrations of most air contaminants during Mir 19 were relatively stable during the mission; however, some activities resulted in spikes in pollutant concentrations on this stable background. Much more frequent sampling would be necessary to detect most of these spikes and identify their sources. Except for formaldehyde, the spikes detected so far have been well below concentrations that could pose a concern about air quality.

For many compounds the GSCs and current SSAS give comparable trace contaminant concentrations; however, some highly volatile compounds are not quantitatively sampled by the SSAS. An investigation is underway to identify sorbents that will enable the SSAS to efficiently retain highly volatile contaminants. The contaminants found on the AK-1 tubes were quantitatively and qualitatively different than those found in GSCs and the SSAS. The cause of this difference is unclear; however, it would be a mistake to conclude from these limited data that the AK-1 system will continue to give results that differ from the GSCs and SSAS. Well controlled, ground-based testing of the methods with thoroughly-characterized atmospheres is the best way to compare the methods.

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TABLE 1. ANALYTICAL RESULTS OF MIR 19 CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m <sup>3</sup> )													
	AA01198 7/26/95 CMCP 23:00	AA01164 8/4/95 CMP N1 9:50	AA01165 8/17/95 CMCP 11:21	AA01194 8/30/95 CMCP 9:36	AA01166 9/7/95 CMP N1	AA01195 10/26/95 CMCP 16:14	AA01191 10/26/95 CMCP 16:15	AA01197 11/6/95 CMCP 17:46	AA01193 11/8/95 CMCP 10:24	AA01192 11/13/95 CMCP 19:00	AA01190 11/13/95 CMCP 19:02			
<b>TARGET COMPOUNDS (TO-14/POLAR)</b>														
DICHLORODIFLUOROMETHANE	1.2	0.22	TRACE	1.1	0.27	4.2**	4.1**	4.1**	1.3	5.5**	1.3			
CHLOROMETHANE	0.07	0.11	0.07	0.07	0.08	0.07	0.07	0.08	0.08	0.10	0.10			
1,2-DICHLORO-1,1,2,2-TETRAFLUOROETHANE	* < 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050			
ACETALDEHYDE	0.32	0.19	0.17	0.17	0.25	0.21	0.15	0.18	0.23	0.15	0.19			
METHANOL	0.41**	0.35	0.29	0.23	0.25	0.16	0.15	0.18	0.34	0.14	0.16			
VINYL CHLORIDE	# TRACE	TRACE	TRACE	TRACE	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			
ETHANOL	4.0**	1.4**	1.4**	0.32	2.2**	0.70**	0.77**	0.55	1.7**	0.33	0.45			
CHLOROETHANE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE			
PROPENAL	TRACE	< 0.020	TRACE	< 0.020	< 0.020	TRACE	< 0.020	TRACE	TRACE	< 0.020	0.06			
ACETONE	0.67	0.39	0.65	0.47	0.54	0.31	0.24	0.47	0.35	0.35	0.39			
PROPANAL	0.06	TRACE	TRACE	TRACE	0.05	TRACE	TRACE	0.07	TRACE	TRACE	< 0.050			
ISOPROPANOL	0.15	0.15	0.42	0.81**	0.25	TRACE	TRACE	0.50	0.16	0.15	0.21			
TRICHLOROFUOROMETHANE	0.58	0.37	0.37	0.26	0.31	0.33	0.30	0.40	0.23	0.54	0.49			
ACRYLONITRILE	TRACE	< 0.050	< 0.050	TRACE	< 0.050	TRACE	< 0.050	TRACE	TRACE	TRACE	< 0.050			
2-METHYL-2-PROPANOL	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	< 0.050	TRACE	TRACE	TRACE	< 0.050			
METHYLACETATE	TRACE	TRACE	TRACE	TRACE	TRACE	< 0.050	< 0.050	< 0.050	TRACE	TRACE	< 0.050			
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			
DICHLOROMETHANE	TRACE	TRACE	TRACE	TRACE	0.08	0.06	0.05	0.07	TRACE	0.08	0.06			
1,1,2-TRICHLORO-1,1,2-TRIFLUOROETHANE	TRACE	TRACE	TRACE	TRACE	TRACE	< 0.050	< 0.050	TRACE	< 0.050	TRACE	0.08			
N-PROPANOL	< 0.050	TRACE	0.09	0.06	0.05	TRACE	0.06	TRACE	TRACE	TRACE	< 0.050			
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			
BUTANAL	0.07	TRACE	TRACE	TRACE	TRACE	0.05	TRACE	TRACE	TRACE	TRACE	TRACE			
2-BUTANONE	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			
2-METHYLFURAN	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050			
ETHYLACETATE	0.06	0.06	0.05	TRACE	TRACE	TRACE	TRACE	TRACE	0.10	TRACE	TRACE			
CHLOROFORM	TRACE	TRACE	TRACE	< 0.050	TRACE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050			
2-BUTENAL	TRACE	< 0.050	< 0.050	< 0.050	< 0.050	TRACE	< 0.050	TRACE	TRACE	< 0.050	< 0.050			
1,2-DICHLOROETHANE	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			
N-BUTANOL	0.36	0.27	0.22	0.21	0.20	0.19	0.14	0.19	0.27	0.19	0.17			
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			
BENZENE	TRACE	TRACE	< 0.050	TRACE	< 0.050	< 0.050	TRACE	< 0.050	TRACE	TRACE	TRACE			
2-PENTANONE	< 0.050	TRACE	TRACE	< 0.050	TRACE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050			
PENTANAL	0.05	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	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			
CARBON TETRACHLORIDE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050			



TABLE 1. ANALYTICAL RESULTS OF MIR 19 CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m3)													
	AA01198 7/26/95 CMCP 23:00	AA01164 8/4/95 CMPN1 9:50	AA01165 8/17/95 CMCP 11:21	AA01194 8/30/95 CMCP 9:36	AA01191 9/7/95 CMPN1 16:14	AA01195 10/26/95 CMCP 16:15	AA01197 11/6/95 CMCP 17:46	AA01193 11/8/95 CMCP 10:24	AA01192 11/13/95 CMCP 19:00	AA01190 11/13/95 CMCP 19:02				
<b>NON-TARGET COMPOUNDS</b>														
OCTAFLUOROPROPANE***	12**	59	53	5.9	62	7.9	6.6	5.3	8.5	3.3	8.0			
BROMOTRIFLUOROMETHANE	0.24	&BL	BL	BL	BL	BL	BL	BL	0.23	BL	BL			
PROPENE	0.09	BL	BL	0.09	BL	0.12	0.10	0.12	0.10	0.11	0.06			
C4-ALKANE	BL	BL	BL	BL	BL	BL	BL	BL	BL	0.08	BL			
PERFLUORODIMETHYLCYCLOHEXANES****	6.9	1.1	0.84	71**	65**	7.8	8.0	22**	1.0	23**	14**			
C5-ALKANE	0.04	BL	0.04	BL	0.05	0.03	BL	0.06	BL	0.09	0.11			
2-METHYL-1-PROPANOL	BL	0.07	BL	BL	BL	BL	BL	BL	BL	BL	BL			
C7-ALKANES	0.21	0.11	0.05	BL	0.04	0.06	BL	0.05	0.04	BL	0.12			
HEXAMETHYLCYCLOTRISILOXANE	2.7	1.5	0.57	0.78	0.52	1.4	0.84	2.3	1.2	0.61	0.42			
BENZALDEHYDE	0.10	0.10	BL	BL	BL	BL	BL	0.08	BL	BL	BL			
PINENEISOMER	BL	0.08	0.07	BL	BL	BL	BL	BL	BL	BL	BL			
C8-ALCOHOL	0.27	0.24	0.29	BL	0.25	0.35	0.16	0.28	BL	0.40	0.49			
LIMONENE	0.26	0.51	0.36	0.24	0.19	0.16	0.14	0.13	0.32	0.11	0.06			
NONANAL	BL	0.08	BL	BL	BL	BL	BL	BL	BL	BL	BL			
DECAMETHYLCYCLOPENTASILOXANE	0.66	0.46	0.38	BL	BL	BL	BL	BL	BL	BL	BL			
<b>TARGET COMPOUNDS(GC)</b>														
CARBON MONOXIDE	3.2	2.5	2.8	2.7	TRACE	2.5	3.0	TRACE	3.6	TRACE	3.2			
METHANE	570	520	540	590	530	630	670	690	590	690	680			
HYDROGEN	11	13	23	27	19	13	16	11	15	13	12			
<b>TOTAL CONCENTRATION (NON-METHANE HYDROCARBONS)</b>	35	71	63	84	140	27	24	40	18	38	28			

