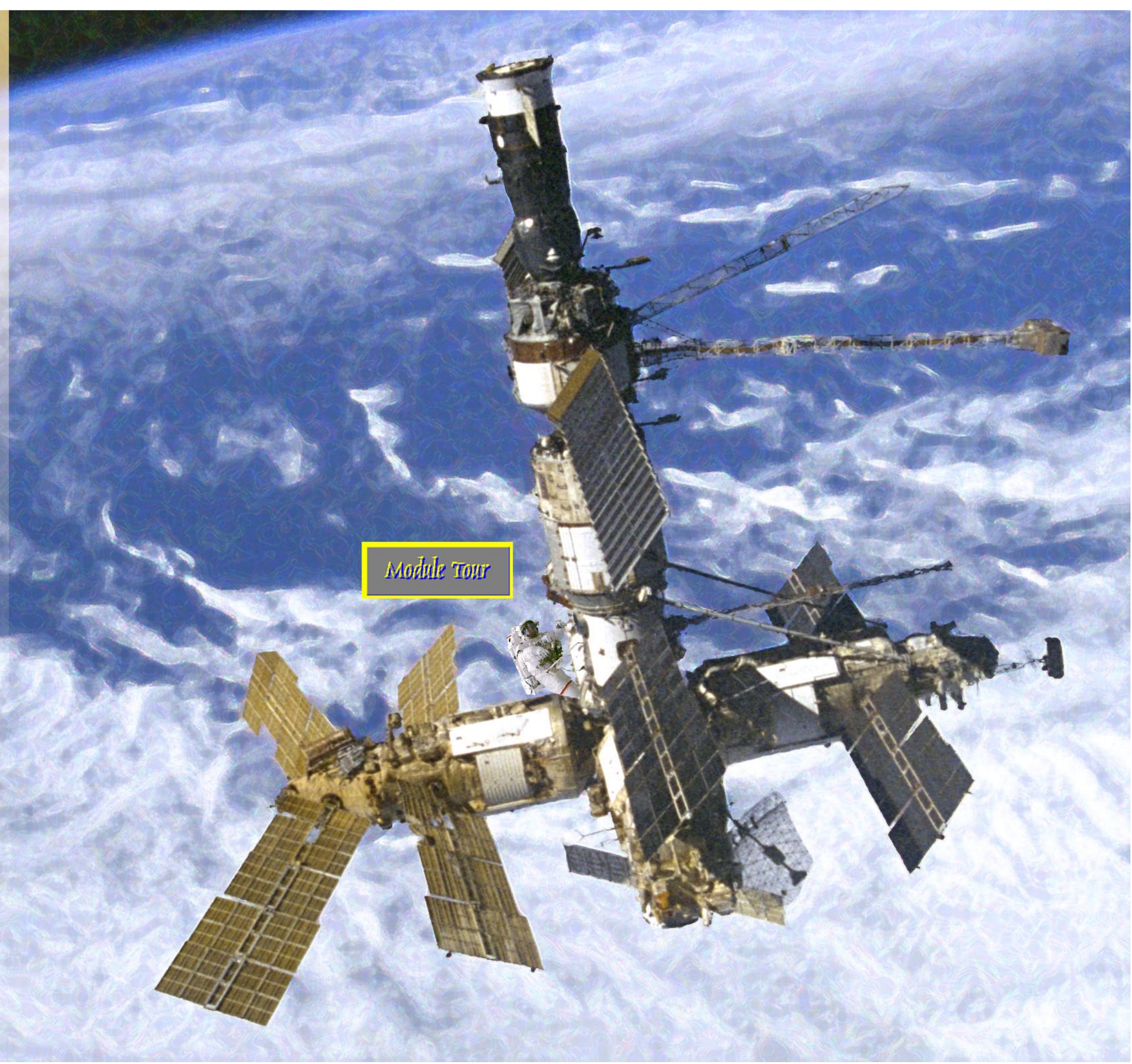
Phase 1:
A Journey to Mir
1994-1998



Module Tour

List of Experiments

List of Experiments by Increment

MIR SAMPLE RETURN EXPERIMENT (MSRE)

EXPERIMENT DESCRIPTION

Passive ultramicro-cellular silica aerogel capture cells placed in aluminum trays for cosmic dust collection. These trays are launched and mounted externally to the Mir via EVA. After 6 months of particle collection, the trays are retrieved and returned for postflight analysis.

SCIENCE OBJECTIVES

- To collect intact cosmic dust for chemical, isotopic, and organic analysis. These results will affect what future cosmic dust collection experiments are flown in LEO.

HARDWARE DESCRIPTION

The MSRE uses Trek hardware already on orbit for attachment to the Kvant II exterior surface.

MSRE TRAY

Each MSRE Tray is a 48.26 x 48.26 x 1.85 cm 6061 Aluminum platform divided into 25 individual cells with dimensions of 9.08 x 9.08 x 1 cm each.

Each MSRE Tray is designed to house 24 silicate aerogel capture cells and 1 Acoustic Time-of-Impact Recorder. The recorder is housed in the center cell of each tray. Silicate aerogel is a transparent lowest density solid material suitable for capturing hyper-velocity particles intact. Silicate aerogel is fabricated from silicon dioxide by a solgel process through critical point extraction.

The 25 cells are covered with a stainless steel wire grid to prevent damage to the capture cells during handling. The stainless steel wire has a diameter of 0.08128 cm, and the grid is spaced at 1.27 cm intervals.

