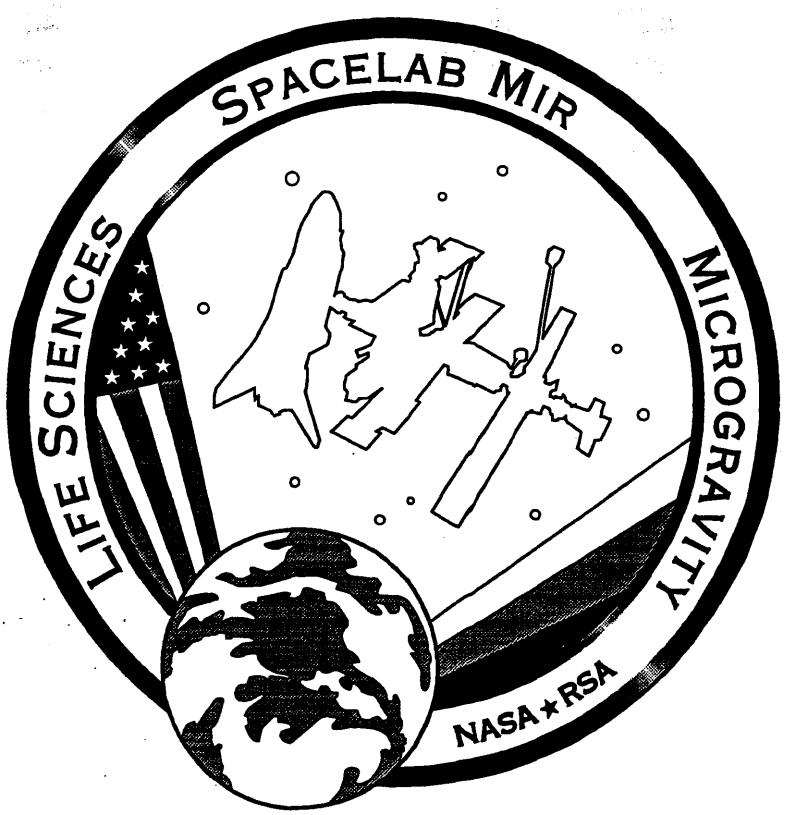
JSC-26733

# MISSION SCIENCE REQUIREMENTS DOCUMENT

# SPACELAB-MIR (STS-71)




National Aeronautics
and Space Administration

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# TRACE CHEMICAL CONTAMINATION EXPERIMENT 5.3

## INVESTIGATORS


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## HYPOTHESIS

Spacecraft atmosphere composition reaches a state of equilibrium during long-term missions. Disruptions of this atmospheric equilibrium are periodic and short-term. Contaminants in spacecraft atmospheric humidity condensate are effectively removed by processes used to produce potable water.

## OBJECTIVES

1. To study the characteristics of an atmosphere which has reached equilibrium following years of partially-closed air revitalization operation.

2. To explore the atmospheric dynamics that occur over a 12 week time interval.

3. To characterize the chemical composition of Mir potable water and to provide an in-flight demonstration of water sampling hardware currently being designed for future US missions.

4. To provide a better understanding of the interaction between atmospheric and water contaminants.

## FUNCTIONAL OBJECTIVES

Formaldehyde Monitor

One crewmember wears a formaldehyde monitor near his breathing zone for a period of 10-12 hours during his work cycle. The monitors are used to determine the concentration of formaldehyde in the atmosphere.

Solid Sorbent Air Sampler (SSAS)

The SSAS is used to collect volatile organic compounds from the atmosphere. The SSAS is used to collect a one-day sample once/week for approximately seven weeks. These samples are collected both on Mir and on Shuttle.

Grab Sample Container

The grab sample containers (GSC) are used to obtain samples of atmosphere once/week for approximately seven weeks. These samples are collected both on Mir and on Shuttle. These samples are used to determine the concentration of carbon monoxide, methane, hydrogen, low molecular weight hydrocarbons, and polar compounds.

Potable Water

The water sampling kit, which contains a Sampler with a Mir port adapter, is used to collect samples of Mir potable water (regenerated and ground supplied) for postflight analysis. Five 1-liter samples are collected on four separate mission days. Three samples are collected during the docked phase.

Transfer Session

All data collected during the 90-day Mir 18 mission are transferred from the Mir to the Shuttle and stowed for return.

Debrief

Crew members provide a debrief to investigators postflight.