\* <: Value is less than the laboratory report detection limit.  
 # 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; 0.65 mg/m3 for CH4; 0.41 mg/m3 for H2; 0.05 mg/m3 for VOCs; and 0.02 mg/m3 for propenal).  
 &BL: Area below the search routine limit (<20% of the fluorobenzene peak area).  
 \*\*: Concentrations exceed the calibration range. The GC/MS analyses were checked for saturation; no saturated peaks were detected.  
 \*\*\*: Compound was reanalyzed on 10/31/95 for AA01164, AA01165, and AA01166, and on 2/28-3/1/96 for the remaining samples.  
 \*\*\*\*: Compound was reanalyzed on 10/31/95 and quantified based on two 3-point calibrations performed on 1/1-2/95, for AA01164, AA01165, and AA01166; compound was reanalyzed on 2/28-3/1/96 for the remaining samples.

**TABLE 2. ANALYTICAL RESULTS OF MIR 19 SSAS AIR SAMPLES**

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m3)						
	TUBE 1	TUBE 2	TUBE 3	TUBE 4	TUBE 5	TUBE 6	TUBE 7
	7/6/95	7/23/95	8/4/95	8/11/95	8/17/95	8/30/95	11/10/95
	10:22	11:00	9:40	10:20	11:45	9:40	15:50
	7/7/95	7/24/95	8/5/95	8/12/95	8/18/95	8/31/95	11/11/95
	11:43	14:30	9:40	10:36	12:00	10:40	16:54
<b>TARGET COMPOUNDS (TO-14/POLAR)</b>							
DICHLORODIFLUOROMETHANE	1.5	2.7	2.2	2.0	2.1	1.6	11
CHLOROMETHANE	* < 0.69	# TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,2-DICHLORO-1,1,2,2-TETRAFLUOROETHANE	< 0.19	< 0.21	< 0.19	< 0.18	< 0.07	< 0.18	< 0.18
ACETALDEHYDE	0.06	0.08	0.06	0.06	0.10	0.07	0.10
METHANOL	TRACE	TRACE	0.16	0.16	TRACE	TRACE	TRACE
VINYL CHLORIDE	< 0.029	< 0.031	TRACE	< 0.034	TRACE	TRACE	< 0.030
BROMOMETHANE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
ETHANOL	0.98**	6.1**	1.0**	1.0**	1.3**	0.70**	0.51
CHLOROETHANE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
PROPENAL	< 0.011	< 0.012	< 0.013	< 0.013	< 0.013	< 0.013	< 0.012
ACETONE	0.45**	0.56**	0.40	0.47	0.69**	0.60**	0.30
PROPANAL	< 0.029	TRACE	TRACE	< 0.034	< 0.033	TRACE	< 0.030
ISOPROPANOL	0.47**	0.17	0.20	0.30	0.41	1.8**	0.31
TRICHLOROFLUOROMETHANE	1.9	3.8	2.0	1.3	2.2	1.7	2.3
ACRYLONITRILE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
2-METHYL-2-PROPANOL	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
METHYLACETATE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	< 0.030
1,1-DICHLOROETHENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
DICHLOROMETHANE	0.12	0.05	0.04	TRACE	0.04	0.05	0.05
1,1,2-TRICHLORO-1,1,2-TRIFLUOROETHANE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
N-PROPANOL	TRACE	TRACE	TRACE	0.13	0.09	0.06	< 0.030
1,1-DICHLOROETHANE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
BUTANAL	< 0.029	TRACE	TRACE	TRACE	TRACE	TRACE	< 0.030
2-BUTANONE	0.29	0.04	0.06	0.04	TRACE	0.04	TRACE
1,2-DICHLOROETHENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
2-METHYLFURAN	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
ETHYLACETATE	0.047	0.06	0.06	0.10	0.05	0.04	TRACE
CHLOROFORM	< 0.029	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
2-BUTENAL	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
1,2-DICHLOROETHANE	TRACE	0.04	0.04	TRACE	0.03	TRACE	TRACE
1,1,1-TRICHLOROETHANE	TRACE	TRACE	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
N-BUTANOL	0.20	0.29	0.38	0.31	0.24	0.22	0.13
1,1-DICHLOROPROPENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
BENZENE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
CARBON TETRACHLORIDE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
2-PENTANONE	< 0.029	< 0.031	< 0.033	TRACE	< 0.033	< 0.033	< 0.030
PENTANAL	TRACE	TRACE	TRACE	< 0.034	< 0.033	TRACE	TRACE
1,2-DICHLOROPROPANE	TRACE	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
TRICHLOROETHENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
2,5-DIMETHYLFURAN	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
CIS-1,3-DICHLOROPROPENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
2-PENTENAL	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	TRACE
TRANS-1,3-DICHLOROPROPENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
1,1,2-TRICHLOROETHANE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
TOLUENE	0.44	0.28	0.31	0.20	0.21	0.26	0.09
HEXANAL	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
MESITYLOXIDE	< 0.029	< 0.031	TRACE	TRACE	< 0.033	TRACE	< 0.030
1,2-DIBROMOETHANE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
BUTYLACETATE	TRACE	0.03	TRACE	TRACE	TRACE	TRACE	TRACE
TETRACHLOROETHENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
CHLOROBENZENE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
ETHYLBENZENE	TRACE	0.06	0.08	0.06	0.05	0.05	0.03
M- + P-XYLENES	0.11	0.24	0.30	0.23	0.22	0.21	0.13
2-HEPTANONE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE

**TABLE 2. ANALYTICAL RESULTS OF MIR 19 SSAS AIR SAMPLES**

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m3)						
	TUBE 1	TUBE 2	TUBE 3	TUBE 4	TUBE 5	TUBE 6	TUBE 7
	7/6/95 10:22	7/23/95 11:00	8/4/95 9:40	8/11/95 10:20	8/17/95 11:45	8/30/95 9:40	11/10/95 15:50
	7/7/95 11:43	7/24/95 14:30	8/5/95 9:40	8/12/95 10:36	8/18/95 12:00	8/31/95 10:40	11/11/95 16:54
<b>TARGET COMPOUNDS (TO-14/POLAR) contd.</b>							
CYCLOHEXANONE	TRACE	0.03	0.04	0.04	0.03	TRACE	TRACE
HEPTANAL	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
STYRENE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,1,2,2-TETRACHLOROETHANE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
O-XYLENE	0.10	0.22	0.27	0.21	0.20	0.19	0.12
1,3,5-TRIMETHYLBENZENE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,2,4-TRIMETHYLBENZENE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,3-DICHLOROBENZENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
1,4-DICHLOROBENZENE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
1,2-DICHLOROBENZENE	< 0.029	TRACE	< 0.033	< 0.034	TRACE	< 0.033	< 0.030
1,2,4-TRICHLOROBENZENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
HEXACHLORO-1,3-BUTADIENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
<b>TARGET COMPOUNDS (TOXIC)</b>							
1,3-BUTADIENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
ETHYLENE OXIDE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
FURAN	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
CHLOROPROPENE	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
CARBON DISULFIDE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE
2-METHYL-2-PROPENAL	< 0.029	< 0.031	< 0.033	< 0.034	< 0.033	< 0.033	< 0.030
3-BUTEN-2-ONE	< 0.029	< 0.031	TRACE	< 0.034	< 0.033	< 0.033	< 0.030
DIMETHYLDISULFIDE	< 0.029	TRACE	TRACE	< 0.034	< 0.033	TRACE	< 0.030
2-ETHOXYETHANOL	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	< 0.030
OCTAMETHYLCYCLOTETRAILOXANE	0.49	0.71	0.85	0.78	0.75	0.93	0.52
<b>NON-TARGET COMPOUNDS</b>							
PERFLUORODIMETHYLCYCLOHEXANES***	0.74	0.56	0.14	0.18	0.15	5.5	1.4
C5-ALKANE	0.03	0.04	0.02	BL	0.04	0.03	0.05
2-METHYL-1-PROPANOL	& BL	0.06	0.07	BL	BL	BL	BL
C7-ALKANES	0.16	0.19	0.15	0.09	0.08	0.14	0.08
HEXAMETHYLCYCLOTETRAILOXANE	0.26	0.33	0.47	0.05	0.46	0.60	0.25
PINENE ISOMER	BL	BL	0.03	BL	0.04	0.03	BL
C8-ALCOHOL	BL	BL	BL	0.18	0.19	0.19	0.29
LIMONENE	0.31	0.24	0.39	0.03	0.40	0.29	0.11
<b>TOTAL CONCENTRATION</b>	<b>9.2</b>	<b>18</b>	<b>10</b>	<b>8.5</b>	<b>10</b>	<b>16</b>	<b>18</b>