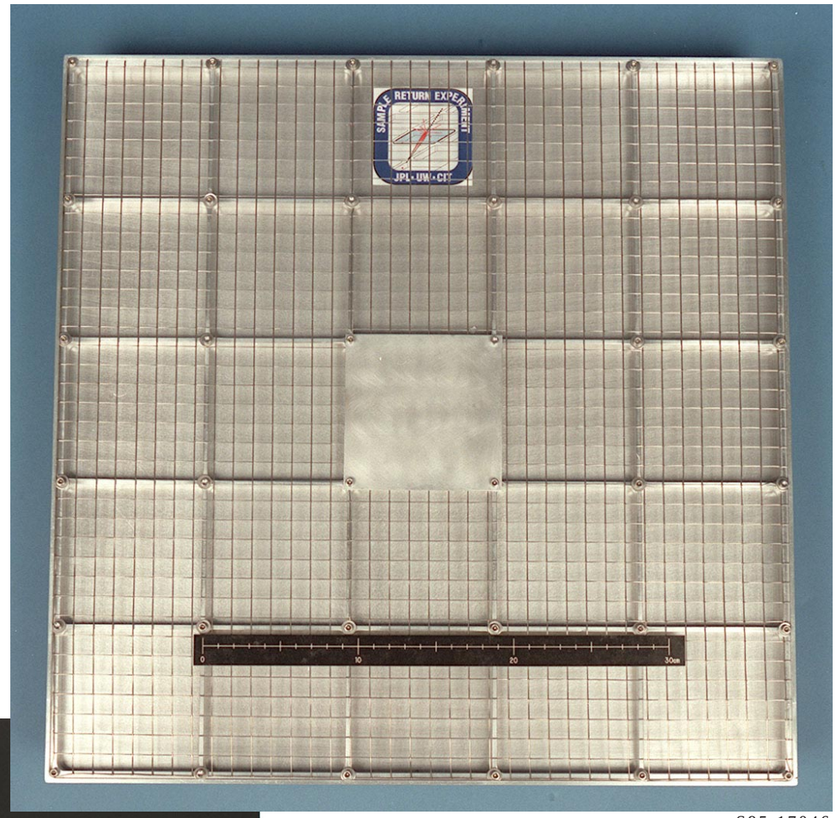
The wire grid is attached to each tray upper edge by thirty-two 6/32 captive screws. The four MSRE Trays were mounted on top of four Trek Panels using four 6/32 stainless steel screws at the four corners.

ACOUSTIC TIME-OF-IMPACT RECORDER

An Acoustic Time-of-Impact Recorder powered by 2 lithium batteries is located in the center cell of each of the four MSRE Trays. This recorder contains no switches and is designed to operate for approximately 3 years. The recorder is activated when the fifth (shortest) fastener is installed. The electronics package at the center of the tray is attached via wire to four piezo-electric sensors mounted using adhesive tape beneath the aerogel in the center cell of each of the four side walls of each tray. Each electronics package contains a charge-coupled preamplifier and an internal clock. The capture signals are merged with the clock signal and recorded on solid state random access memory. The memory capacity of each recorder is approximately 64 k. The location of the particle impact is ascertained by triangulation of the signal received from the four sensors. The electronic packages are housed inside an aluminum 6061 box covered on the top side with silver Teflon tape for thermal control then installed in the center cell of each tray.

STS79-834-050

Figure SS-1 Exterior Photo of MSRE on Spektr



S95-17046

Figure SS-2 Photo of MSRE

HARDWARE OPERATIONS

The MSRE hardware was attached to the Trek Panels inside the Mir station prior to deployment. The attachment is via 20 stainless steel screws (5 per panel) using an Allen-type wrench. Once the MSRE trays are attached to the Trek Panels, the deployment (via EVA) is identical to the procedure followed in the past to deploy the Trek Panels. ❋

Principal Investigator:
Peter Tsou
JPL
(818)354-8094

MIR SAMPLE RETURN EXPERIMENT TRAY (MSRE)

P/N:	JPL-11-JPL-14
Qty:	4
Mass:	2.34 kg
Power:	N/A
x,y,z:	48.26 x 48.26 x 1.85 cm

Particle Impact Experiment (PIE) Complex

EXPERIMENT DESCRIPTION

The PIE Complex is a passive collector for capturing particles for laboratory analyses. The collector is launched and mounted exernally to the Mir via EVA. The collector remained deployed for a minimum of 6 months prior to retrieval and return for postflight analysis.

SCIENCE OBJECTIVE

- To capture micron/submicron particles for chemical, isotopic, and mineralogical analysis.

HARDWARE DESCRIPTION

PIE COMPLEX

The PIE Complex is comprised of four separate units attached together with hinges and locking mechanisms. The individual units fold together to allow ease of handling and launching. The complex is an adaptation of the ARAGATZ experiment originally flown on Mir in 1987. Three of the four PIE units are designed to house micropore foam capture material and other samples to be exposed to the space environment. One unit acts as an outer cover for the complex.

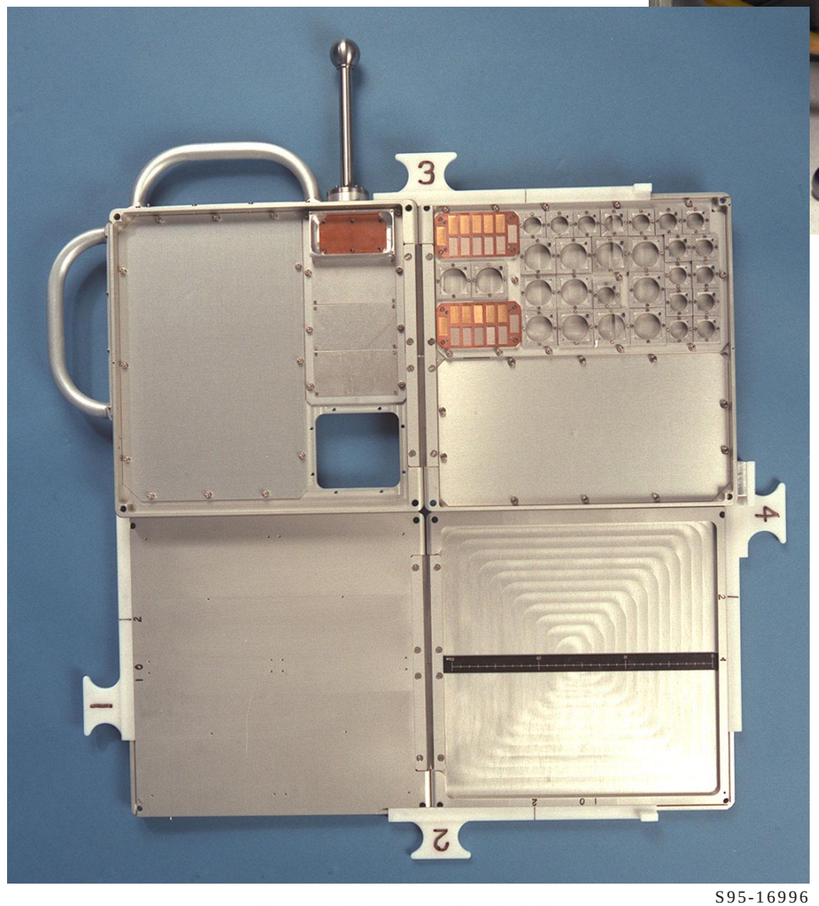
During flight, and after docking of the Priroda Module to Mir, the PIE Unit is fixed to the outer surface of the Kvant 2 Module using the magnetic lock at the conic cylinder junction. After at least 6 months of exposure to the space environment, the PIE Unit is retrieved, sealed and returned to Earth for analysis of the constituent materials.

