

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION STS-89

PRESS KIT
JANUARY 1998



SHUTTLE / MIR MISSION-08 (S/MM-08)

STS-89 INSIGNIA

STS089-S-001 -- The link between the United States and Russia is symbolically represented on the STS-89 insignia by the space shuttle Endeavour and Russia's Mir space station orbiting above the Bering Strait between Siberia and Alaska. The success of the joint United States-Russian missions is depicted by the space shuttle and Mir colored by the rising sun in the background. A shadowed representation of the International Space Station (ISS) rising with the sun represents the future program for which the Shuttle-Mir missions are prototypes. The inside rim of the insignia describes the outline of the number eight representing STS-89 as the eighth Shuttle/Mir docking mission. The nine stars represent the nine joint missions to be flown of the program and - when combined with the number eight in the rim -- reflect the mission number. The nine stars also symbolize the children of the crewmembers who will be the future beneficiaries of the joint development work of the space programs of the two countries. Along the rim are the crewmembers' names with David A. Wolf's name on the left and Andrew S. W. Thomas' name on the right, the returning and upgoing cosmonaut guest researcher crew members. In between and at the bottom is the name of Salizan S. Sharipov, payload specialist representing Russian Space Agency (RSA), in Cyrillic alphabet. The other crewmembers are Terrence W. Wilcutt, commander; Joe F. Edwards Jr., pilot; and mission specialists Michael P. Anderson, Bonnie J. Dunbar, and James F. Reilly. The red, white and blue of the rim reflect the colors of the American and Russian flags which are also represented in the rim on either side of the joined spacecraft.

The NASA insignia design for space shuttle flights is reserved for use by the astronauts and for other official use as the NASA Administrator may authorize. Public availability has been approved only in the form of illustrations by the various news media. When and if there is any change in this policy, which we do not anticipate, it will be publicly announced.

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RELEASE: J98-3

SEVENTH ASTRONAUT TO FLY ON MIR HIGHLIGHTS FIRST SHUTTLE MISSION OF 1998

The continuing cooperative effort in space exploration between the United States and Russia and a joint spacewalk will be the focus of NASA's first Shuttle mission of 1998 with the launch of Space Shuttle Endeavour on Mission STS-89.

This is the eighth of nine planned missions to Mir and the fifth one involving an exchange of U.S. astronauts. Astronaut Dave Wolf, who has been on Mir since late September 1997, will be replaced by Astronaut Andrew Thomas. Thomas will spend approximately 4 months on the orbiting Russian facility before returning to Earth when Discovery docks to Mir in late May during STS-91.

The STS-89 crew will be commanded by Terrence W. Wilcutt who will be making his third Shuttle flight. The pilot, Joe Frank Edwards Jr., will be making his first flight. There are five mission specialists assigned to this flight. James F. Reilly II, serving as Mission Specialist-1, and Mission Specialist-2 Michael P. Anderson are both making their first flight. Bonnie J. Dunbar is both Mission Specialist-3 and the STS-89 Payload Commander and is making her fifth flight. Salizhan Shakirovich Sharipov, a Russian Cosmonaut, will be Mission Specialist-4 and is making his first flight. Mission Specialist-5 Andrew Thomas is making his second space flight. Shortly after docking, Thomas and Wolf will conduct their handover with Thomas becoming a member of the Mir 24 crew and Wolf becoming STS-89 Mission Specialist-6 through the end of the flight.

Endeavour is targeted for launch on Jan. 22, 1998 from NASA's Kennedy Space Center Launch Complex 39-A. The current launch time of 9:48 p.m. EST may vary slightly based on calculations of Mir's precise location in space at the time of liftoff due to Shuttle rendezvous phasing requirements. The STS-89 mission is scheduled to last 8 days, 19 hours, 48 minutes. An on-time launch on Jan. 22 and nominal mission duration would have Endeavour landing back at Kennedy Space Center on Jan. 31 at 5:36 p.m. EST.

STS-89 will be the first docking of Endeavour with the Mir. All the previous docking missions were with Atlantis. This also will be Endeavour's first flight since STS-77 in May 1996, after which the orbiter went to Palmdale, CA, for refurbishment and modifications during its first Orbiter Maintenance Down Period. An external airlock was installed in the orbiter as part of the modifications it underwent to support International Space Station operations.

Endeavour's rendezvous and docking with the Mir actually begin with the precisely timed launch setting the orbiter on a course for rendezvous with the orbiting Russian facility. Over the next two to three days, periodic firings of Endeavour's small thruster engines will gradually bring the Shuttle within closer proximity to Mir.

The STS-89 mission is part of the NASA/Mir program which consists of nine Shuttle-Mir dockings and seven long-duration flights of U.S. astronauts aboard the Russian space station. The U.S. astronauts will launch and land on a Shuttle and serve as Mir crew members, while the Mir cosmonauts use their traditional Soyuz vehicle for launch and landing. This series of missions will expand U.S. research on Mir by providing resupply materials for experiments to be performed aboard the station as well as returning experiment samples and data to Earth.

Endeavour will again be carrying the SPACEHAB module in the payload bay of the orbiter. The double module configuration will house experiments to be performed by Endeavour's crew along with logistics equipment to be transferred to Mir.

The current Mir 24 mission began when cosmonauts Commander Anatoliy Solovyev and Flight Engineer Pavel Vinogradov were launched on Aug. 5, 1997 in a Soyuz vehicle and docked with the Mir two days

later. They will return to Earth in mid-February. Dave Wolf began his stay on the orbiting Russian facility in late September with the docking of STS-86. Wolf's replacement, Andrew Thomas, will become a member of the Mir 25 crew when Commander Talgat Musabayev and Flight Engineer Nikolai Budarin relieve Solovyev and Vinogradov in mid February. Thomas will return home when Shuttle Discovery docks with Mir in late May.

The STS-89 mission and the work performed by Thomas during his time on the Mir station will include investigations in the fields of advanced technology, Earth sciences, fundamental biology, human life sciences, International Space Station risk mitigation, microgravity sciences and space sciences.

STS-89 will be the 12th flight of Endeavour and the 89th mission flown since the start of the Space Shuttle program in April 1981.

(END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS.)

MEDIA SERVICES INFORMATION

NASA Television Transmission

NASA Television is available through the GE2 satellite system which is located on Transponder 9C, at 85 degrees west longitude, frequency 3880.0 MHz, audio 6.8 MHz.

The schedule for television transmissions from the orbiter and for mission briefings will be available during the mission at Kennedy Space Center, FL; Marshall Space Flight Center, Huntsville, AL; Dryden Flight Research Center, Edwards, CA; Johnson Space Center, Houston, TX; and NASA Headquarters, Washington, DC. The television schedule will be updated to reflect changes dictated by mission operations.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter.

Briefings

A mission press briefing schedule will be issued before launch. During the mission, status briefings by a flight director or mission operations representative and when appropriate, representatives from the payload team, will occur at least once each day. The updated NASA television schedule will indicate when mission briefings are planned.

Internet Information

Information on STS-89 is available through several sources on the Internet. The primary source for mission information is the NASA Shuttle Web, part of the World Wide Web. This site contains information on the crew and its mission and will be updated regularly with status reports, photos and video clips throughout the flight. The NASA Shuttle Web's address is:

<http://shuttle.nasa.gov>

If that address is busy or unavailable, Shuttle information is available through the Office of Space Flight Home Page:

<http://www.osf.hq.nasa.gov/>

General information on NASA and its programs is available through the NASA Home Page and the NASA Public Affairs Home Page:

<http://www.nasa.gov> or <http://www.nasa.gov/newsinfo/index.html>

Information on other current NASA activities is available through the Today@NASA page:

<http://www.nasa.gov/today.html>.