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

# TRACE: Amount detected is sufficient for compound identification only.

Calculations are based on one-half of the laboratory report detection limit.

& BL: Area below the search routine limit (<20% of the fluorobenzene peak area).

\*\* : Concentrations exceed the calibration range. The GC/MS analyses were checked for saturation; no saturated peaks were detected.

\*\*\*: Concentrations were calculated based on an average RRF of perfluorodimethylcyclohexane, measured through 9/19/95-3/1/96, with a % RSD of 17.7. No retention volume correction was considered.

**TABLE 3. ANALYTICAL RESULTS OF  
MIR 19 AK-1 AIR SAMPLES**

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m <sup>3</sup> )	
	AA01185 8/17/95	AA01186 9/7/95
<b>TARGET COMPOUNDS (TO-14/POLAR)</b>		
DICHLORODIFLUOROMETHANE	# TRACE	TRACE
CHLOROMETHANE	* < 0.053	TRACE
1,2-DICHLORO-1,1,2,2-TETRAFLUOROETHANE	< 0.088	< 0.088
ACETALDEHYDE	0.23	3.5**
METHANOL	0.15	0.50
VINYL CHLORIDE	< 0.053	< 0.053
BROMOMETHANE	< 0.053	< 0.053
ETHANOL	0.69**	4.3**
CHLOROETHANE	< 0.053	TRACE
PROPENAL	0.06	2.2**
ACETONE	1.7**	2.0**
PROPANAL	< 0.053	0.61
ISOPROPANOL	1.6**	1.1**
TRICHLOROFLUOROMETHANE	0.61	0.52
ACRYLONITRILE	0.07	TRACE
2-METHYL-2-PROPANOL	TRACE	TRACE
METHYLACETATE	TRACE	TRACE
1,1-DICHLOROETHENE	< 0.053	< 0.053
DICHLOROMETHANE	0.19	0.18
1,1,2-TRICHLORO-1,1,2-TRIFLUOROETHANE	0.10	TRACE
N-PROPANOL	0.30	0.14
1,1-DICHLOROETHANE	< 0.053	< 0.053
BUTANAL	0.15	0.38
2-BUTANONE	0.25	0.22
1,2-DICHLOROETHENE	< 0.053	< 0.053
2-METHYLFURAN	TRACE	0.10
ETHYLACETATE	0.42	0.22
CHLOROFORM	0.08	TRACE
2-BUTENAL	< 0.053	0.09
1,2-DICHLOROETHANE	0.14	TRACE
1,1,1-TRICHLOROETHANE	TRACE	TRACE
N-BUTANOL	3.9**	1.0**
1,1-DICHLOROPROPENE	< 0.053	< 0.053
BENZENE	0.16	0.13
CARBON TETRACHLORIDE	TRACE	TRACE
2-PENTANONE	< 0.053	< 0.053
PENTANAL	0.15	0.33
1,2-DICHLOROPROPANE	0.14	TRACE
TRICHLOROETHENE	TRACE	< 0.053
2,5-DIMETHYLFURAN	< 0.053	< 0.053
CIS-1,3-DICHLOROPROPENE	< 0.053	< 0.053
2-PENTENAL	< 0.053	< 0.053
TRANS-1,3-DICHLOROPROPENE	< 0.053	< 0.053
1,1,2-TRICHLOROETHANE	< 0.053	< 0.053
TOLUENE	1.8**	0.52
HEXANAL	0.18	0.26
MESITYL OXIDE	TRACE	TRACE
1,2-DIBROMOETHANE	< 0.053	< 0.053
BUTYLACETATE	0.13	TRACE
TETRACHLOROETHENE	TRACE	< 0.053
CHLOROBENZENE	0.10	TRACE
ETHYLBENZENE	0.33	0.09

**TABLE 3. ANALYTICAL RESULTS OF  
MIR 19 AK-1 AIR SAMPLES**

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m <sup>3</sup> )	
	AA01185	AA01186
	8/17/95	9/7/95
<b>TARGET COMPOUNDS (TO-14/POLAR) contd.</b>		
M- + P-XYLENES	1.1	0.34
2-HEPTANONE	TRACE	TRACE
CYCLOHEXANONE	0.35	0.10
HEPTANAL	0.06	0.18
STYRENE	0.08	TRACE
1,1,2,2-TETRACHLOROETHANE	< 0.053	< 0.053
O-XYLENE	0.98	0.30
1,3,5-TRIMETHYLBENZENE	TRACE	TRACE
1,2,4-TRIMETHYLBENZENE	0.13	0.06
1,3-DICHLOROBENZENE	< 0.053	< 0.053
1,4-DICHLOROBENZENE	0.06	TRACE
1,2-DICHLOROBENZENE	TRACE	< 0.053
1,2,4-TRICHLOROBENZENE	< 0.053	< 0.053
HEXACHLORO-1,3-BUTADIENE	< 0.053	< 0.053
<b>TARGET COMPOUNDS (TOXIC)</b>		
1,3-BUTADIENE	< 0.053	< 0.053
ETHYLENE OXIDE	< 0.053	< 0.053
FURAN	TRACE	0.21
CHLOROPROPENE	< 0.053	< 0.053
CARBON DISULFIDE	TRACE	TRACE
2-METHYL-2-PROPENAL	TRACE	0.21
3-BUTEN-2-ONE	< 0.053	0.08
DIMETHYLDISULFIDE	TRACE	TRACE
2-ETHOXYETHANOL	< 0.053	< 0.053
OCTAMETHYLCYCLOTETRAISILOXANE	2.6	1.2
<b>NON-TARGET COMPOUNDS</b>		
PROPENE	&BL	0.06
C4-ALKENES	BL	0.16
PERFLUORODIMETHYLCYCLOHEXANES ***	1.0	4.5
ACETONITRILE	0.03	0.06
C5-ALKANES	1.3	0.39
2-METHYL-1,3-BUTADIENE	0.13	0.08
TRIMETHYLSILANOL	0.27	2.1
ACETIC ACID, ETHENYL ESTER	0.09	0.22
2-METHOXY-2-METHYLPROPANE	0.08	0.15
C6-ALKANES	0.25	0.07
2-METHYLPROPANENITRILE	0.06	0.02
2-METHYL-1-PROPANOL	0.30	0.11
C7-ALKANES	1.9	0.70
METHYLCYCLOPENTANE	0.09	BL
CYCLOHEXANE	0.57	0.19
DIMETHYLCYCLOPENTANE ISOMER	0.08	BL
ACETIC ACID, PROPYLESTER	0.10	BL
METHYLCYCLOHEXANE	0.14	0.05
C8-ALKANE	0.05	BL
OXYGENATED HYDROCARBONS (MW $\leq$ 114)	0.10	BL
HEXAMETHYLCYCLOTETRAISILOXANE	2.0	1.1
C9-ALKANE	0.05	BL
BENZALDEHYDE	0.41	0.25
PINENE ISOMERS	0.24	0.07
2-PROPENOIC ACID, 2-METHYL-, BUTYLESTER	0.10	BL
C3-BENZENE	0.11	0.01