A second PIE Complex will be used for training and in the WET-F (Hydrolab) certification.

The PIE Complex provides for:

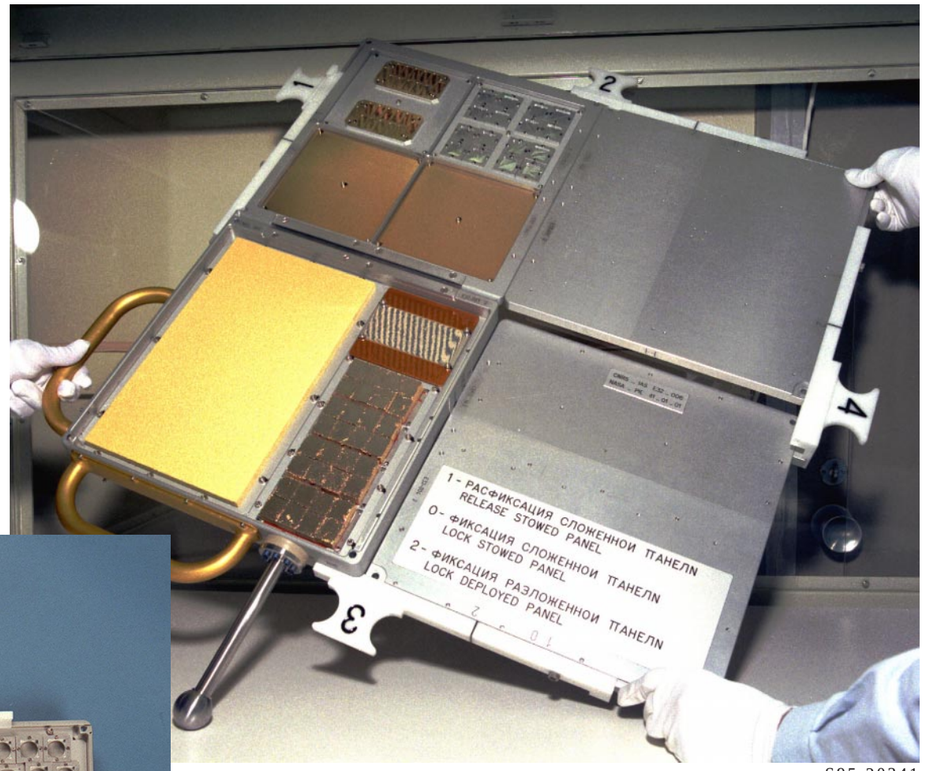
- Collection of cosmic dust grains with minimal particle degradation using micropore foam materials and stacked thin film detectors — the cosmic dust is analyzed to determine mass of grains, its sizes, impact velocity (in the range of 100 m/s - 15 km/s, and flux distribution

- Definition of the effects of the Mir surrounding contamination parameters, including the influence of rendezvous and docking from other vehicles, by means of passive second surface witness mirrors



S95-16996

Figure SS-3 View of Folded PIE



S95-20341

Figure SS-4 View of PIE Unfolded

- Measurement of Mir surrounding atomic oxygen fluxes and variations of these parameters as a function of attitude by means of an amorphous carbon witness sample

- Indication of the incident heat flux during on-orbit operations

LOG BOOK

A paper log book stowed with the PIE unit is designed to record deployment time, condition at deployment, on-orbit anomalies, attitudes and stowage time, and condition.

HARDWARE INTERFACE WITH SYSTEMS

There is no interface with any Mir power system during on-orbit operations.

Once installed there is no operation of the PIE.

Principal Investigator:
Carl Maag
T & M Engineering

PARTICLE IMPACT EXPERIMENT (PIE) UNIT

P/N:	NASA.PIE.41.01.01
Qty:	1
Mass:	11.30 kg
Power:	None
x,y,z:	35.00 x 40.50 x 10.00 cm