The NASA TV schedule is available from the NTV Home Page:

<http://www.nasa.gov/ntv>.

Status reports, TV schedules and other information also are available from the NASA Headquarters FTP (File Transfer Protocol) server, <ftp.hq.nasa.gov>. Log in as anonymous and go to the directory /pub/pao. Users should log on with the user name "anonymous" (no quotes), then enter their E-mail address as the password. Within the /pub/pao directory there will be a "readme.txt" file explaining the directory structure:

- Pre-launch status reports (KSC): <ftp.hq.nasa.gov/pub/pao/statrpt/ksc>
- Mission status reports(JSC): <ftp.hq.nasa.gov/pub/pao/statrpt/jsc>
- Daily TV schedules: <ftp.hq.nasa.gov/pub/pao/statrpt/jsc/tvsked>

NASA Spacelink, a resource for educators, also provides mission information via the Internet. Spacelink may be accessed at the following address:

<http://spacelink.nasa.gov>.

Access by CompuServe

Users with CompuServe accounts can access NASA press releases by typing "GO NASA" (no quotes) and making a selection from the categories offered.

STS-89 QUICK LOOK

Launch Date/Site:	January 22, 1998/KSC Launch Pad 39-A
Launch Time:	Approximately 9:48 P.M. EST
Launch Window:	Approximately 5 minutes
Orbiter:	Endeavour, (OV-105), 12th flight
Orbit Altitude:	160 nautical miles, 213 n.m. for rendezvous
Orbit Inclination:	51.6 degrees
Mission Duration:	Approximately 8 days, 19 hours, 48 minutes
Landing Date:	January 31, 1998
Landing Time:	Approximately 5:36 P.M. EST
Primary Landing Site:	Kennedy Space Center, Florida
Abort Landing Sites:	Return to Launch Site - KSC Transoceanic Abort Sites - Zaragoza, Spain Ben Guerir, Morocco Moron, Spain Abort-Once Around - Kennedy Space Center
Crew:	Terrence Wilcutt, Commander (CDR), 3rd flight Joe Edwards, Pilot (PLT), 1st flight Jim Reilly, Mission Specialist 1 (MS 1), 1st flight Mike Anderson, Mission Specialist 2 (MS 2), 1st flight Bonnie Dunbar, Payload Commander, (MS 3), 5th flight Salizhan Sharipov, Mission Specialist 4, (MS 4), 1st flight Andy Thomas, Mission Specialist 5 (up), (MS 5), 2nd flight Dave Wolf, Mission Specialist 6 (down), (MS 6), 2nd flight
EVA Crewmembers:	Jim Reilly (EV 1), Mike Anderson (EV 2)
Cargo Bay Payloads:	Spacehab Double Module Orbiter Docking System
In-Cabin Payloads:	Microgravity Plant Nutrient Experiment MPNE Shuttle Ionospheric Modification with Pulsed Local Exhaust (SIMPLEX) Closed Equilibrated Biological Aquatic System (CEBAS) TeleMedicine Instrumentation Pack (TMIP) Global Positioning System Development Test Objective (GPS DTO) Human Performance (HP) Surface and Air Sampling (MSD-022) EarthKAM Orbiter Space Vision System(OSVS) Shuttle Condensate Collection (RME-1331) Thermal Electric Holding Module (TEHM) Space Linear Acceleration Mass Measurement Device (DSO 914) Co-Culture Experiments (CoCult) Biochemistry of 3-D Tissue Engineering (BIO3D)

Spacehab Payloads: Advanced X-Ray Detector (ADV XDT)
 Advanced Commercial Generic Bioprocessing Apparatus (ADV CGBA)
 Enhanced Orbiter Refrigerator/Freezer (EORF)
 Mechanics of Granular Materials (MGM)
 Intra-Vehicular Radiation Environment Measurements by the
 Real-Time Radiation Monitor (RME-1312)
 Space Acceleration Measurement System (SAMS)
 Volatile Organic Analyzer (VOA)
 Volatile Removal Assembly (VRA)

CREW RESPONSIBILITIES

Payloads	Prime	Backup
Rendezvous	Wilcutt	Edwards
Rendezvous Tools	Edwards	Dunbar, Anderson
Spacehab	Dunbar	Reilly, Anderson
Logistics Transfers	Reilly	Dunbar
EVA Intravehicular Crewmember	Reilly (EV 1) Dunbar	Anderson (EV 2) -----
Russian Language	Dunbar	Reilly
Orbiter Docking System	Reilly, Anderson	Dunbar, others
EarthKam	Wilcutt	Dunbar
CEBAS	Anderson	Edwards
SIMPLEX	Wilcutt	Anderson
Earth Observations	Reilly	Wilcutt
Ascent Seat on Flight Deck	Reilly	-----
Entry Seat on Flight Deck	Dunbar	-----
SPACEHAB	Dunbar	Reilly
TMIP	Wilcutt	Dunbar

STS-89 ORBITAL EVENTS SUMMARY
(based on a January 22, 1998 Launch)
(All times shown are approximate)

Event	MET	Time of Day (EST)
Launch	0/00:00	9:48 PM, January 22
Mir Docking	1/16:55	2:38 PM, January 24
Crew News Conference	5/16:15	1:58 PM, January 28
Mir Undocking	6/13:37	11:20 AM, January 29
KSC Landing	8/19:48	5:36 PM, January 31

**DEVELOPMENTAL TEST OBJECTIVES /
DETAILED SUPPLEMENTARY OBJECTIVES/
RISK MITIGATION EXPERIMENTS**

DTO 258	Shuttle Proximity Operations with One Nose X Jet
DTO 312	External Tank TPS Performance
DTO 700-11	Orbiter Space Vision System Flight Testing
DTO 700-12	Global Positioning System/Inertial Navigation System Testing
DTO 700-14	Single String Global Positioning System
DTO 805	Crosswind Landing Performance
DTO 914	Space Linear Acceleration Mass Measurement Device
DTO 1118	Photographic and Video Survey of Mir Space Station
DSO 331	LES and Sustained Weightlessness on Egress Locomotion
DSO 334	In-Flight Evaluation of the Telemedicine Instrumentation Pack
DSO 484C	Assessment of Sleep Quality and Circadian Rhythms in Astronauts
DSO 496	Individual Susceptibility To Post-Spaceflight Orthostatic Intolerance
RME 1303	Shuttle/Mir Experiment Kit Transportation
RME 1307	Optical Properties Monitor (return only)
RME 1312	Real-time Radiation Monitor Device (RRMD)
RME 1326	Volatile Removal Assembly (VRA)
RME 1331	Shuttle Condensate Collection for ISS

PAYLOAD AND VEHICLE WEIGHTS

	<u>Pounds</u>
Orbiter (Endeavour) empty and 3 SSMEs	182,62
Shuttle System at SRB Ignition	4,512,528
Orbiter Weight at Landing with Cargo	251,612
Orbiter Docking System	4,016
Spacehab Double Module	12,917
CEBAS	79
MPNE	70

MISSION SUMMARY TIMELINE

Flight Day 1

Launch/Ascent
OMS-2 Burn
Payload Bay Door Opening
Spacehab Activation
Rendezvous Maneuver

Flight Day 2

Rendezvous Tool Checkout
Centerline Camera Installation
Secondary Experiment Activation
Water Bag Fills for Transfer to Mir

Flight Day 3

Rendezvous and Docking
Hatch Opening/Welcoming Ceremony
Soyuz Seatliner Transfer and Installation
Thomas/Wolf Crew Transfer
Logistics Transfers

Flight Day 4

Logistics Transfers
Thomas/Wolf Handover

Flight Day 5

Logistics Transfers
Thomas/Wolf Handover

Flight Day 6

Logistics Transfers
Thomas/Wolf Handover

Flight Day 7

Thomas/Wolf Handover
Final Logistics Transfers
Crew News Conference/Farewell Ceremony
Hatch Closure

Flight Day 8

Undocking and Flyaround
Transfer Item Stowage
Off-Duty Time

Flight Day 9

Flight Control System Checkout
Reaction Control System Hot-Fire
Cabin Stowage

Flight Day 10

Payload Bay Door Closing
Deorbit Burn
KSC Landing

SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, Orbiter and its payload. Abort modes for STS-89 include:

- Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with the orbital maneuvering system engines.
- Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit of the Earth before landing at Kennedy Space Center, Fla.
- Transoceanic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Zaragoza or Moron in Spain or Ben Guerir in Morocco.
- Return-To-Launch-Site (RTL) -- Early shutdown of one or more engines, and without enough energy to reach a TAL site, would result in a pitch around and thrust back toward Kennedy until within gliding distance.