**TABLE 3. ANALYTICAL RESULTS OF  
MIR 19 AK-1 AIR SAMPLES**

CHEMICAL CONTAMINANT	CONCENTRATION (mg/m <sup>3</sup> )	
	AA01185 8/17/95	AA01186 9/7/95
<b>NON-TARGET COMPOUNDS contd.</b>		
2-PENTYLFURAN	0.05	0.07
OCTANAL	0.18	0.17
C11-ALKANE	0.11	BL
C8 ALCOHOL	0.67	0.96
C4 BENZENE	0.07	BL
LIMONENE	1.8	0.39
ACETOPHENONE	0.25	BL
NONANAL	0.17	0.77
C13-ALKANE	0.09	0.10
DECAMETHYLCYCLOPENTASILOXANE	0.90	0.96
DECANAL	BL	0.80
<b>TOTAL CONCENTRATION</b>	<b>33</b>	<b>36</b>

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

# TRACE: Amount detected is sufficient for compound identification only.

& BL: Area below the search routine limit (<20% of the fluorobenzene peak area).

\*\* : Concentrations exceed the calibration concentration range. The GC/MS analyses were checked for saturation; no saturated peaks were detected.

\*\*\*: Concentrations were calculated based on an average RRF of perfluorodimethylcyclohexane, measured through 9/19/95 - 3/1/96, with a % RSD of 17.7. No retention volume correction was considered.

TABLE 4. ANALYTICAL RESULTS OF MIR 19 CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE														
	23:00	9:50	9:50	11:21	9:36	9:36	8/30/95	8/30/95	9/7/95	10/26/95	10/26/95	11/6/95	11/8/95	11/13/95	11/13/95
	CMCP	CMPN1	CMCP	CMCP	CMCP	CMPN1	CMCP	CMCP	CMCP	CMCP	CMCP	CMCP	CMCP	CMCP	CMCP
<b>TARGET COMPOUNDS (TO-14/POLAR)</b>															
DICHLORODIFLUOROMETHANE	0.00240	0.00045	0.00005	0.00164	0.00226	0.00054	0.00854	0.00838	0.00845	0.00272	0.01129	0.00270			
CHLOROMETHANE	0.00171	0.00267	0.00164	ND	0.00159	0.00200	0.00181	0.00178	0.00191	0.00191	0.00241	0.00253			
1,2-DICHLORO-1,1,2,2-TETRAFLUOROETHANE	*ND	ND	ND	ND											
ACETALDEHYDE	0.07892	0.04663	0.04249	0.03185	0.02533	0.02770	0.05238	0.03810	0.04524	0.05840	0.03724	0.04843			
METHANOL	0.04596	0.03889	0.03185	0.00833	0.00833	0.00833	0.01816	0.01712	0.01989	0.03776	0.01570	0.01723			
VINYLCHELORIDE	0.00833	0.00833	0.00833	0.00833	0.00833	0.00833	0.00833	0.00833	0.00833	0.00833	0.00833	0.00833			
BROMOMETHANE	ND	ND	ND												
ETHANOL	0.00202	0.00070	0.00071	0.00010	0.00016	0.00108	0.00035	0.00038	0.00027	0.00090	0.00017	0.00023			
CHLOROETHANE	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010			
PROPENAL	0.33333	ND	0.33333	ND	0.33333	ND	0.33333	ND	0.33333	0.33333	ND	1.87200			
ACETONE	0.01345	0.00773	0.01300	0.00026	0.00935	0.01082	0.00615	0.00485	0.00931	0.00695	0.00700	0.00780			
PROPANAL	0.00068	0.00026	0.00026	0.00283	0.00026	0.00053	0.00026	0.00026	0.00079	0.00026	0.00026	ND			
ISOPROPANOL	0.00100	0.00101	0.00283	0.00539	0.00165	0.00165	0.00017	0.00017	0.00332	0.00104	0.00098	0.00138			
TRICHLOROFLUOROMETHANE	0.00104	0.00066	0.00067	0.00047	0.00056	0.00047	0.00059	0.00053	0.00071	0.00041	0.00097	0.00087			
ACRYLONITRILE	0.00893	ND	ND	ND	0.00893	ND	0.00893	ND	0.00893	0.00893	0.00893	ND			
2-METHYL-2-PROPANOL	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021			
METHYLACETATE	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021	0.00021			
1,1-DICHLOROETHENE	ND	ND	ND												
DICHLOROMETHANE	0.00250	0.00250	0.00250	0.00006	0.00250	0.00850	0.00558	0.00543	0.00742	0.00250	0.00782	0.00604			
1,1,2-TRICHLORO-1,1,2-TRIFLUOROETHANE	0.00006	0.00006	0.00006	0.00092	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00019			
N-PROPANOL	0.00026	0.00026	0.00092	0.00061	0.00053	0.00053	0.00026	0.00062	0.00026	0.00026	0.00026	0.00026			
1,1-DICHLOROETHANE	ND	ND	ND												
BUTANAL	0.00056	0.00021	0.00021	0.00083	0.00021	0.00021	0.00043	0.00021	0.00021	0.00021	0.00021	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												
2-METHYLFURAN	ND	ND	ND												
METHYLACETATE	0.00035	0.00033	0.00030	0.00510	0.00014	0.00014	0.00014	0.00014	0.00014	0.00053	0.00014	0.00014			
CHLOROFORM	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510			
2-BUTENAL	0.00021	ND	ND	ND	ND	ND	0.00021	ND	0.00021	0.00021	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												
N-BUTANOL	0.00901	0.00681	0.00549	0.00517	0.00494	0.00494	0.00467	0.00346	0.00486	0.00663	0.00479	0.00413			
1,1-DICHLOROPROPENE	ND	ND	ND												
BENZENE	0.12500	0.12500	ND	0.12500	ND	ND	0.12500	0.12500	ND	0.12500	0.12500	0.12500			
CARBON TETRACHLORIDE	ND	ND	ND												
2-PENTANONE	ND	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036	0.00036			
PENTANAL	0.00049	0.00023	0.00023	0.00023	0.00023	0.00023	0.00023	0.00023	0.00023	0.00023	0.00023	0.00023			
1,2-DICHLOROPROPANE	ND	ND	ND												

TABLE 4. ANALYTICAL RESULTS OF MIR 19 CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE											
	23:00	9:50	11:21	9:36	16:14	16:15	17:46	10:24	19:00	19:02	19:00	19:02
<b>TARGET COMPOUNDS (TO-14/POLAR) contd.</b>												
TRICHLOROETHENE	ND											
2,5-DIMETHYLFURAN	ND											
CIS-1,3-DICHLOROPROPENE	ND											
2-PENTENAL	ND											
TRANS-1,3-DICHLOROPROPENE	ND											
1,1,2-TRICHLOROETHANE	ND											
TOLUENE	0.00315	0.00263	0.00248	0.00176	0.00148	0.00189	0.00158	0.00219	0.00168	0.00140	0.00140	0.00140
HEXANAL	0.01079	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510	0.00510
MESITYLOXIDE	ND	0.00063	0.00063	ND	ND	ND	ND	ND	0.00063	ND	ND	ND
1,2-DIBROMOETHANE	ND											
BUTYLACETATE	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013	0.00013
TETRACHLOROETHENE	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
ETHYLBENZENE	0.00048	0.00047	0.00019	0.00019	0.00019	0.00019	0.00019	0.00043	0.00019	0.00019	0.00019	0.00019
M- + P-XYLENES	0.00111	0.00110	0.00079	0.00069	0.00055	0.00088	0.00085	0.00096	0.00079	0.00062	0.00062	0.00062
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	0.00042	0.00042	0.00042	0.00042	0.00042	0.00042	0.00042
HEPTANAL	0.00446	0.00446	0.00446	0.00446	0.00446	0.00446	0.00446	0.00446	0.00446	0.00446	0.00446	0.00446
STYRENE	0.00058	0.00058	0.00058	0.00058	ND	ND	0.00058	ND	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND											
O-XYLENE	0.00105	0.00099	0.00075	0.00067	0.00051	0.00078	0.00076	0.00074	0.00075	0.00054	0.00054	0.00054
1,3,5-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
1,2,4-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											
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											
1,2,4-TRICHLOROBENZENE	ND											
HEXACHLORO-1,3-BUTADIENE	ND											
<b>TARGET COMPOUNDS (TOXIC)</b>												
1,3-BUTADIENE	ND											
ETHYLENEOXIDE	ND											
FURAN	0.22727	0.22727	0.22727	0.22727	0.22727	0.22727	0.22727	0.22727	0.22727	0.22727	0.22727	0.51437
CHLOROPROPENE	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	0.00156
2-METHYL-2-PROPENAL	ND											
3-BUTEN-2-ONE	0.05814	ND	ND	ND	ND	0.05814	ND	0.05814	ND	ND	ND	ND
DIMETHYLDISULFIDE	ND											
2-ETHOXYETHANOL	ND											
OCTAMETHYLCYCLOTETRAILOXANE	0.01525	0.01947	0.01632	0.00458	0.01141	0.00721	0.00513	0.01028	0.00550	0.00413	0.00413	0.00277