OSCILLOSCOPE

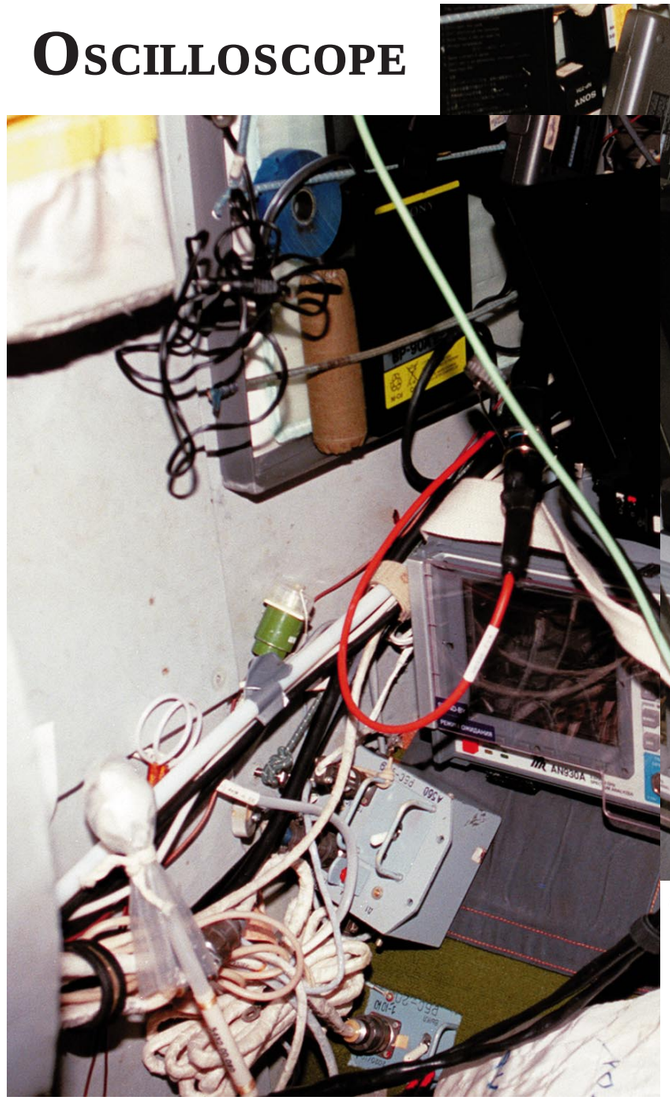


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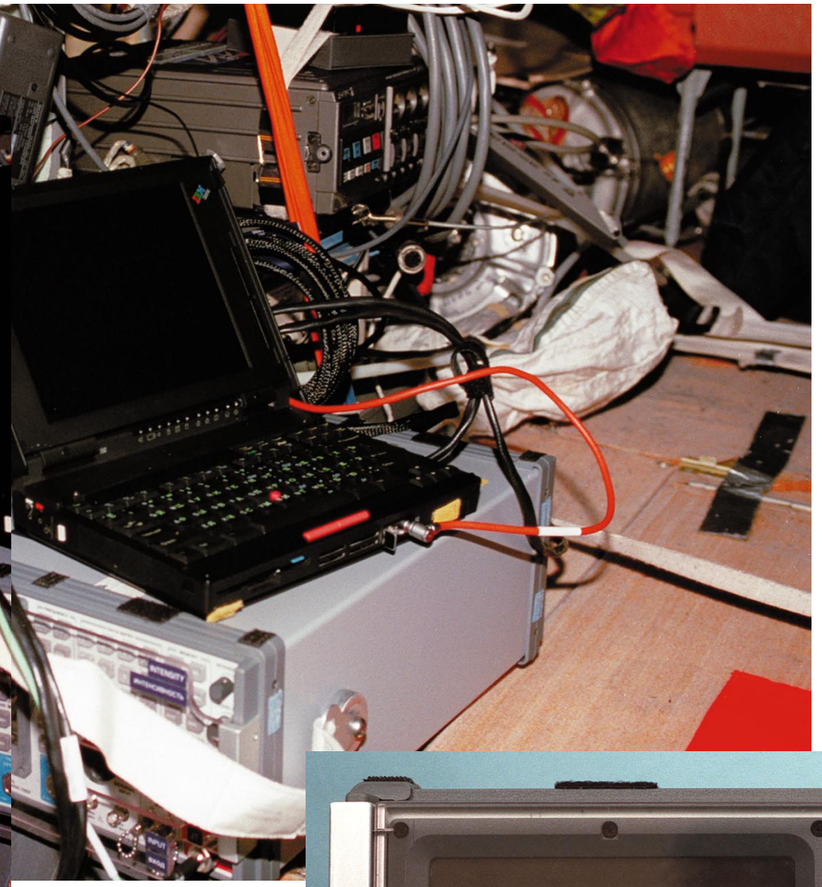
Figure SH-1 Oscilloscope



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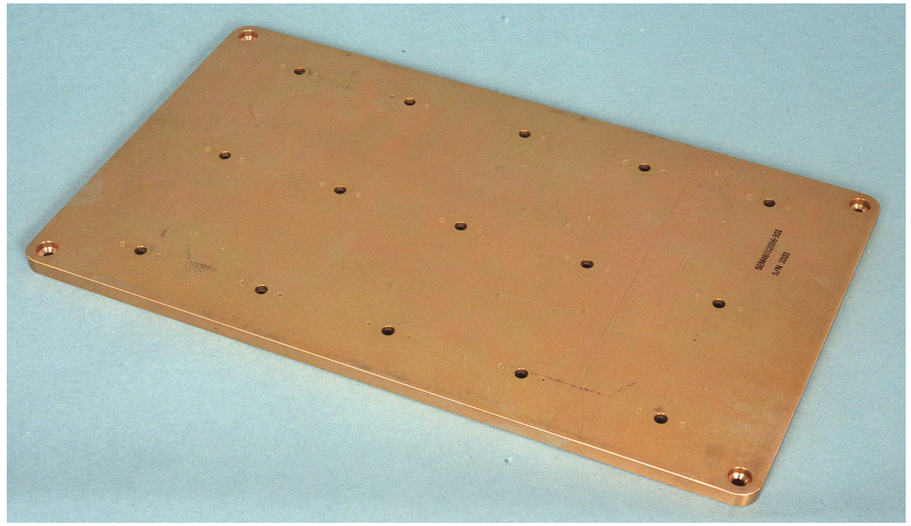
S96-13160