STS-89 MIR RENDEZVOUS, DOCKING & UNDOCKING

Endeavour's rendezvous and docking with the Russian Space Station Mir actually begins with the precisely timed launch of the shuttle on a course for the Mir, and, over the next two days, periodic small engine firings that will gradually bring Endeavour to a point eight nautical miles behind Mir on docking day, the starting point for a final approach to the station.

Mir Rendezvous & Docking-- Flight Day 3

About two hours before the scheduled docking time on Flight Day Three of the mission, Endeavour will reach a point about eight nautical miles behind the Mir Space Station and conduct a Terminal Phase Initiation (TI) burn, beginning the final phase of the rendezvous. Endeavour will close the final eight nautical miles to Mir during the next orbit. As Endeavour approaches, the shuttle's rendezvous radar system will begin tracking Mir and providing range and closing rate information to Endeavour. Endeavour's crew also will begin air-to-air communications with the Mir crew using a VHF radio.

As the Shuttle reaches close proximity to Mir, the Trajectory Control Sensor, a laser ranging device mounted in the payload bay, will supplement the shuttle's onboard navigation information by supplying additional data on the range and closing rate. As Endeavour closes in on the Mir, the Shuttle will have the opportunity for four small successive engine firings to fine-tune its approach using its onboard navigation information. Flying a slightly modified rendezvous profile for improved efficiency, Endeavour will aim for a point directly below Mir, along the Earth radius vector (R-Bar), an imaginary line drawn between the Mir center of gravity and the center of Earth. Approaching along the R-Bar, from directly underneath the Mir, allows natural forces to assist in braking Endeavour's approach. During this approach, the crew will begin using a hand-held laser ranging device to supplement distance and closing-rate measurements made by other Shuttle navigational equipment.

Endeavour will intercept the R-Bar at a point 600 feet below Mir. Commander Wilcutt will fly the Shuttle using the aft flight deck controls as Endeavour begins moving up toward Mir. Because of the approach from underneath Mir, Wilcutt will have to perform very few braking firings. However, if such firings are required, the shuttle's jets will be used in a mode called "Low-Z," a technique that uses slightly offset jets on Endeavour's nose and tail to slow the spacecraft rather than firing jets pointed directly at Mir. This technique avoids contamination of the space station and its solar arrays by exhaust from the Shuttle steering jets.

Using the centerline camera fixed in the center of Endeavour's docking mechanism, Wilcutt will center Endeavour's docking mechanism with the Docking Module mechanism on Mir, continually refining this alignment as he approaches within 300 feet of the station.

When Endeavour is 170 feet from the station, the Shuttle will briefly stop and stationkeep. At that time, a final go or no-go decision to proceed with the docking will be made by flight control teams in both Houston and Moscow.

At a distance of about 30 feet from docking, Wilcutt will again stop Endeavour briefly to adjust the docking mechanism alignment, if necessary.

When Endeavour proceeds with docking, the Shuttle crew will use ship-to-ship communications with Mir to inform the Mir crew of the Shuttle's status and to keep them informed of major events, including confirmation of contact, capture and the conclusion of damping. Damping, the halt of any relative motion between the two spacecraft after docking, is performed by shock absorber-type springs within the docking device. Mission Specialist James Reilly will oversee the operation of the Orbiter Docking System from onboard Endeavour.

Undocking and Separation

Once Endeavour is ready to undock from Mir, the initial separation will be performed by springs that will gently push the Shuttle away from the docking module. Both the Mir and Endeavour will be in a mode called "free drift" during the undocking, a mode that has the steering jets of each spacecraft shut off to avoid any inadvertent firings.

Once the docking mechanism's springs have pushed Endeavour away to a distance of about two feet from Mir, where the docking devices will be clear of one another, Endeavour's steering jets will be turned back on and fired in the Low-Z mode to begin slowly moving away from Mir.

The shuttle will continue to back away through a corridor similar to that used during approach until it reaches a distance of approximately 240 feet below the Mir. If propellant margins permit, pilot Joe Edwards will then perform a flyaround of the station before a final maneuvering burn is performed and Endeavour will depart the vicinity of the station.

SHUTTLE-MIR SCIENCE PROGRAM

Scientific research has always been a major objective of both the United States and Russian space programs. The Phase 1 NASA- Mir science program is a joint research program between Russia and the US that was initiated to conduct long-duration space research in the most efficient manner possible, utilizing both countries' resources and personnel. Using the Russian space station Mir as a platform for jointly developed hardware and science investigations allows US researchers to conduct experiments in microgravity for several months at a time. This currently is not possible to do within the US space program, since the average Shuttle mission lasts only a few weeks.

Long-duration space flight presents a unique opportunity for the US, as many human adaptations to spaceflight experiments, along with crystal growth, space sciences, and other biological investigations cannot be performed within the short time span of a typical Shuttle mission. In return for the use of facilities on their space station, the Russian Space Agency has access to nine Shuttle flights that will dock to the station. These Shuttle flights allow additional resupply for both station maintenance and science experiments, along with transportation of an American crewmember to the Mir. The American is trained as a Mir crewmember to perform routine maintenance on the station, in addition to performing joint science activities, and will be a permanent resident until his replacement arrives on the next Shuttle. The Shuttle provides a unique opportunity for the Russian space program, since large science payloads can now be delivered to the Mir, along with providing significant refrigerator and freezer space for samples taken to the station or returned to Earth.

Both partners in this program are being given the opportunity to do things that they could not do independently. This international cooperation provides a wealth of knowledge about space flight, and is the first of its kind of this magnitude. Not since the days of Apollo-Soyuz has an international cooperation between space programs returned so much. These first steps coupling both programs to increase their respective yields leads directly to the framework for the International Space Station, the first element of which is slated for launch in 1998.

The American long duration astronauts perform the majority of the experiment operations while on orbit, while their Russian counterparts primarily concern themselves with station upkeep and maintenance. All are equal contributors to the joint program and have dedicated their time during intensive training in both the US and Russia, as well as by staying on board the Mir for several months.

Dr. Norm Thagard was the American who took the first step in this era of joint space cooperation by staying onboard the Mir for 116 days (which set the space duration record for an American). He was also the only astronaut to travel to Mir on a Soyuz rocket, with his Mir 18 crewmates. Dr. Thagard was followed by Dr. Shannon Lucid, who stayed on the Mir for 188 days, breaking Dr. Thagard's record and setting a new record as the longest stay in space for a woman. Colonel John Blaha replaced Shannon Lucid in September 1996. Dr. Jerry Linenger replaced John Blaha in January 1997. Dr. C. Michael Foale replaced Jerry Linenger in May 1997 and he was replaced by Dr. David Wolf in September 1997. These American crewmembers' stays on Mir have demonstrated to the world the commitment of both countries to work together for the betterment of human kind through scientific advancement.