TABLE 4. ANALYTICAL RESULTS OF MIR 19 CONTAINER AIR SAMPLES

CHEMICAL CONTAMINANT	T-VALUE													
	AA01198 7/26/95 CMCP 23:00	AA01164 8/4/95 CMPN1 9:50	AA01165 8/17/95 CMCP 11:21	8/30/95 CMCP 9:36	AA01194 9/7/95 CMPN1 9:36	AA01166 10/26/95 CMCP 16:14	AA01195 10/26/95 CMCP 16:15	AA01191 10/26/95 CMCP 16:15	AA01197 11/6/95 CMCP 17:46	AA01193 11/8/95 CMCP 10:24	AA01192 11/13/95 CMCP 19:00	AA01190 11/13/95 CMCP 19:02		
<b>NON-TARGET COMPOUNDS</b>														
OCTAFLUOROPROPANE	0.06020	0.30753	0.27445	0.03048	0.32057	0.04088	0.03431	0.02755	0.04416	0.01691	0.04149			
BROMOTRIFLUOROMETHANE	0.00002	&BL	BL	BL	BL	BL	BL	BL	0.00002	BL	BL			
PROPENE	0.00011	BL	BL	0.00010	BL	0.00014	0.00011	0.00014	0.00012	0.00013	0.00007			
C4-ALKANE	BL	BL	BL	BL	BL	BL	BL	BL	BL	0.00033	BL			
PERFLUORODIMETHYLCYCLOHEXANES	0.01674	0.00279	0.00205	0.17373	0.15944	0.01910	0.01959	0.05298	0.00250	0.05567	0.03496			
C5-ALKANE	0.00015	&BL	0.00014	BL	0.00018	0.00010	BL	0.00021	BL	0.00029	0.00038			
2-METHYL-1-PROPANOL	BL	0.00061	BL	BL	BL	BL	BL	BL	BL	BL	BL			
C7-ALKANES	0.00109	0.00055	0.00023	BL	0.00020	0.00032	BL	0.00024	0.00022	BL	0.00060			
HEXAMETHYLCYCLOTRISILOXANE	0.01187	0.00649	0.00247	0.00337	0.00225	0.00601	0.00367	0.01014	0.00513	0.00267	0.00184			
BENZALDEHYDE	0.00056	0.00060	BL	BL	BL	BL	BL	0.00046	BL	BL	BL			
PINENE ISOMER	BL	0.00059	0.00052	BL	BL	BL	BL	BL	BL	BL	BL			
C8-ALCOHOL	0.00500	0.00443	0.00551	BL	0.00476	0.00662	0.00305	0.00535	BL	0.00747	0.00928			
LIMONENE	0.00046	0.00091	0.00063	0.00042	0.00034	0.00029	0.00025	0.00024	0.00058	0.00020	0.00012			
NONANAL	BL	0.00289	BL	BL	BL	BL	BL	BL	BL	BL	BL			
DECAMETHYLCYCLOPENTASILOXANE	0.00350	0.00242	0.00203	BL	BL	BL	BL	BL	BL	BL	BL			
<b>TARGET COMPOUNDS(GC)</b>														
CARBONMONOXIDE	0.27749	0.21361	0.24488	0.23571	0.05000	0.21482	0.26527	0.05000	0.31672	0.05000	0.27806			
METHANE	0.16438	0.17085	0.17831	0.16951	0.17493	0.18310	0.19432	0.19987	0.16961	0.19995	0.19453			
HYDROGEN	0.03266	0.03916	0.06729	0.08062	0.05779	0.03968	0.04735	0.03322	0.04404	0.04011	0.03518			
<b>TOTAL T-VALUE</b>	1.57208	1.29860	1.52166	1.21145	1.19233	1.30643	1.06312	1.17525	1.45968	0.88154	3.25724			

\* ND: Not detected.  
& BL: Area below the search routine limit (<20% of the fluorobenzene peak area); T-Value not calculated.

**TABLE 5. ANALYTICAL RESULTS OF MIR 19 SSAS AIR SAMPLES**

CHEMICAL CONTAMINANT	T-VALUE						
	TUBE 1	TUBE 2	TUBE 3	TUBE 4	TUBE 5	TUBE 6	TUBE 7
	7/6/95	7/23/95	8/4/95	8/11/95	8/17/95	8/30/95	11/10/95
	10:22	11:00	9:40	10:20	11:45	9:40	15:50
	7/7/95	7/24/95	8/5/95	8/12/95	8/18/95	8/31/95	11/11/95
	11:43	14:30	9:40	10:36	12:00	10:40	16:54
<b>TARGET COMPOUNDS (TO-14/POLAR)</b>							
DICHLORODIFLUOROMETHANE	0.00297	0.00543	0.00458	0.00415	0.00438	0.00331	0.02297
CHLOROMETHANE	ND	0.00094	0.00085	0.00084	0.00087	0.00081	0.00082
1,2-DICHLORO-1,1,2,2-TETRAFLUOROETHANE	ND						
ACETALDEHYDE	0.01602	0.02012	0.01543	0.01468	0.02389	0.01678	0.02509
METHANOL	0.00881	0.00976	0.01812	0.01827	0.00905	0.00839	0.00852
VINYL CHLORIDE	ND	ND	0.00549	ND	0.00547	0.00550	ND
BROMOMETHANE	ND						
ETHANOL	0.00049	0.00307	0.00051	0.00050	0.00065	0.00035	0.00025
CHLOROETHANE	0.00013	0.00015	0.00013	0.00013	0.00014	0.00013	0.00013
PROPENAL	ND						
ACETONE	0.00893	0.01110	0.00803	0.00931	0.01372	0.01198	0.00597
PROPANAL	ND	0.00016	0.00017	ND	ND	0.00017	ND
ISOPROPANOL	0.00316	0.00112	0.00134	0.00197	0.00272	0.01216	0.00204
TRICHLOROFLUOROMETHANE	0.00347	0.00687	0.00361	0.00234	0.00387	0.00304	0.00405
ACRYLONITRILE	0.00511	0.00555	0.00588	0.00602	0.00586	0.00589	0.00532
2-METHYL-2-PROPANOL	0.00033	0.00037	0.00033	0.00033	0.00034	0.00031	0.00032
METHYLACETATE	0.00012	0.00013	0.00014	0.00014	0.00014	0.00014	ND
1,1-DICHLOROETHENE	ND						
DICHLOROMETHANE	0.01236	0.00523	0.00356	0.00169	0.00431	0.00506	0.00508
1,1,2-TRICHLORO-1,1,2-TRIFLUOROETHANE	0.00019	0.00021	0.00019	0.00019	0.00020	0.00018	0.00019
N-PROPANOL	0.00015	0.00016	0.00017	0.00129	0.00093	0.00065	ND
1,1-DICHLOROETHANE	ND						
BUTANAL	ND	0.00013	0.00014	0.00014	0.00014	0.00014	ND
2-BUTANONE	0.00961	0.00129	0.00199	0.00138	0.00055	0.00145	0.00050
1,2-DICHLOROETHENE	ND						
2-METHYLFURAN	ND						
ETHYLACETATE	0.00026	0.00035	0.00032	0.00058	0.00030	0.00022	0.00008
CHLOROFORM	ND	0.00317	0.00336	0.00344	0.00335	0.00337	0.00304
2-BUTENAL	ND						
1,2-DICHLOROETHANE	0.01431	0.04141	0.03721	0.01685	0.03429	0.01649	0.01488
1,1,1-TRICHLOROETHANE	0.00009	0.00010	ND	ND	ND	ND	ND
N-BUTANOL	0.00490	0.00736	0.00954	0.00771	0.00591	0.00545	0.00323
1,1-DICHLOROPROPENE	ND						
BENZENE	0.07156	0.07764	0.08230	0.08427	0.08205	0.08245	0.07442
CARBON TETRACHLORIDE	ND						
2-PENTANONE	ND	ND	ND	0.00024	ND	ND	ND
PENTANAL	0.00013	0.00014	0.00015	ND	ND	0.00015	0.00014
1,2-DICHLOROPROPANE	0.00034	ND	ND	ND	ND	ND	ND
TRICHLOROETHENE	ND						
2,5-DIMETHYLFURAN	ND						
CIS-1,3-DICHLOROPROPENE	ND						
2-PENTENAL	ND	ND	ND	ND	ND	ND	0.00709
TRANS-1,3-DICHLOROPROPENE	ND						
1,1,2-TRICHLOROETHANE	ND						
TOLUENE	0.00740	0.00459	0.00508	0.00332	0.00343	0.00435	0.00157
HEXANAL	0.00292	0.00317	0.00336	0.00344	0.00335	0.00337	0.00304
MESITYL OXIDE	ND	ND	0.00041	0.00042	ND	0.00041	ND
1,2-DIBROMOETHANE	ND						
BUTYLACETATE	0.00008	0.00018	0.00009	0.00009	0.00009	0.00009	0.00008
TETRACHLOROETHENE	ND						
CHLOROBENZENE	0.00031	0.00034	0.00036	0.00037	0.00036	0.00036	0.00032
ETHYLBENZENE	0.00011	0.00047	0.00061	0.00045	0.00041	0.00040	0.00024
M- + P-XYLENES	0.00051	0.00111	0.00138	0.00103	0.00098	0.00095	0.00061
2-HEPTANONE	0.00062	0.00068	0.00072	0.00073	0.00071	0.00072	0.00065