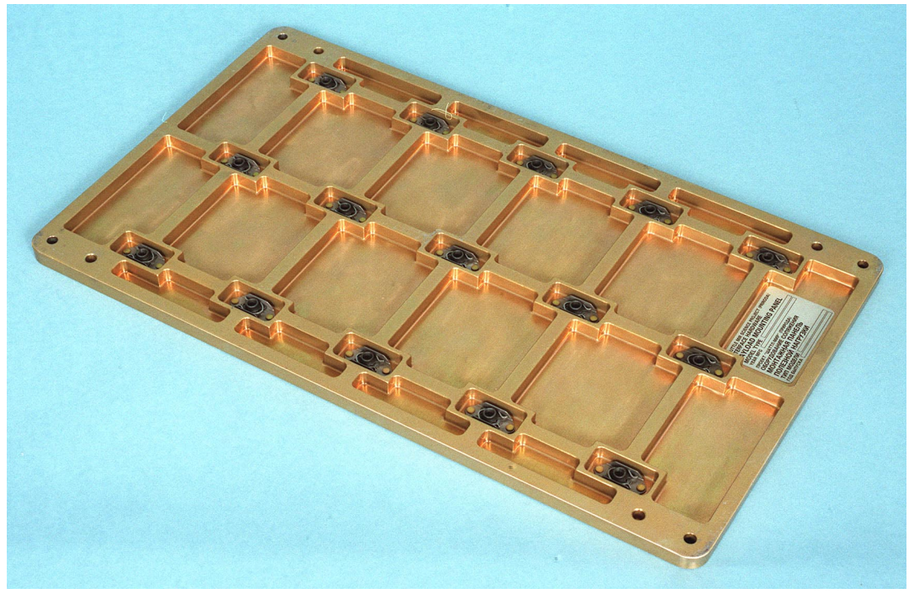
Figure SH-2 Oscilloscope, Front Face

Payload Mounting Panel (PMP) And Water Stowage Containers



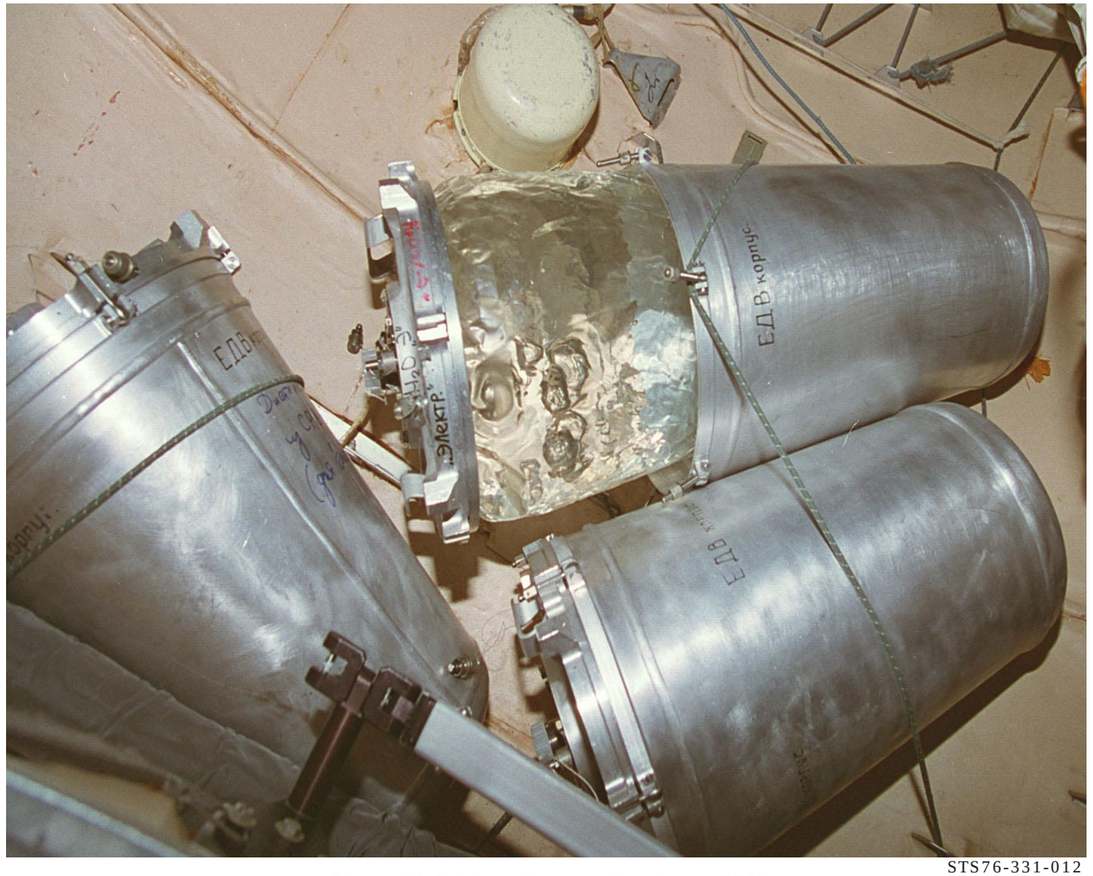
S96-13112

Figure SH-3 Payload Mounting Panel, Top



S96-13111

Figure SH-4 Payload Mounting Panel, Bottom



STS76-331-012

Figure SH-5 Water Stowage Containers (EDV)

PAYLOAD MOUNTING PANELS

P/N: SEM46112056-301
Qty: 2
Mass: 1.9 kg (ea)
Power: N/A
x,y,z: 1.27 x 46 x 27.32 cm
Loc: Priroda, SIC2-II-1, SIC2-II-2
DID#: SLM46111806, SLM46112493

SHUTTLE INFLIGHT FOOD WARMER (SOIFW)

HARDWARE DESCRIPTION

The SOIFW is an aluminum case with two latches and a transportation handle. The body of the case contains a heater assembly and two foam inserts which are used to restrain the food packages during heating.

One insert is located in the enclosure lid and the other is located in the enclosure base. The foam inserts are constructed of melamine foam with a rubber coating to inhibit moisture absorption.

The heating assembly consists of a heating element placed between two aluminum plates, which are connected to each other by rivets along the perimeter. On one of the plates, under the protective white Teflon shield, there are two thermostats and a relay. The heating assembly is attached by a hinge between the base and the lid. On the lid side of the heating assembly, there is a fiberglass border approximately 3 cm wide with holes for convenient usage and protection against burns. Both sides of the heating assembly have restraint springs (two on one side and three on the other side for holding the food packages in place). The food packages can also be placed in the cavities of the foam inserts in the lid. It is possible to simultaneously heat beverages and food packages for four crewmembers.

S95-18593

Figure SH-6 SOIFW Heating Locations

The SOIFW power switch, power indication lamp, circuit breaker, and cable connection are located on the side of the case.

ELECTRICAL CHARACTERISTICS

The SOIFW is designed to operate at nominal operating voltage of 28V DC but can operate within the prescribed range (23-32V DC). The rated power of the SOIFW at the nominal voltage is 200 Watts (maximum power - 274).

The SOIFW is powered from the onboard circuit through the power cable, which is included as part of the SOIFW assembly. The power cable is four meters long and has labels in English and Cyrillic. The cable connectors are also labeled to ensure proper connections. The power cable is designed to handle a 140% current overload and grounding is provided through the power cable. The SOIFW has an individual two-positional power switch (OFF-ON). The power indicator is illuminated when the SOIFW power is ON.

The SOIFW has overload protection in the form of a manually-resettable circuit breaker rated for 10 amperes which is located on the control panel adjacent to the power cable connector. SOIFW temperature control is accomplished with the use of redundant thermostats which power a relay. The thermostats are rated to open at 82.2°C ± 2.8°C (180°F ± 5°F) and close at 73.9°C ± 2.8°C (16 5°F ± 5°F). The thermostats control a relay which supplies power to the heater element.