STS-89 marks the eighth of nine planned missions to dock an American Space Shuttle with Russia's Mir space station. This mission will deliver Astronaut Andrew Thomas to Mir as the NASA 7 astronaut and will return Dr. David Wolf to Earth. Andrew Thomas will stay on board until STS-91, the ninth and final US Shuttle mission to the Mir space station, returns him to Earth. In addition to the NASA 7 crewmember, the Shuttle will transport approximately 6,000 pounds of research equipment and supplies to the station.

During the docked phase of STS-89, astronauts and cosmonauts will transfer from the Mir space station to the Shuttle the science samples collected by the Mir 24/NASA 6 crew. After return to Earth, the samples will be analyzed by researchers on the ground. The Shuttle crew will also transfer hardware and supplies to Mir in support of the health and well being of the Mir 25/NASA 7 crew, station maintenance,

and future investigations on the Mir. This research will focus on 27 studies in the areas of advanced technology, Earth sciences, human life sciences, microgravity research, and ISS risk mitigation.

The commercial initiated research from the advanced technology discipline will evaluate new technologies and techniques using the Mir space station and the Shuttle as a test bed. Such research in reduced gravity will contribute to an enhanced knowledge base for implementation on the International Space Station and other space vehicles.

Earth sciences research in ocean biochemistry, land surface hydrology and meteorology will also be performed. Observation and documentation of transient natural and human-induced changes will be accomplished with the use of hand-held photography. Earth orbit allows for documentation of atmospheric conditions, ecological changes, seasonal changes over long time periods, and unpredictable events.

Human life sciences research consists of investigations that focus on the crewmembers' adaptation to weightlessness in terms of skeletal muscle and bone changes, immune response, psychological interactions and metabolism. This set of investigations will continue the characterization of the integrated human response to a prolonged presence in space.

The International Space Station risk mitigation discipline consists of several technology demonstrations associated with human factors and maintenance of crew health and safety aboard the space station. In order to improve the design and operation of the International Space Station, information is gathered to fully evaluate the Mir interior and exterior environments. This discipline includes investigations of radio interference, particle impact on the station, docked configuration stability, and radiation.

Microgravity research has the general goal of advancing scientific understanding through research in biotechnology, crystal growth and materials science. The ambient acceleration and vibration environment of Mir will also be characterized to support future research programs.

The success of all the past Shuttle/Mir missions is due to the dedication of all the researchers involved in these different areas, as well as all the mission support personnel, crew trainers and the crew themselves. The Phase 1 program is a difficult and unique program because of its international scope and length of mission duration, but it is providing both an excellent scientific return, and a training ground for future operations on the International Space Station.

STS-89 GET AWAY SPECIAL EXPERIMENTS

Four different Get Away Special (GAS) payloads will be onboard the Space Shuttle Endeavour during the STS-89 mission. Students and scientists from the University of Michigan, Germany and China built and designed the scientific projects. The Get Away Special Program is managed by engineers at the Goddard Space Flight Center in Greenbelt, Md. The purpose of the program is to provide an opportunity for individuals, organizations and countries to send scientific research and development experiments into space aboard a NASA Space Shuttle for a comparatively modest cost. For more information about the Get Away Special Program, consult the following Internet address: <http://sspp.gsfc.nasa.gov>

G-093

The G-093 payload was designed and built by the students of the University of Michigan, Ann Arbor. Also known as the Vortex Ring Transit Experiment (VORTEX), G-093 will attempt to answer some basic questions about fluid atomization which is the process whereby a liquid is converted into small droplets. VORTEX will investigate the propagation of a vortex ring through a liquid-gas interface in microgravity.

The scientific objective of the experiment is to conduct observations of the liquid drop formation process in the case of surface-tension-dominated interface dynamics. The data returned should lead to better methods for atomizing, the effect of a liquid being turned into a mist, fuel. This process is important in the operation of internal combustion engines, as well as producing powders of desired characteristics and manufacturing encapsulated microdroplets for drug delivery.

The main components of the G-093 experiment are a fluid test cell system, a laser-based illumination system, a charge coupled device (CCD) digital imaging system, and a computer based acquisition and control system. For each experiment, the fluid test cell is partially filled with silicone oil to establish the liquid-gas interface. The vortex ring generator, which is located at the bottom of the test cell, consists of a piston moving inside the cylinder cavity. For each test, the piston lowers itself in the cylinder at which point the cylinder is filled with silicone oil seeded with silver-coated hollow glass microspheres. The rapid upward motion of the piston generates the vortex ring to the liquid/gas interface. The laser system is used to illuminate a cross section of the fluid cell. The CCD camera captures digital images of the fluid motion and the drop formation process which are then stored in the computer. A data acquisition system simultaneously records the liquid temperature and the acceleration in the fluid test cell. All data is stored on hard disk for analysis after the canister is returned to Earth.

The principal investigator for G-093 is Sven Bilen from the University of Michigan. Susan Olden from Goddard Space Flight Center is the mission manager and Lee Shiflett, also from Goddard, is the technical manager.

G-141

The German Aerospace Center, Bonn, Germany, in conjunction with the University Giessen, Germany, have designed the G-141 experiment or the Structure of Marangoni Convection in Floating Zones payload.

Marangoni convection is a gravity independent natural convection phenomenon. A liquid with a free surface will show an inner (bulk) motion if one applies a temperature differential just to the free surface of the liquid. This effect is called Marangoni convection. Marangoni convection is relevant for melt processing (i.e., crystal growth), because it influences the shape of the growth and the homogeneity.

In the commercial production technique for high quality silicon crystals (the basic material for electronic chips), temperature differences are unavoidable. For this reason, Marangoni convection will influence the crystallization process and thereby the quality of the crystals obtained.

Depending mainly on temperature differences and geometry, the inner motion of the liquid will show different flow patterns (ranging from regular to chaotic) in a transparent model system. Microgravity conditions are needed to eliminate buoyancy convection (bulk liquid will rise like a hot air balloon) and allows the researchers to study Marangoni convection without disturbances.

D. Schwabe and S. Frank from the University of Giessen are the principal investigators for the G-141 payload. The mission manager is Susan Olden at Goddard. The technical manager is Charles Knapp also from Goddard.

G-145

The experiment to be flown as GAS payload G-145 is entitled Glass Fining. G-145 is a collaboration of the German Aerospace Center and the Technical University of Clausthal, Federal Republic of Germany. The scientific objective of the experiment is to gain further insight into the process of glass fining or the removal of all visible gaseous bubbles from a glass melt. Glass fining is one of the most complicated, yet one of the most important processes in technical glass melting.

Refining is the removal of gas bubbles from the glass melt to improve the glass quality, a process that has been largely empirical until now.

A cylindrical sample of a soda-lime-silica melt with an artificial oxygen bubble at its center will be heated up to 2,370 degrees Fahrenheit in a furnace and kept at this temperature for about two hours. The overall duration of the experiment will be about 3.5 hours, with about one hour to heat the sample up to the desired temperature. The cooling period will be observed for about half an hour. At 2,370 degrees Fahrenheit, the glass melts and oxygen dissolves in the melt causing a shrinkage of the bubble. The process of shrinking will be recorded by taking pictures to achieve high resolution. For continuous observation of the shrinking process, a video-camera and a video cassette recorder have been added to the existing experimental set-up. The principal investigator is G.H. Frischat of the Technical University of Clausthal. The mission manager is Susan Olden of Goddard. Charles Knapp, also of Goddard, is the technical manager of G-145.

G-432

Get Away Special experiment 432 was built and designed by the Chinese Academy of Sciences, Beijing, China. This payload consists of five separate experiments. Three out of the five of the experiments consist of growing crystals.

Super Cooling is the first experiment contained within the G- 432 payload. Super Cooling is the temperature difference between the melting point and the solidification temperature. By comparison with experimental results on Earth, one can investigate the maximum degree of super cooling that can be obtained near pure diffusion conditions.