## Table 5.3 Trace Chemical Contamination

| Functional Objective | PHASE | | | | |
|---|---|---|---|---|---|
| | Pre-flight | Mir 18 In-flight | STS-71 In-flight | Post-flight | Mir 19 In-flight |
| Formaldehyde Monitoring | | X | | | X |
| Solid Sorbent Air Sampler | | X | X | | X |
| Grab Sample Containers | | X | X | | X |
| Potable water | | X | X | | X |
| Sample Transfer | | | X | | |
| Debrief | | | | X | |

SESSION DESCRIPTION

1. Session ID: HSR:I:6 Rev. Date: 06/20/95

2. Session Title: Mir Potable Hot Water Sampling (HSR-MIC-5.1, HSR-TCC-5.3)

3. Session Timelining:

   3.1 Scheduled Day(s):

   FD7

   3.2 Crewtime Usage:

   1g: 65 man-mins = 1.08 man-hrs
   0g: 65 man-mins = 1.08 man-hrs

4. Session Scenario:

Unstow hardware from Spacelab. Go to Mir. Unstow hardware from Mir. Collect 3 1-Liter samples of Mir hot drinking water. Two samples are for Microbiology study and 1 sample is for the Trace Chemical study. Stow water sampling kit on Mir. Stow water samples on Mir with other samples collected earlier on the Mir mission.

5. Session Constraints:

   1. This session should occur as late as possible during the docked phase.

   2. This session should be performed by a Mir 18 crewmember.

   3. This session must be followed immediately by HSR:I:7.

   4. These samples must be refrigerated.

   5. Adequate cooling must occur before the hot water samples are placed into the refrigerator. Samples should be stored at an ambient temperature for a minimum of 3 hours but no longer than 5 hours.

6. Session Operational Module and Time Requirements:

N/A

7. Session Science Flow:

| 1g time (min) | 0g Time/factor | Oper/ Subj | Activity |
|---|---|---|---|
| 5 | 5/1.00 | 1/0 | Unstow water sampling kit from Shuttle |
| 5 | 5/1.00 | 1/0 | Go to Mir |
| 10 | 10/1.00 | 1/0 | Unstow Potable Water Sampler (PWS), 3 Sample Bags (1 archival chemical and 2 archival microbiology), 1 Waste Bag, 3 Storage Bags, and disinfection wipes |
| 5 | 5/1.00 | 1/0 | Disinfect Mir hot drink dispenser |
| 10 | 10/1.00 | 1/0 | Attach PWS and waste bag to drink dispenser and flush system (200 ml) |
| 25 | 25/1.00 | 1/0 | Mark each sample bag with starting MET; collect hot potable water samples (3 1-Liter samples); mark end MET on each sample bag |
| 5 | 5/1.00 | 1/0 | Stow water sampling kit and samples on Mir |

SESSION DESCRIPTION

Session ID: HSR:I:9 Rev. Date: 06/20/95

2. Session Title: Solid Sorbent Air Sampler Deployed and Activated in the Spacelab (HSR-TCC-5.3)

3. Session Timelining:

3.1 Scheduled Day(s):

FD2, FD3, FD5, FD6, FD7, FD8, FD10, FD11

3.2 Crewtime Usage:

FD2:
1g: 10 man-mins = 0.17 man-hrs
0g: 10 man-mins = 0.17 man-hrs

FD3, FD5, FD6, FD7, FD9, FD10, FD11:

1g: 5 man-mins = 0.08 man-hrs
0g: 5 man-mins = 0.08 man-hrs

FD11:

1g: 10 man-mins = 0.17 man-hrs
0g: 10 man-mins = 0.17 man-hrs

4. Session Scenario:

The SSAS will be deployed and the crewmember will activate by turning a rotary valve to the correct sampling position toggling the instrument on and record MET. Every 32 hrs, the rotary valve will be advanced with MET recorded.