**TABLE 5 ANALYTICAL RESULTS OF MIR 19 SSAS AIR SAMPLES**

CHEMICAL CONTAMINANT	T-VALUE						
	TUBE 1	TUBE 2	TUBE 3	TUBE 4	TUBE 5	TUBE 6	TUBE 7
	7/6/95	7/23/95	8/4/95	8/11/95	8/17/95	8/30/95	11/10/95
	10:22	11:00	9:40	10:20	11:45	9:40	15:50
	7/7/95	7/24/95	8/5/95	8/12/95	8/18/95	8/31/95	11/11/95
	11:43	14:30	9:40	10:36	12:00	10:40	16:54
<b>TARGET COMPOUNDS (TO-14/POLAR) contd.</b>							
CYCLOHEXANONE	0.00024	0.00055	0.00070	0.00062	0.00055	0.00027	0.00025
HEPTANAL	0.00256	0.00277	0.00294	0.00301	0.00293	0.00294	0.00266
STYRENE	0.00033	0.00036	0.00038	0.00039	0.00038	0.00038	0.00035
1,1,2,2-TETRACHLOROETHANE	ND						
O-XYLENE	0.00043	0.00101	0.00124	0.00094	0.00093	0.00088	0.00055
1,3,5-TRIMETHYLBENZENE	0.00095	0.00104	0.00110	0.00112	0.00109	0.00110	0.00099
1,2,4-TRIMETHYLBENZENE	0.00095	0.00104	0.00110	0.00112	0.00109	0.00110	0.00099
1,3-DICHLOROBENZENE	ND						
1,4-DICHLOROBENZENE	0.00048	0.00052	0.00055	0.00056	0.00055	0.00055	0.00050
1,2-DICHLOROBENZENE	ND	0.00052	ND	ND	0.00055	ND	ND
1,2,4-TRICHLOROBENZENE	ND						
HEXACHLORO-1,3-BUTADIENE	ND						
<b>TARGET COMPOUNDS (TOXIC)</b>							
1,3-BUTADIENE	ND						
ETHYLENE OXIDE	ND						
FURAN	0.13011	0.14117	0.14963	0.15322	0.14917	0.14991	0.13530
CHLOROPROPENE	ND						
CARBON DISULFIDE	0.00174	0.00192	0.00174	0.00171	0.00178	0.00165	0.00168
2-METHYL-2-PROPENAL	ND						
3-BUTEN-2-ONE	ND	ND	0.03828	ND	ND	ND	ND
DIMETHYLDISULFIDE	ND	0.07764	0.08230	ND	ND	0.08245	ND
2-ETHOXYETHANOL	0.04771	0.05176	0.05486	0.05618	0.05470	0.05497	ND
OCTAMETHYLCYCLOTETRAILOXANE	0.00329	0.00470	0.00568	0.00522	0.00501	0.00621	0.00344
<b>NON-TARGET COMPOUNDS</b>							
PERFLUORODIMETHYLCYCLOHEXANES	0.00179	0.00135	0.00033	0.00045	0.00036	0.01346	0.00347
C5-ALKANE	0.00009	0.00012	0.00007	BL	0.00012	0.00011	0.00017
2-METHYL-1-PROPANOL	& BL	0.00052	0.00055	BL	BL	BL	BL
C7-ALKANES	0.00082	0.00093	0.00076	0.00045	0.00043	0.00067	0.00036
HEXAMETHYLCYCLOTRIILOXANE	0.00115	0.00145	0.00202	0.00021	0.00200	0.00262	0.00111
PINENE ISOMER	BL	BL	0.00025	BL	0.00027	0.00021	BL
C8-ALCOHOL	BL	BL	BL	0.00334	0.00362	0.00365	0.00556
LIMONENE	0.00055	0.00043	0.00070	0.00006	0.00071	0.00052	0.00020
<b>TOTAL T-VALUE</b>	<b>0.36858</b>	<b>0.50229</b>	<b>0.56070</b>	<b>0.41491</b>	<b>0.43870</b>	<b>0.51888</b>	<b>0.34818</b>

\* ND : Value is less than the laboratory report detection limit.

&amp; BL: Area below the search routine limit (&lt;20% of the fluorobenzene peak area).