Experiment two is the Processing of High Critical Test. The Chinese are working on superconductors that work at high temperatures. Superconductors are materials that conduct electricity very quickly with little loss of heat. Presently, superconductors have to be kept very cold and are expensive. If the experimenters can process superconductors that can perform at higher temperatures, computers can be made much faster, as well as faster trains that hover off the tracks.

The Growth of Gallium Antimony experiment was designed to grow and study crystals. The scientists hope to grow a more homogeneous crystal in space and on Earth. They will look at the influence of microgravity on such growths.

The Liquid Phase Epitaxy experiment will grow a crystal rod in space and compare it to a crystal rod grown on Earth.

Lastly, the Wettability Test will be performed on different materials such as nickel, iron, etc. The wettability test shows how big a bubble forms, whether the liquid beads up, whether it stays together and so on. A camera has been set up to take pictures of the test. Testing will be done at several temperatures.

The principal investigator is Peiwen Ge of the Chinese Academy of Sciences. The mission manager is Susan Olden at Goddard . Charles Knapp, from Goddard, is the technical manager of this payload.

CLOSED EQUILIBRATED BIOLOGICAL AQUATIC SYSTEM (CEBAS)

The Closed Equilibrated Biological Aquatic System is a secondary middeck payload which fits inside a standard middeck locker. The payload hardware has been developed by the German Space Agency (DLR formerly DARA).

The CEBAS Minimodule, a habitat for aquatic organisms, enables scientists to conduct various gravity-related experiments in the areas of zoology, botany and developmental biology, as well as in interdisciplinary areas such as scientific research on artificial ecosystems. This research will be carried out for the most part on biological objects with various research goals and emphasis.

CEBAS provides energy and food for animals (fish and snails) as well as plants. The experiment will support a mission duration of up to 3 weeks (including launch delays and contingency days). The organisms will return alive, which means that no chemical fixation of the samples is foreseen.

MICROGRAVITY PLANT NUTRIENT EXPERIMENT (MPNE)

The main goal of the Microgravity Plant Nutrient Experiment is to test a nutrient delivery technology that will support plant growth in space. Plants are grown in MPNE to validate the use of a porous tube delivery system and not specifically for biological research. MPNE is stowed in a standard Space Shuttle middeck locker with an internal layer of 1/2 inch pyrell foam. The MPNE hardware includes a plant enclosure, fluid system, light bank, Command and Data Management System (CDMS), power converter, batteries, instrumentation, fans and payload container.

MPNE is launched with a dry nutrient delivery system and wheat seeds packed on germination paper. The experiment is activated on flight day four, initiating germination of the seeds. A closed-loop feedback control system is used during the experiment to maintain the proper amount of nutrient solution on the surface of the porous tubes. MPNE contains enough nutrient solution to maintain healthy plant growth for 7 continuous days. The plant tissue returns to Earth fresh and undergoes post-flight analysis. During the mission, the crew will be available at regular intervals to monitor and control the experiment operation.

EarthKAM

As part of the STS-89 Space Shuttle mission, students from 51 middle schools in three nations will have the unique opportunity to experience the excitement of the space program and investigate our planet from their classrooms.

An education R&D program called EarthKAM, building on the success of KidSat, will allow these students to gain a new perspective on planet Earth by operating a digital camera mounted in the overhead window of the Space Shuttle. The students engage in selecting sites around the world to be photographed during Shuttle flights, participate in solving real-world problems that arise, and use tools of modern science, (computers and the Internet) to study the images and the Earth Science processes that they illustrate. EarthKAM fosters a cooperative, team environment that models both space operations and scientific research, and promotes student growth, discovery and achievement.

EarthKAM's primary sponsors are the University of California at San Diego; TERC; Johnson Space Center, Houston, TX; Langley Research Center, Hampton, VA; Goddard Space Flight Center, Greenbelt, MD, and the Jet Propulsion Laboratory, Pasadena, CA. Other NASA Center education offices also are supporting the EarthKAM program at various schools in their geographic location.

EarthKAM is supported by the Office of Human Resources and Education, with support from the Offices of Mission to Planet Earth and Space Flight.

Additional information about the EarthKam education program can be found at the following URL:

<http://www.kidsat.ucsd.edu/kidsat/>.

MECHANICS OF GRANULAR MATERIALS

Mechanics of Granular Materials

Principal Investigator: Dr. Stein Sture, University of Colorado at Boulder

Project Scientist and co-investigator: Dr. Nicholas C. Costes, Marshall Space Flight Center, Huntsville, Ala.

The Mechanics of Granular Materials experiment is aimed at understanding the behavior of granular materials - such as sand or salt - under very low confining pressure. Confining pressure is the force that keeps a granular material "sticking together."

The experiment has applications in a wide range of fields, including earthquake engineering; coastal and off-shore engineering; mining; transportation of granular materials; soil erosion; the handling of granular materials such as grains and powders; off-road vehicles; geology of the Earth; and planetary geology and exploration. Findings from the experiment may lead to improved selection and preparation of building sites, better management of undeveloped land, and improved handling of materials in chemical, agricultural and other industries.

There are many examples of encounters with granular pressures in everyday life: Expose a vacuum-packed coffee bag to air, and the contents suddenly change from a brick-like solidity to behaving almost like a liquid. On Earth, soil can behave much the same way: An earthquake's shock waves can turn compacted, rock-like earth into liquid as microscopic gaps between soil grains expand and contract, forcing water or air in and out of the soil.

On Earth, researchers have been unable to study the true frictional forces between soil grains because Earth's gravity triggers the collapse of granular materials when they become unstable. But in studies that began on Space Shuttle Atlantis during the STS-79 mission in September 1996, researchers were able to simulate and record key moments - moments that occur in a fraction of a second during an earthquake - when soil behaves like liquid as the ground vibrates.

This investigation continues on the STS-89 mission. Researchers will extend their study of the effects of compression forces on three granular material specimens under low confining pressure in the microgravity environment of space. Three additional specimens will undergo rapid pumping that simulates earthquake-type loading. The experiment is automated, but requires some participation by the crew during its activation and deactivation. Crew members also will monitor the samples during processing. Scientists on the ground will take measurements of the loads, specimen deformations and instabilities. To better understand how soil mechanics is influenced by friction, pressure and load, the specimens will undergo further analysis following the mission.

Samples from the first Mechanics of Granular Materials experiment, on STS-79, have been analyzed by researchers at Los Alamos National Labs in New Mexico. X-ray computed tomography scans, or CT scans, of the samples - allowing a view inside the specimens - resulted in valuable findings. Samples returned from the STS-89 mission will undergo similar study.

ASTROCULTURE(TM)TM

ASTROCULTURETM

Principal Investigator: Dr. Ray Bula, University of Wisconsin-Madison, Madison, Wisconsin

Plants will play an important role in future long-duration space flights, providing crews with oxygen, food, pure water and assisting in carbon dioxide removal from space habitats. It is therefore important to develop an effective plant growth facility. The ASTROCULTURETM flight unit is an apparatus that provides a controlled environment in which to grow plants in near-zero gravity. It was developed by the Wisconsin Center for Space Automation and Robotics, a Commercial Space Center established jointly by NASA and the University of Wisconsin in Madison. The ASTROCULTURETM hardware is based on commercially available components -- significantly reducing the development costs.

The STS-89 Mir-docking mission will transport the ASTROCULTURETM flight unit to orbit. Once the Shuttle has docked with Mir, the facility will be transferred to the Russian space station to begin an 80-day experiment to determine if wheat plants will produce seed in microgravity.