SYSTEM OPERATION

The SOIFW utilizes a single mode of operation with no temperature adjustment. A cycle of operation entails set-up, food package loading, heating cycle, and unloading.

The set-up entails mounting the SOIFW in a suitable location for use and the proper power cable connection. The SOIFW can be loaded with food packages, as required, using the package restraint springs or merely fitting the packages into the cavities in the foam inserts. After the food packages are loaded into the food warmer and the case is closed and latched, power can be activated using the power switch. Note that the power indication lamp should be lit. If the power indication lamp is not lit, the circuit breaker located parallel to the cable connection should be checked.

S95-18594

Figure SH-8 SOIFW

S95-18595

Figure SH-7 SOIFW Electronics

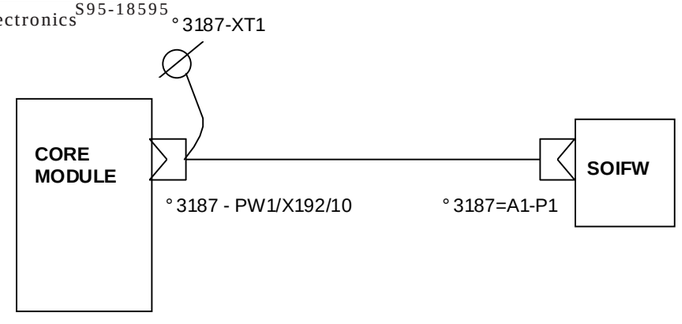


Figure SH-9 SOIFW Wiring Connections

The heating time requirement is two hours for heating a nominal meal for four crewmembers; however, the actual heating time is much shorter (typically 45 minutes to one hour). Food items can be checked for temperature by powering down and opening the SOIFW to check by touch. Care must be taken not to touch the heater deck assembly when testing food. ✵

SHUTTLE ORBITER INFLIGHT FOOD WARMER

P/N: SED39114053-306
Qty: 1
Mass: 5 kg
Power: 200 W
x,y,z: 49 x 15.4 x 34.5 cm
Loc: Mir Core
DID#: SLM39137224

Tool Kits

STS81-372-007

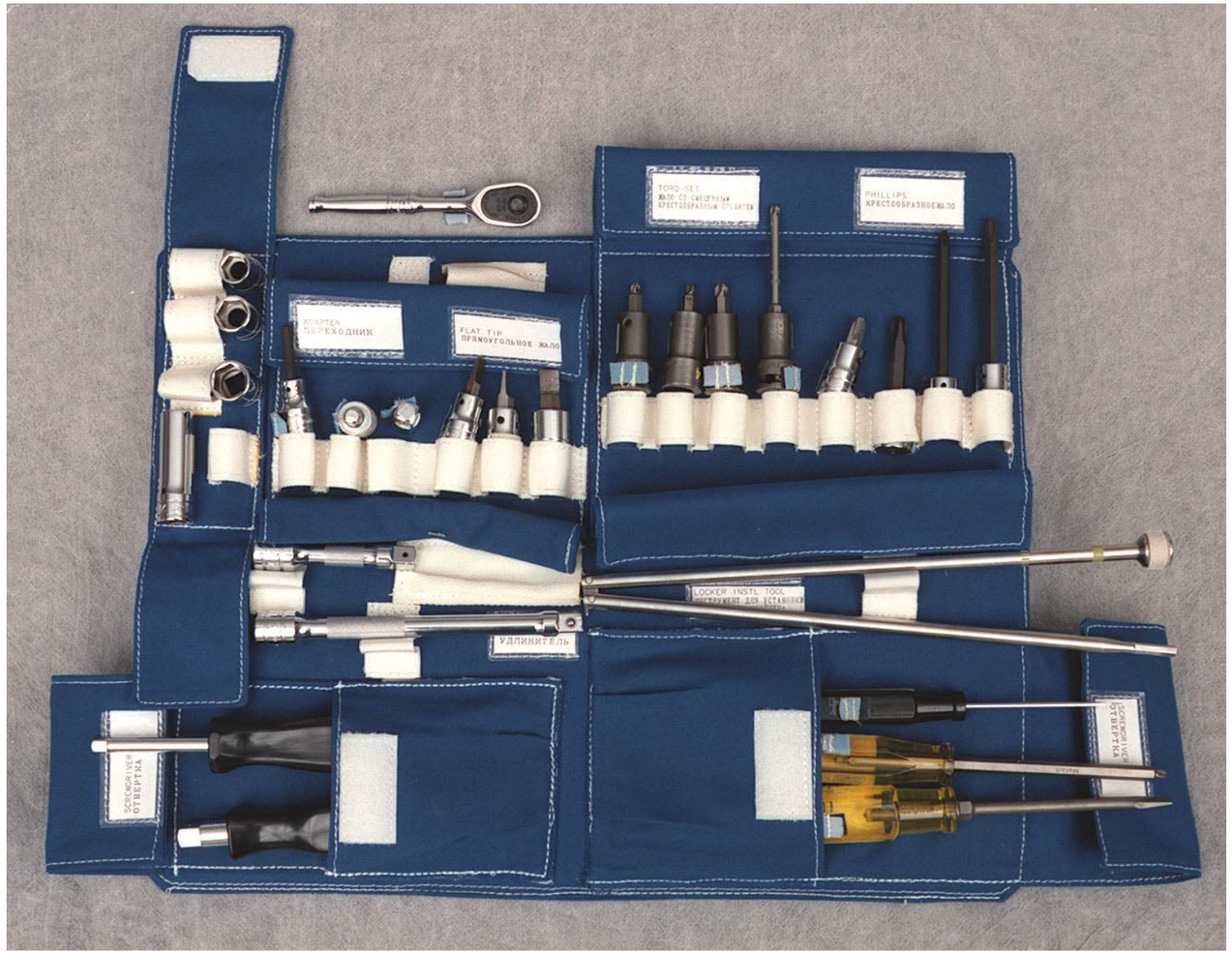
Figure SH-10 Mir's Tool Kit

STS81-372-019

Figure SH-11 Mir's Tool Kit

INFLIGHT MAINTENANCE (IFM) TOOL KIT, FA-1 1994

P/N:	SEM46111409-301
Qty:	1
Mass:	6.90 kg
Power:	N/A
x,y,z:	45 x 31.8 x 10.9 cm
Loc:	Spektr, A1
DID#:	SLM46111661