**TABLE 6. ANALYTICAL RESULTS OF  
MIR 19 AK-1 AIR SAMPLES**

CHEMICAL CONTAMINANT	T-VALUES	
	AA01185 8/17/95	AA01186 9/7/95
<b>TARGET COMPOUNDS (TO-14/POLAR)</b>		
DICHLORODIFLUOROMETHANE	0.00034	0.00034
CHLOROMETHANE	*ND	0.00064
1,2-DICHLORO-1,1,2,2-TETRAFLUOROETHANE	ND	ND
ACETALDEHYDE	0.05674	0.86676
METHANOL	0.01701	0.05532
VINYLCHLORIDE	ND	ND
BROMOMETHANE	ND	ND
ETHANOL	0.00034	0.00217
CHLOROETHANE	ND	0.00010
PROPENAL	2.1301	73.190
ACETONE	0.03463	0.04015
PROPANAL	ND	0.00641
ISOPROPANOL	0.01035	0.00706
TRICHLOROFUOROMETHANE	0.00109	0.00092
ACRYLONITRILE	0.02627	0.00943
2-METHYL-2-PROPANOL	0.00022	0.00022
METHYLACETATE	0.00022	0.00022
1,1-DICHLOROETHENE	ND	ND
DICHLOROMETHANE	0.01933	0.01833
1,1,2-TRICHLORO-1,1,2-TRIFLUOROETHANE	0.00024	0.00009
N-PROPANOL	0.00310	0.00146
1,1-DICHLOROETHANE	ND	ND
BUTANAL	0.00122	0.00317
2-BUTANONE	0.00829	0.00718
1,2-DICHLOROETHENE	ND	ND
2-METHYLFURAN	0.20308	0.78358
ETHYLACETATE	0.00236	0.00120
CHLOROFORM	0.01724	0.00539
2-BUTENAL	ND	0.00078
1,2-DICHLOROETHANE	0.14337	0.02640
1,1,1-TRICHLOROETHANE	0.00017	0.00017
N-BUTANOL	0.09717	0.02559
1,1-DICHLOROPROPENE	ND	ND
BENZENE	0.81727	0.66417
CARBON TETRACHLORIDE	0.00203	0.00203
2-PENTANONE	ND	ND
PENTANAL	0.00136	0.00296
1,2-DICHLOROPROPANE	0.00330	0.00063
TRICHLOROETHENE	0.00264	ND
2,5-DIMETHYLFURAN	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	0.03052	0.00873
HEXANAL	0.03695	0.05204
MESITYLOXIDE	0.00066	0.00066
1,2-DIBROMOETHANE	ND	ND
BUTYLACETATE	0.00068	0.00014
TETRACHLOROETHENE	0.00078	ND
CHLOROBENZENE	0.00221	0.00057
ETHYLBENZENE	0.00253	0.00068

**TABLE 6 ANALYTICAL RESULTS OF  
MIR 19 AK-1 AIR SAMPLES**

CHEMICAL CONTAMINANT	T-VALUES	
	AA01185 8/17/95	AA01186 9/7/95
<b>TARGET COMPOUNDS (TO-14/POLAR) contd.</b>		
M- + P-XYLENES	0.00522	0.00153
2-HEPTANONE	0.00115	0.00115
CYCLOHEXANONE	0.00585	0.00170
HEPTANAL	0.01007	0.03249
STYRENE	0.00196	0.00061
1,1,2,2-TETRACHLOROETHANE	ND	ND
O-XYLENE	0.00445	0.00137
1,3,5-TRIMETHYLBENZENE	0.00176	0.00176
1,2,4-TRIMETHYLBENZENE	0.00834	0.00368
1,3-DICHLOROBENZENE	ND	ND
1,4-DICHLOROBENZENE	0.00216	0.00088
1,2-DICHLOROBENZENE	0.00088	ND
1,2,4-TRICHLOROBENZENE	ND	ND
HEXACHLORO-1,3-BUTADIENE	ND	ND
<b>TARGET COMPOUNDS (TOXIC)</b>		
1,3-BUTADIENE	ND	ND
ETHYLENE OXIDE	ND	ND
FURAN	0.24000	1.9283
CHLOROPROPENE	ND	ND
CARBON DISULFIDE	0.00165	0.00165
2-METHYL-2-PROPENAL	0.01553	0.12486
3-BUTEN-2-ONE	ND	0.19242
DIMETHYLDISULFIDE	0.13200	0.13200
2-ETHOXYETHANOL	ND	ND
OCTAMETHYLCYCLOTETRAILOXANE	0.01737	0.00827
<b>NON-TARGET COMPOUNDS</b>		
PROPENE	&BL	0.00007
C4-ALKENES	BL	0.00036
PERFLUORODIMETHYLCYCLOHEXANES	0.00248	0.01100
ACETONITRILE	0.00419	0.00880
C5-ALKANES	0.00434	0.00129
2-METHYL-1,3-BUTADIENE	0.00023	0.00014
TRIMETHYLSILANOL	0.00686	0.05372
ACETIC ACID, ETHENYL ESTER	0.00846	0.01989
2-METHOXY-2-METHYLPROPANE	0.00094	0.00163
C6-ALKANES	0.00284	0.00080
2-METHYLPROPANENITRILE	0.00758	0.00324
2-METHYL-1-PROPANOL	0.00248	0.00091
C7-ALKANES	0.00964	0.00350
METHYLCYCLOPENTANE	0.00169	BL
CYCLOHEXANE	0.00270	0.00089
DIMETHYLCYCLOPENTANE ISOMER	0.00268	BL
ACETIC ACID, PROPYLESTER	0.00062	BL
METHYLCYCLOHEXANE	0.00241	0.00080
C8-ALKANE	0.00021	BL
OXYGENATED HYDROCARBONS (MW $\leq$ 114)	0.96233	BL
HEXAMETHYLCYCLOTETRAILOXANE	0.00867	0.00455
C9-ALKANE	0.00041	BL
BENZALDEHYDE	0.00236	0.00144
PINENE ISOMERS	0.00173	0.00045
2-PROPENOIC ACID, 2-METHYL-, BUTYLESTER	0.00067	BL
C3-BENZENES	0.00729	0.00055

**TABLE 6 ANALYTICAL RESULTS OF  
MIR 19 AK-1 AIR SAMPLES**

CHEMICAL CONTAMINANT	T-VALUES	
	AA01185 8/17/95	AA01186 9/7/95
<b>NON-TARGET COMPOUNDS contd.</b>		
2-PENTYLFURAN	0.45368	0.71592
OCTANAL	0.00703	0.00636
C11-ALKANE	0.00238	BL
C8 ALCOHOL	0.00318	0.01804
C4 BENZENE	0.00663	BL
LIMONENE	0.00317	0.00070
ACETOPHENONE	0.00098	BL
NONANAL	0.00572	0.02645
C13-ALKANE	0.00162	0.00174
DECAMETHYLCYCLOPENTASILOXANE	0.00472	0.00505
DECANAL	BL	0.02488
<b>TOTAL T-VALUE</b>	5.6551	79.131

\*ND : Value is less than the laboratory report detection limit.

& BL: Area below the search routine limit (<20% of the fluorobenzene peak area).

**TABLE 7. SUMMARY OF SAMPLES TAKEN AT APPROXIMATELY THE SAME TIME DURING MIR 19**

Date of Sample	Grab Sample Container		Solid Sorbent Sample		Russian AK-1 Sample Column in Table 3
	Time	Column in Table 1	Time	Tube Number	
8/4/95	9:50	2	9:40	3	ns
8/17/95	11:21	3	11:45	5	1
8/30/95	9:36	4	9:40	6	ns
9/7/95	ns	5	ns	ns	2

**TABLE 8. A COMPARISON OF RESULTS ON FIVE MARKER COMPOUNDS FROM THE SSAS AND GSCS SAMPLES TAKEN AT THE SAME TIME**

Compound	Concentrations GSC/SSAS			Average Percent GSC/SSAS
	8/4/95	8/17/95	8/30/95	
acetone	0.39/0.40	0.65/0.69	0.47/0.60	90%
n-butanol	0.27/0.38	0.22/0.24	0.21/0.22	86%
m&p-xylenes	0.24/0.30	0.17/0.22	0.15/0.21	76%
o-xylene	0.22/0.27	0.16/0.20	0.15/0.19	80%
limonene	0.51/0.39	0.36/0.40	0.24/0.29	101%
AVERAGE				87%

**TABLE 9. A COMPARISON OF FIVE MARKER COMPOUNDS FROM AK-1 RESULTS**

Compound	Sample Date	Concentrations (mg/m <sup>3</sup> )		
		GSC	SSAS	AK-1
acetone	8/17/95	0.65	0.69	1.7
n-butanol		0.22	0.24	3.9
m&p-xylenes		0.17	0.22	1.1
o-xylene		0.16	0.2	0.98
limonene		0.36	0.4	1.8
acetone	9/7/95	0.54	ns	2
n-butanol		0.2	ns	1
m&p-xylenes		0.12	ns	0.34
o-xylene		0.11	ns	0.3
limonene		0.19	ns	0.39