5. Session Constraints:

1. SSAS: Should be deployed and activated in the Spacelab early in the mission (prior to docking).

2. Advance SSAS 32 hrs +/- 10 hrs from previous data collection.

3. SSAS should be stowed and deactivated as late as possible in the mission.

4. This session should be performed by a STS-71 crewmember (PLT).

6. Session Operational Module and Time Requirements:

N/A

HSR:I:9 (Continued)

7. Session Science Flow:

| 1g time (min) | 0g Time/factor | Oper/ Subj | Activity |
|---|---|---|---|
| 10 | 10/1.00 | 1/0 | Deploy and activate SSAS (FD2 only) |
| 5 | 5/1.00 | 1/0 | Change sampling position |
| 10 | 10/1.00 | 1/0 | Deactivate/stow (FD11 only) |

SESSION DESCRIPTION

1. Session ID: HSR:I:10 Rev. Date: 06/20/95

2. Session Title: Grab Air Sample Collection (HSR-TCC-5.3)

3. Session Timelining:

3.1 Scheduled Day(s):

FD 2, 4, 6, 8, 11

3.2 Crewtime Usage:

1g: 11 man-mins = 0.18 man-hrs
0g: 11 man-mins = 0.18 man-hrs

4. Session Scenario:

Four grab samples of the Spacelab atmosphere will be collected in flight. One grab sample of the Middeck atmosphere will be collected in flight. For each sample collection a crewmember places the evacuated container at the sampling location, opens the valve on the container for a period of 10 seconds and then closes the valve. MET and location will be recorded on the sample label. One operator will be needed.

Session Constraints:

1. First sample should be taken as soon as possible after Spacelab activation.

2. One of the grab samples should be collected just prior to docking with the Mir.

3. Second 2 samples should be collected at 2-day intervals.

4. This session should be performed by a STS-71 crewmember (PLT).

6. Session Operational Module and Time Requirements:

N/A

7. Session Science Flow:

| 1g time (min) | 0g Time/factor | Oper/ Subj | Activity |
|---|---|---|---|
| 5 | 5/1.00 | 1/0 | Unstow |
| 1 | 1/1.00 | 1/0 | Grab air samples collected per day |
| 5 | 5/1.00 | 1/0 | Stow |

SESSION DESCRIPTION

1. Session ID: HSR:I:13 Rev. Date: 06/20/95

2. Session Title: Mir Potable Cold Water Sampling (HSR-TCC-5.3)

3. Session Timelining:

   3.1 Scheduled Day(s):

   FD7

   3.2 Crewtime Usage:

   1g: 55 man-mins = 0.92 man-hrs
   0g: 55 man-mins = 0.92 man-hrs

4. Session Scenario:

Unstow hardware from Shuttle. Go to Mir. Unstow hardware from Mir. Collect 2 samples. Mark start MET and end MET on each sample bag. A 300 ml sample is collected into a small sample bag. A 1-liter ml sample is collected into a large sample bag. Temporarily stow sample. Remove PWS and stow in the kit.

Go to the Rodnick water supply system on the Mir. Using the Rodnick's manual system, pump the system to allow the collection of 1600 ml of water. Collect 400 ml in small sample bag. Collect 1-liter in large sample bag. Temporarily stow samples. Remove PWS and stow in the Kit. Return the Water Sampling Kit to SL-M stowage. Transfer all 4 samples to the Shuttle refrigerator for return to Earth.

5. Session Constraints:

   1. This session should occur as late as possible during the docked phase.

   2. This session should be performed by a crewmember familiar with the operation of the Mir galley and Rodnick supply system.

6. Session Operational Module and Time Requirements:

N/A

7. Session Science Flow:

| 1g time (min) | 0g Time/factor | Oper/ Subj | Activity |
|---|---|---|---|
| 5 | 5/1.00 | 1/0 | Unstow water sampling kit from Spacelab |

HSR:I:13 (Continued)

| 1g time (min) | 0g Time/factor | Oper/ Subj | Activity |
|---|---|---|---|
| 5 | 5/1.00 | 1/0 | Go to Mir |
| 5 | 5/1.00 | 1/0 | Unstow sterile Potable Water Sampler, 2 sample bags, 1 waste bag, 2 storage bags, and disinfection wipes |
| 15 | 15/1.00 | 1/0 | Disinfect cold drink dispenser; attach PWS, collect waste sample (200 ml) and discard; collect 2 cold water samples (300 ml sample and 1-Liter sample) |
| 5 | 5/1.00 | 1/0 | Go to Rodnick water supply and unstow PWS, 2 sample bags, 1 waste bag, 2 storage bags, and disinfection wipes |
| 15 | 15/1.00 | 1/0 | Disinfect Rodnick port; manually pump system; collect waste sample (200 ml) and discard, collect 2 samples of Rodnick water (400-ml sample and 1-liter sample) |
| 5 | 5/1.00 | 1/0 | Stow Kit and samples on Shuttle |