S95-14076

Figure SH-12 IFM Tool Kit Pallet

PRIRODA INFLIGHT MAINTENANCE (IFM) TOOL KIT HARDWARE DESCRIPTION

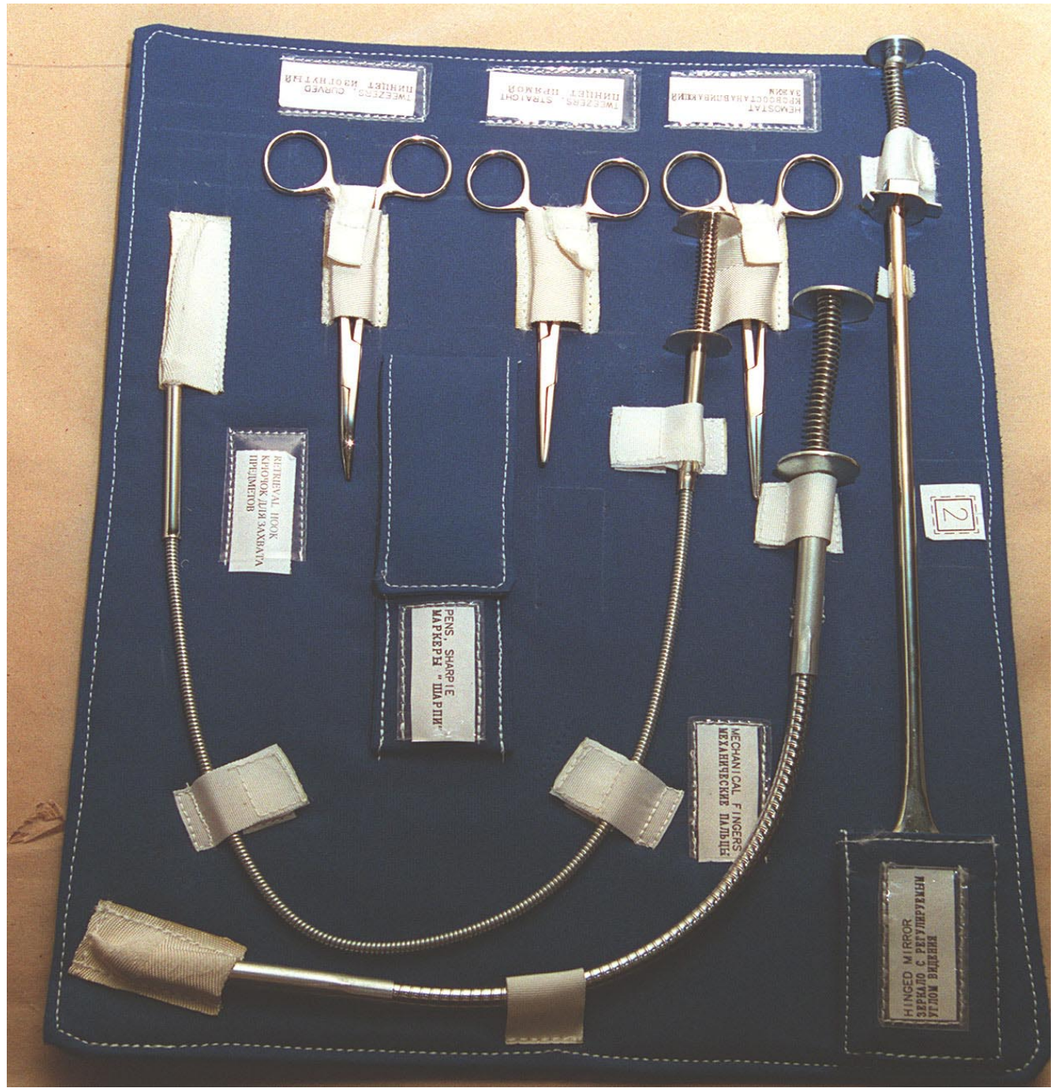
A standard Tool Kit is being provided on board the Priroda Module for use by all hardware developers. The list of tools in the Priroda Inflight Maintenance (IFM) Tool Kit is provided in Table SH.1.

TABLE SH.1
PRIRODA TOOL LIST

Part Number	Description	Flight Qty
35000	Sharpie Black Extra Fine	2
10104-20004-04	Velcro Kit	1
10104-20004-05	Velcro Kit	1
528-20145-11	10” Adjustable Wrench	1
528-20145-14	Connector Pliers	1
528-20145-18	4” Ratchet Wrench	1
528-20146-1	Torque Tip Screwdriver #6	1
528-20146-6	Torque Bit Handle 1/4” Drive	1
528-20146-7	3/8” Driver Handle	1
528-20146-8	Flat Tip Screwdriver	1
528-20146-9	Flat Tip Screwdriver	1
528-20147-15	3/16” Hex Driver	1
528-20147-27	Adapter 1/4” to 3/8”	1
528-20147-29	3/8” to 1/4” Adapter	1
528-20147-34	Phillips Head Driver	1
528-20147-35	Phillips Head Driver	1
528-20147-36	Phillips Head Driver	1
528-20147-37	Torqset Screw Driver #6L	1
528-20147-39	Torqset Screw Driver #2	1
528-20147-40	Torqset Screw Driver #4	1
528-20147-41	Torqset Screw Driver #8	1
528-20148-1	Mechanical Fingers	1
528-41798-8	General Purpose Tape 2”	1
528-50000-2	Ziploc Bags	10
528-50000-4	Ziploc Bags	10
D2685-1A	Hemostat (Straight Kelly Forceps)	1
F42	Flat Head Screwdriver 1/4”	1
F52	Flat Head Screwdriver 5/16”	1
F62	Flat Head Screwdriver 3/8”	1
FS141	7/16” STD Depth Socket, 3/8” Drive	1
SFS141	7/16” Deep Depth Socket, 3/8” Drive	1
FP41B	Phillips Head Screwdriver #4	1
FXK3	Torque Wrench Ext. Bar	1
FXK6	Torque Wrench Ext. Bar	1
GA427A	Tape Measure	1
GA51A	Hinged Mirror	1
MPC6	Curved Serrated Jaws (Tweezers)	1
MPS6	Straight Serrated Jaws (Tweezers)	1
SRP5A	Snap Ring Pliers	1
TE12FUZ	Torque Wrench	1
V625-650899-013	Middeck Locker Installation Tool	1
YA837	Flexible Four-Claw Retrieval Hook	1
FS161	1/2” Std Depth Socket, 3/8” Drive	1
FS181	9/16” Std Depth Socket, 3/8” Drive	1