The ASTROCULTURETM unit has flown on five previous Shuttle flights -- USML-1, USML-2 and the SPACEHAB 1, 2 and 3 missions -- to validate the performance of plant growth technologies in the unique environment of space. Each of the flight experiments has involved the incremental addition of important subsystems required to provide the necessary environmental control for plant growth. During these flights, lighting, temperature, humidity, nutrient composition and supply, and carbon dioxide and atmospheric contaminant control subsystems were successfully evaluated. The Mir experiment will be the first long-term test of ASTROCULTURETM.

Once the ASTROCULTURETM facility has been transferred to Mir, crew members will activate the unit. The fluid delivery systems will be among the subsystems to begin operation. After water is introduced into the growth chamber, wheat seeds that were planted prior to take-off will germinate.

As the wheat plants grow, the crew will monitor the growth chamber's environment and the plants' development. On a regular basis, the plants' growth cycle will be recorded on video.

After 80 days, crew members will deactivate the system by turning off the water supply. The mature wheat plants will dry out and be returned to Earth in the enclosed chamber on STS-91, scheduled for launch in May 1998. Once back on Earth, the plants grown on Mir will be compared with wheat plants grown on Earth.

The information from the ASTROCULTURETM flight experiments will become the basis for developing large scale plant-growing units required in a life support system. But, development of the ASTROCULTURETM technology has already begun to pay dividends. High intensity light emitting diodes -- developed as plant lighting for the facility may soon be used in cancer treatment, saving lives on Earth. A treatment technique called Photodynamic Therapy uses tiny, densely packed light emitting diodes to activate light-sensitive, tumor-treating drugs.

The ASTROCULTURETM program is part of a cooperative experiment with the Secondary Payload Program of NASA's Office of Life and Microgravity Sciences and Applications and the Space Product Development Office of the Marshall Space Flight Center in Huntsville, Ala.

X-RAY DETECTOR TEST

X-ray Detector Test

Principal Investigator: Dr. Larry DeLucas, Director of the Center for Macromolecular Crystallography, University of Alabama at Birmingham, Birmingham, Ala.

One sophisticated piece of laboratory equipment being built for the International Space Station is the X-ray Crystallography Facility. It will be used to grow and analyze protein crystals in space, activities which will benefit from the Space Station's permanent presence in orbit and which may lead to the development of new and better drugs on Earth.

The X-ray detector is one of the essential elements for this facility. It detects X-rays reflected from protein crystals and helps to determine their structure, or makeup. The X-ray Detector Test will be conducted during STS-89 to measure the sensitivity of the device to background space radiation and determine any detrimental effect this radiation may have on the instrument.

During the STS-89 Shuttle flight to Mir, the crew will take initial measurements and collect preliminary data. Once aboard Mir, the space station crew will conduct a long-duration test. The device will be retrieved from Mir during the STS-91 mission, scheduled for June 1998. Researchers will compile information from the tests for study once the device is retrieved.

DIFFUSION-CONTROLLED CRYSTALLIZATION APPARATUS FOR MICROGRAVITY (DCAM) EXPERIMENT

Diffusion-Controlled Crystallization Apparatus for Microgravity (DCAM)

Experiment Principal Investigator: Dr. Dan Carter, New Century Pharmaceuticals, Huntsville, Ala.

The Diffusion-Controlled Crystallization Apparatus for Microgravity (DCAM) experiment which will be carried aboard Endeavour is designed to grow protein crystals at slow, controlled rates in the microgravity environment of space. Researchers are using this apparatus to try to grow larger and purer crystals in the pursuit of therapeutic research to counter the Herpes virus, fundamental virus mapping and to develop new drug delivery systems.

The low gravity environment in space encourages larger crystal growth size, purity and structural integrity. In many cases, the analysis of protein crystals grown in space has revealed more about a protein's molecular structure than has been possible even after years of effort with crystals grown on Earth.

Crew members will be placing six experiment trays with a total of 162 protein crystal test samples on board Mir. These samples will be removed and returned to Earth for analysis on the STS-91 mission at the end of May 1998. These samples will be used in basic biological research, pharmacology and drug development. Research teams will analyze the returning samples to discover their molecular structure. By pinpointing a protein's structure, researchers can design a drug that will fit into the protein's unique shape to block its undesirable characteristics.

Designed to grow protein crystals in a near-weightless environment, each chamber of the crystallization apparatus is a little larger than a 35 mm film canister. The canisters use the liquid-to-liquid and dialysis methods of protein crystal growth in which a condensing solution mixes or diffuses into a bulk solution. Inside the canister, a "button" covered by a semi-permeable membrane holds a small protein sample. Once activated, the membrane allows a condensing solution to pass into the protein solution to initiate the crystallization process. The membrane passively controls this process over an extended period of time.

This same type of device has been used to grow promising protein samples on past Space Shuttle missions and during previous stays aboard the Russian Mir space station.

GASEOUS NITROGEN DEWAR

Gaseous Nitrogen Dewar

Principal Investigator: Dr. Alexander McPherson, University of California-Irvine.

Frozen protein samples will be transported to the Russian Mir Space Station in a Gaseous Nitrogen Dewar on STS-89.

This investigation is expected to contribute to the understanding of why it is possible for researchers to grow larger and more perfectly formed protein crystals in the microgravity environment of space than on Earth.

To accomplish the evaluation of crystal growth techniques, investigators will vary the volume and solution concentrations as well as the size of sample tubes for the approximately 200 individual protein samples, comprising 19 different protein substances. Post-flight analysis will be used to reveal the best growing conditions for particular samples.

The dewar is a vacuum-jacketed container with an absorbent inner liner saturated with liquid nitrogen. It will remain frozen for approximately two weeks, until the liquid nitrogen has completely boiled off. This provides ample time to transport and transfer the dewar to the Mir station. After the liquid nitrogen is completely discharged, the samples will thaw to ambient temperature and protein crystals will crystallize and grow over a four-month period before being returned to Earth.

DSO 334: INFLIGHT EVALUATION OF THE TELEMEDICINE INSTRUMENTATION PACK

Experiment Overview

Since the beginning of the U.S. space program, NASA has applied telemedicine techniques to provide medical care during space flight. The current telemedicine capabilities, including two-way voice communications, one-way video and data downlink, and biomedical and cabin parameter monitoring, have been adequate to handle the minor in-flight medical problems which have occurred. However, based on current mission planning and risk analyses, it is expected that additional capabilities will need to be provided during the more demanding space missions of the future. Long-duration Space Shuttle flights and International Space Station (ISS) missions will require the capability for the Flight Surgeons to obtain a more in-depth assessment of crew health so that potentially serious medical problems can be handled appropriately and expeditiously. Currently, the level of in-flight medical care is limited to the medical expertise of the Crew Medical Officer (CMO), who is typically not a physician. Two CMOs, each of whom receives only 16 to 18 hours of medical training, are responsible for providing in-flight medical care and relaying symptomatic information to the Flight Surgeon. The Telemedicine Instrumentation Pack (TMIP) can create a virtual presence by extending the visual and auditory senses of the Flight Surgeon. This will enable the Flight Surgeon to more accurately assess an astronaut's health, and make recommendations regarding in-flight treatment and medically-related mission impacts.

On three Flight Days the crewmember participants will perform a simulated medical examination using the Telemedicine Instrumentation Pack (TMIP). The instruments included in the TMIP are related to the most common medical complaints observed or anticipated during spaceflight. As such, the examination is designed to assess the TMIP's ability to resolve the parameters (observations, signs, symptoms) related to such conditions. The examination will include video assessment of the eye, ear, nose, mouth, throat, and skin using the TMIP imaging subsystem. The electronic stethoscope will be used to auscultate heart, lung, and bowel sounds. Electrocardiogram (ECG), blood pressure, percent oxygen saturation, and pulse rate will be measured via the TMIP's biomedical instrumentation. The TMIP will be controlled by a crewmember on board. Ground coordination and data transfer will be conducted by a Flight Surgeon and Biomedical Engineer using the Telemedicine Workstation in a conference room adjacent to the Biomedical Multipurpose Support Room.