**TABLE 10. FORMALDEHYDE CONCENTRATIONS FOUND DURING MIR 19**

Sample Date	Start Time	Sample Time (hours)	Air Concentration (mg/m <sup>3</sup> )
7/6/95(b)	1300	12	0.09
7/6/95(s)	1000	12	0.14
7/23/95(b)	1100	12.8	0.12
7/23/95(s)	1050	13	0.7
8/4/95(b)	940	12.1	0.13
8/4/95(s)	940	12.1	0.77
9/8/95(b)	1200	11.9	0.05

Quality Control: Positive Control Recoveries: 95% and 111%

TABLE 11. TOXICOLOGICAL ANALYSIS OF GSC DATA

Toxic Category	Compound	T-Values from Grab Sample Canisters on Specific Day										
		26-Jul	4-Aug	17-Aug	30-Aug	7-Sep	26-Oct	6-Nov	8-Nov	13-Nov	13-Nov	
<b>Irritants</b>	acetaldehyde	0.08	0.05	0.04	0.04	0.06	0.05	0.04	0.05	0.06	0.04	0.05
	propenal	0.33	nd	0.33	nd	nd	0.33	nd	0.33	0.33	nd	1.87
	3-butene-2-one	0.06	nd	nd	nd	nd	0.06	nd	0.06	nd	nd	nd
	Total	0.49	0.05	0.37	0.04	0.06	0.44	0.04	0.44	0.39	0.04	1.92
<b>Neurotoxicants</b>	methanol	0.05	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.04	0.02	0.02
	acetone	0.01	0.01	0.01	0.01	0.01	0.01	0	0.01	0.01	0.01	0.01
	carbon monox.	0.28	0.21	0.24	0.24	0.05	0.21	0.27	0.05	0.32	0.05	0.28
	Total	0.34	0.26	0.28	0.28	0.09	0.24	0.29	0.08	0.37	0.08	0.31
<b>Carcinogens</b>	1,2-dichloroethane	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	benzene	0.12	0.12	nd	0.12	nd	nd	0.12	nd	0.12	0.12	0.12
	furan	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.51
	Total	0.37	0.37	0.25	0.37	0.25	0.25	0.37	0.25	0.37	0.37	0.65
<b>Cardiotoxicants</b>	Octafluoropropane	0.06	0.31	0.27	0.03	0.32	0.04	0.03	0.03	0.04	0.02	0.04
	Freon 82	0.02	0	0	0.17	0.16	0.02	0.02	0.05	0	0.06	0.03
	carbon monoxide	0.28	0.21	0.24	0.25	0.05	0.21	0.27	0.05	0.32	0.05	0.28
	Total	0.36	0.52	0.51	0.55	0.53	0.27	0.32	0.13	0.36	0.13	0.35
<b>"Explosives"</b>	Methane	0.16	0.17	0.18	0.17	0.17	0.18	0.19	0.2	0.17	0.2	0.19
	Hydrogen	0.03	0.04	0.07	0.08	0.06	0.04	0.05	0.03	0.04	0.04	0.04
	Totals	0.19	0.21	0.25	0.25	0.23	0.22	0.24	0.23	0.21	0.24	0.23
<b>Hepatotoxicant</b>	OMCTS (Total)	0.02	0.02	0.02	0	0.01	0.01	0.01	0.01	0.01	0	0

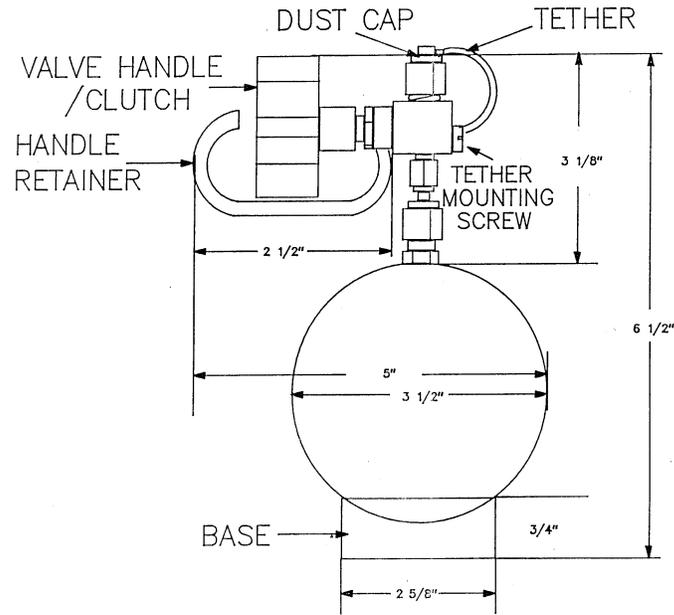


Figure 1. NASA Grab sample canisters

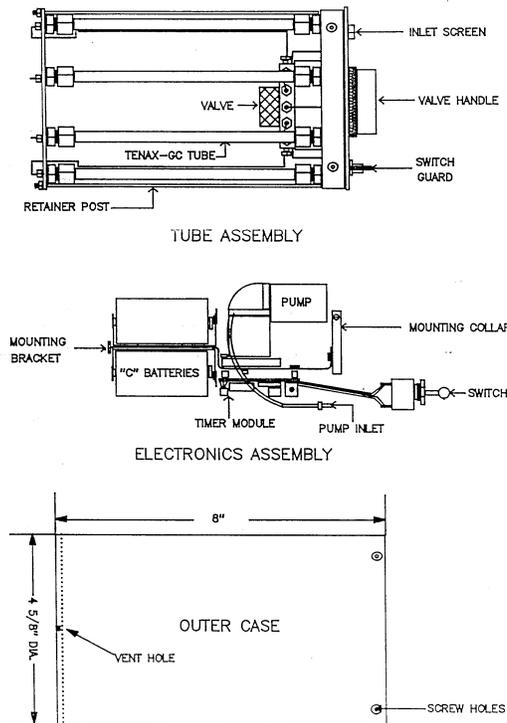
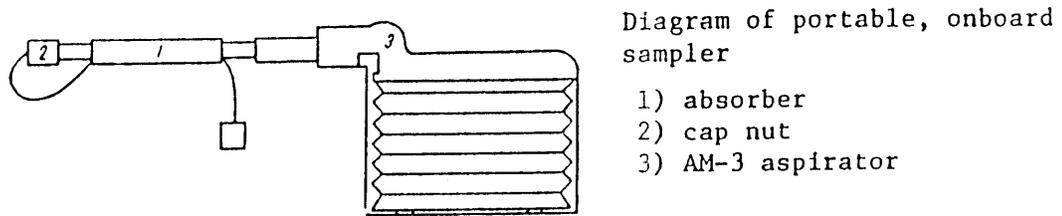
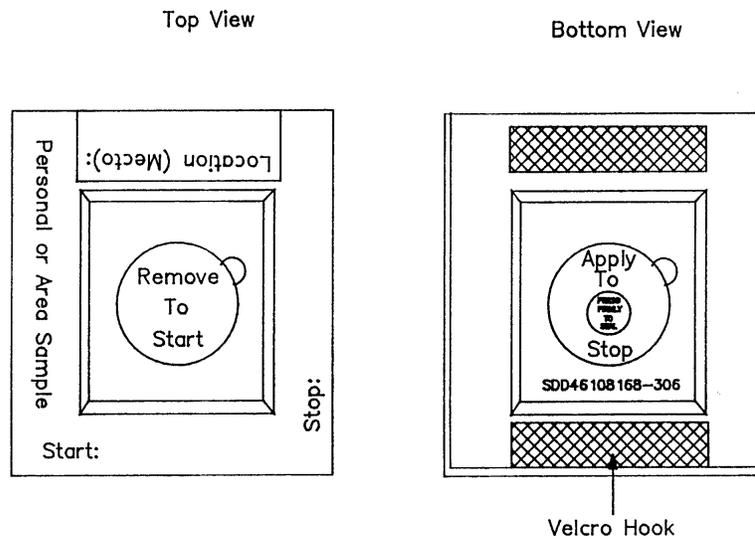


Figure 2. NASA Solid sorbent air sampler



**Figure 3.** IBMPAK-1 Sorbent System



**Figure 4.** NASA Formaldehyde Badges