PRIRODA IFM TOOL KIT

P/N: SEM46113205-301
Qty: 1
Mass: 7.72 kg
Power: 0
x,y,z: 43.18 x 12.07 x 33.02 cm
Loc: Priroda, SIC2-II-2



S96-00215

Figure SH-13 IFM Tool Kit Pallet

THERMAL INTERFACES

Only air cooling is available in the Priroda Module. Fans maintain airflow through the cooling air passage outside the habitable area, and the air is returned to the fan inlet through the habitable volume.

S96-00211

Figure SH-14 IFM Tool Kit Pallet

S96-00209

Figure SH-15 IFM Tool Kit Pallet

Exhaust air from the experiments shall not be vented into the habitable area of the Priroda Module. Using internal fans, the air may be drawn from either the habitable area or the cooling air passage, but exhausted into the cooling air passage only. The maximum pressure difference that experiment fans need to overcome in order to exhaust air into the cooling passages is 2 mm H_20. A gasket or seal shall be provided by the PED to minimize airflow between the cooling air passage and the crew habitable area, such that the maximum leak rate will not exceed 1kg/hr.

In the event a locker or hard-mounted experiment facility must be removed from its location, the resulting breach in the decorative panel should not be exposed for a period longer than one hour. This is to prevent a significant mixing of avionics and cabin air. ✵

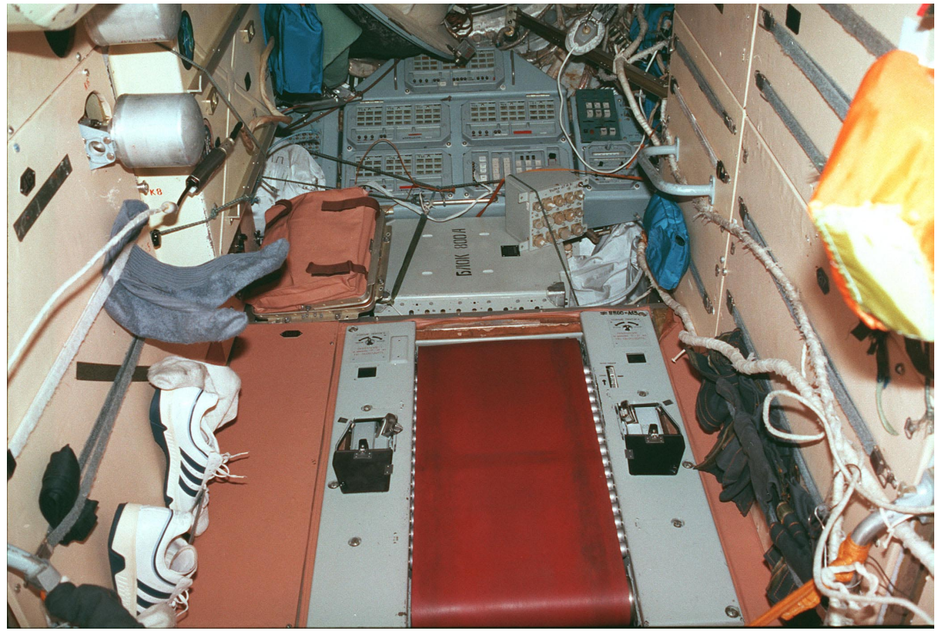
PRIRODA IFM TOOL KIT TAPE 2”

P/N: 367FR
Qty: 2
Mass: .27 kg
Power: N/A
x,y,z: .27 cm
Loc: Priroda, SIC2-IV-4/5
DID#: N/A

TREADMILLS

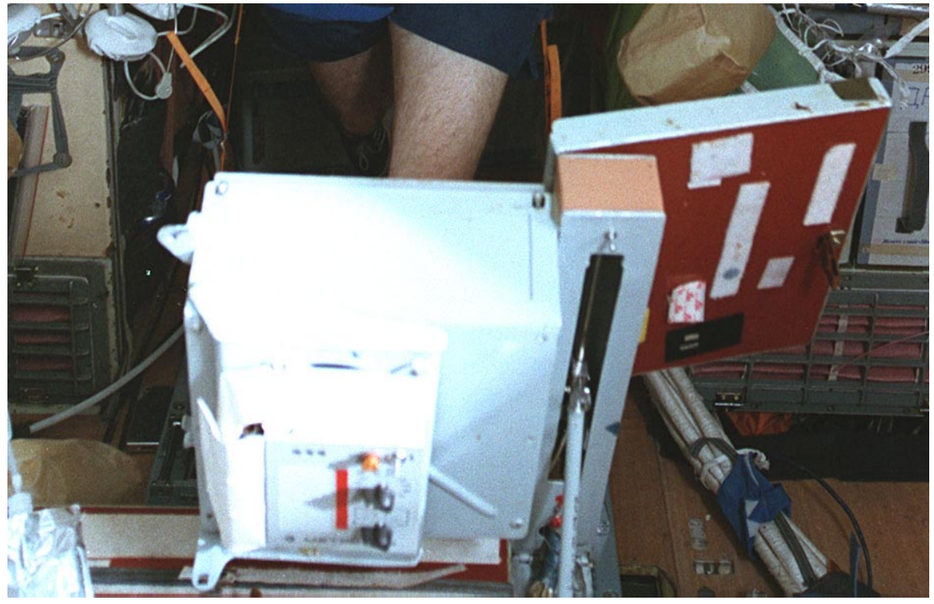
STS79-334-005

Figure SH-16 Core Module Treadmill Control Panel



NM22-160-16

Figure SH-17 Kristall's Treadmill



STS79-334-020

Figure SH-18 Mir Treadmill, Rear of Control Panel