The objectives of DSO 334 are to evaluate:

- ability of the TMIP to capture medical data aboard the Orbiter, and send these data to Mission Control at JSC
- the quality of these data, from a clinical perspective
- the usability of the TMIP in the microgravity environment
- the operational feasibility of using the TMIP for interactive (real-time) air-to-ground medical examination
- the utility of just in time, store and forward medical exams using the TMIP

Instrumentation Pack

In support of the manned space program at the Johnson Space Center, a powerful diagnostic system was developed, the Telemedicine Instrumentation Pack, or TMIP. The TMIP provides a suite of tools to conduct telemedical examinations. This portable system, designed to meet the mass, volume, and power constraints of space flight, provides robust capabilities in a package about the size of a small suitcase.

Although the TMIP was designed for use in space, aboard the Space Shuttle and Space Station, it can be used on Earth to improve the quality of, and access to, medical care. The TMIP can be operated by a variety of medical personnel to capture and display patient audio, video, and data for telemedicine

consultations. Physicians, physician's assistants, or nurses can use the TMIP in a primary care setting to consult with medical specialists in major medical centers. Emergency medical personnel can use the TMIP at accident scenes or aboard air and ground ambulances to consult with emergency medicine and trauma experts. Home health care professionals can use the TMIP for house calls. Military medical corpsmen can use the TMIP aboard ship or on the battlefield to consult with military medical experts in MASH units, field hospitals, hospital ships, or major military medical centers. Medical teams responding to natural or manmade disasters could use the TMIP and a cellular modem or portable satellite uplink terminal to rapidly establish a field hospital to consult with secondary or tertiary medical centers. The TMIP, originally designed for use in space, has a myriad of applications on Earth.

The TMIP comprises four subsystems. The imaging subsystem includes a central, remote-head, charged-couple device (CCD) video camera which attaches via a common interface with all TMIP lens systems, including the otoscopic lens system, the ophthalmoscopic lens system, and the dermatoscopic/macrosopic lens system. Lighting for the imaging subsystem is provided by a single fiberoptic light source. Images and video are displayed on the TMIP full-color flat panel display. A standard NTSC video output port allows the TMIP to be connected to an external monitor or communication system.

The audio subsystem includes an electronic stethoscope for remote auscultation of heart, lung, and bowel sounds. Audio signal output to an external speaker or communication system is available through standard analog audio output ports.

Electrocardiogram, heart rate, blood pressure, and percent oxygen saturation are acquired through the TMIP data acquisition and management subsystem. Data storage, forward, and retrieval also is provided by this subsystem.

This computer is central to the TIP's design, acting as the primary user interface. It controls biomedical monitors and captures, displays, stores, or forwards biomedical data, using virtual instrument software, developed by KRUG. The computer uses video/image overlay and capture cards to display live video on the VGA flat panel or capture still images. The embedded computer system enables the TIP to be used for either real-time or store- and-forward applications.

STS-89 CREWMEMBERS



STS089-S-002 -- These seven astronauts and one cosmonaut represent the flight crew for the STS-89 mission to Russia's Mir space station. In the front row from the left, are astronauts Joe F. Edwards, Jr., pilot; Terrence W. Wilcutt, commander; and Bonnie J. Dunbar, mission specialist. In the back row are David A. Wolf, currently onboard Mir as cosmonaut guest researcher; Salizan S. Sharipov, payload specialist representing the Russian Space Agency (RSA); James F. Reilly, mission specialist; Andrew S. W. Thomas, replacing Wolf aboard the Mir as cosmonaut guest researcher; and Michael P. Anderson, mission specialist.

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BIOGRAPHICAL DATA

TERRENCE W. WILCUTT (LIEUTENANT COLONEL, USMC), MISSION COMMANDER

PERSONAL DATA - Born October 31, 1949, in Russellville, Kentucky. Enjoys flying, running, weight lifting, woodworking

EDUCATION - Graduated from Southern High School, Louisville, Kentucky in 1967; received a bachelor of arts degree in math from Western Kentucky University in 1974.

ORGANIZATIONS - Member of Society of Experimental Test Pilots (SETP).

SPECIAL HONORS - Recipient of the Defense Superior Service Medal, NASA Space Flight Medals (2), Navy Commendation Medal, and Sea Service Deployment Ribbon. Distinguished Graduate of the United States Naval Test Pilot School.

EXPERIENCE - After graduation from college in 1974, Wilcutt taught high school math for two years prior to entering the Marine Corps. He was commissioned in 1976 and earned his wings in 1978. Following initial F-4 Phantom training in VMFAT-101, he reported to VMFA-235, Kaneohe, Hawaii. While assigned to VMFA-235, Wilcutt attended the Naval Fighter Weapons School (Topgun) and made two overseas deployments to Japan, Korea, and the Philippines.

In 1983, he was selected for F/A-18 conversion training and served as an F/A-18 Fighter Weapons and Air Combat Maneuvering Instructor in VFA-125, Lemoore, California. In 1986, Wilcutt was selected to attend the United States Naval Test Pilot School (USNTPS), where he earned the title "Distinguished Graduate." Following graduation from USNTPS he was assigned as a test pilot/project officer for Strike Aircraft Test Directorate (SATD) at the Naval Aircraft Test Center, Patuxent River, Maryland. While assigned to SATD, Wilcutt flew the F/A-18 Hornet, the A-7 Corsair II, the F-4 Phantom, and various other aircraft to test a wide variety of projects and classified programs. He has over 4,400 flight hours in more than 30 different aircraft.

NASA EXPERIENCE - Selected by NASA in January 1990, Wilcutt became an astronaut in July 1991. Technical assignments to date include: working on Space Shuttle Main Engine and External Tank issues; serving on the astronaut support personnel team at the Kennedy Space Center, Florida, supporting Space Shuttle launches and landings, and technical issues for the Astronaut Office Operations Development Branch. A veteran of two space flights, he has logged over 512 hours in space. He served as pilot on STS-68 (September 30-October 11, 1994) and STS-79 (September 16-26, 1996). Wilcutt will command the crew of STS-89, the eighth of nine planned missions to dock the Space Shuttle with Russia's Mir space station. STS-89 is scheduled for a January 1998 launch on Space Shuttle Endeavour.

STS-68, Space Radar Lab-2 (SRL-2), launched from the Kennedy Space Center, Florida, on September 30, 1994. As part of NASA's Mission to Planet Earth, SRL-2 was the second flight of three advanced radars called SIR-C/X-SAR (Spaceborne Imaging Radar-C/X-Band Synthetic Aperture Radar), and a carbon monoxide pollution sensor, MAPS (Measurement of Air Pollution from Satellites). SIR-C/X-SAR and MAPS operated together in Endeavour's cargo bay to study Earth's surface and atmosphere, creating radar images of Earth's surface environment and mapping global production and transport of carbon monoxide pollution. Real-time crew observations of environmental conditions, along with over 14,000 photographs, aided the science team in interpreting the SRL data.

The SRL-2 mission was a highly successful test of technology intended for long-term environmental and geological monitoring of planet Earth. Following 183 orbits of the Earth, the eleven-day mission ended with Space Shuttle Endeavour landing at Edwards Air Force Base, California, on October 11, 1994.

STS-79, fourth in the joint American-Russian Shuttle-Mir series of missions, launched from the Kennedy Space Center (KSC), Florida, on September 16, 1996. STS-79 rendezvoused with the Russian Mir space station and ferried supplies, personnel, and scientific equipment to this base 240 miles above the Earth. The crew transferred over 3.5 tons of supplies to and from the Mir and exchanged U.S. astronauts on Mir for the first time - leaving John Blaha and bringing Shannon Lucid home after her record six month stay aboard Mir. Following 160 orbits of the Earth, the ten-day mission ended with Space Shuttle Atlantis landing at KSC on September 26, 1996.

BIOGRAPHICAL DATA

JOE FRANK EDWARDS Jr., (COMMANDER, USN), PILOT

PERSONAL DATA - Born February 3, 1958, in Richmond, Virginia. Considers Lineville, Alabama, and Roanoke, Alabama, to be his hometowns. Married to the former Janet Leigh Ragan of Leonardtown, Maryland. He enjoys basketball, running, football and softball. His parents, Joe Frank and Jane McMurray Edwards, reside in Roanoke, Alabama.

EDUCATION - Graduated from Lineville High School, Lineville, Alabama, in 1976. Bachelor of Science degree in Aerospace Engineering from the United States Naval Academy, 1980. Master of Science degree in Aviation Systems from University of Tennessee, Knoxville, 1994.

ORGANIZATIONS - Society of Experimental Test Pilots, Association of Naval Aviation, U.S. Naval Institute.

SPECIAL HONORS - Distinguished Flying Cross, Air Medal, Defense Meritorious Service Medal, Navy Commendation Medal, Navy Achievement Medal. Daedalian Superior Airmanship Award 1992, Fighter Squadron 143 Fighter Pilot of the Year, 1984, 1985, Fighter Squadron 142 Fighter Pilot of the Year, 1990, 1991, 1992. Carrier Airwing Seven Pilot of the Year, 1985, 1990, 1991.

EXPERIENCE: Designated a Naval Aviator in February 1982. Assigned to Fighter Squadron 143 in 1983 after completion of F-14 Tomcat training. Flew fighter escort and reconnaissance combat missions over Lebanon in 1983 and graduated from U.S. Navy Fighter Weapons School in 1984. Graduated from U.S. Naval Test Pilot School in 1986 and subsequently worked as project flight test officer and pilot for F-14A(PLUS) and F-14D Full Scale Development. Flew the first Navy flight of the F-14D and a high angle of attack/departure from controlled flight test program for the F-14 airframe/F-110 engine integration. Served as Operations and Maintenance Officer in Fighter Squadron 142 1989-1992. Worked as Operations Officer in the Operations Directorate of the Joint Chiefs of Staff, Washington D.C. from 1992-1994. He has flown over 2600 hours in over 25 different aircraft and logged over 650 arrested landings.

NASA EXPERIENCE - Selected as an astronaut candidate by NASA in December 1994, Edwards reported to the Johnson Space Center in March 1995. He has completed a year of training and evaluation and is currently qualified for assignment as a shuttle pilot. Since then he has worked technical issues in the Safety Department of the Astronaut Office, and served as Technical Assistant to the Director, Flight Crew Operations Directorate. Edwards is currently assigned as pilot on STS-89. Scheduled for a January 1998 launch on Endeavour, STS-89 is the eighth of nine planned missions to dock the Space Shuttle with Russia's Mir space station.

BIOGRAPHICAL DATA

JAMES F. REILLY, II (PH.D.), MISSION SPECIALIST-1

PERSONAL DATA - Born March 18, 1954, Mountain Home Air Force Base, Idaho. Considers Mesquite, Texas, to be his hometown. Married to the former Jo Ann Strange, a native of Dallas, Texas. Three children. He enjoys flying, skiing, photography, running, soccer, hunting and fishing. His father, James F. Reilly, resides in Rockwall, Texas. His mother, Billie N. Ruether, resides in Tyler, Texas. Her parents, Robert and Mildred Strange, reside in Dallas, Texas.

EDUCATION - Graduated from Lake Highlands High School, Dallas Texas, in 1972. Bachelor of science degree in geosciences from University of Texas-Dallas, 1977. Master of science degree in geosciences from University of Texas-Dallas, 1987. Doctorate in geosciences from University of Texas-Dallas, in 1995.

ORGANIZATIONS - Member of the American Association of Petroleum Geologists, Aircraft Owners and Pilots Association, American Institute of Aeronautics and Astronautics.

SPECIAL HONORS - Awarded the Antarctic Service Medal, 1978. US Navy ROTC scholarship, 1972.

EXPERIENCE - After receiving his bachelor of science degree in 1977, Reilly entered graduate school and was selected to participate as a research scientist specializing in stable isotope geochronology as part of the 1977-1978 scientific expedition to Marie Byrd Land, West Antarctica. In 1979, he accepted employment as an exploration geologist with Santa Fe Minerals Inc., in Dallas, Texas. From 1980 to the time he was selected for the astronaut program, Reilly was employed as an oil and gas exploration geologist for Enserch Exploration Inc., in Dallas, Texas, rising to the position of Chief Geologist of the Offshore Region. He has experience in exploration and operation activities in both international and domestic regions, primarily in the deep- water regions of the Gulf of Mexico. Concurrent with his duties as an exploration geologist, he was actively involved in the application of new imaging technology for industrial applications in deep water engineering projects and biological research. As part of this work, Reilly has spent approximately 22 days in deep submergence vehicles operated by Harbor Branch Oceanographic Institution and the US Navy. Concurrent with his employment with Enserch, Reilly received his master of science degree in geosciences in 1987, and has completed his dissertation on the geologic controls on the distribution of chemosynthetic communities in the Gulf of Mexico, receiving his doctorate in geosciences in 1995.

NASA EXPERIENCE - Selected by NASA in December 1994, Reilly reported to the Johnson Space Center in March 1995, has completed a year of training and evaluation, and is qualified for flight assignment as a mission specialist. He was initially assigned to work technical issues for the Astronaut Office Computer Support Branch. Reilly is currently assigned as a mission specialist on the crew of STS-89, scheduled for a January 1998 launch on Space Shuttle Endeavour. STS-89 is the eighth of nine planned missions to dock the Space Shuttle with Russia's Mir space station.

BIOGRAPHICAL DATA

MICHAEL P. ANDERSON (MAJOR, USAF), MISSION SPECIALIST-2

PERSONAL DATA - Born December 25, 1959, in Plattsburgh, New York. Considers Spokane, Washington, to be his hometown. Married. Enjoys photography, chess, computers, and tennis.

EDUCATION - Graduated from Cheney High School in Cheney, Washington, in 1977. Bachelor of science degree in physics/astronomy from University of Washington, 1981. Master of science degree in physics from Creighton University, 1990.

SPECIAL HONORS - Distinguished graduate USAF Communication Electronics Officers course. Recipient of the Armed Forces Communication Electronics Associations Academic Excellence Award 1983. Received the USAF Undergraduate Pilot Training Academic Achievement Award for Class 87-08 Vance AFB. Awarded the USAF Meritorious Service Medal, and the USAF Achievement Medal with one oak leaf cluster.

EXPERIENCE - Anderson graduated from the University of Washington in 1981 and was commissioned a second lieutenant. After completing a year of technical training at Keesler AFB, Mississippi, he was assigned to Randolph AFB, Texas. At Randolph he served as Chief of Communication Maintenance for the 2015 Communication Squadron and later as Director of Information System Maintenance for the 1920 Information System Group. In 1986 he was selected to attend Undergraduate Pilot Training at Vance AFB, Oklahoma. Upon graduation he was assigned to the 2nd Airborne Command and Control Squadron, Offutt AFB, Nebraska as a EC 135 pilot, flying the Strategic Air Commands airborne command post code named "Looking Glass". From January 1991 to September 1992 he served as an aircraft commander and instructor pilot in the 920th Air Refueling Squadron, Wurtsmith AFB, Michigan. From September 1992 to February 1995 he was assigned as an instructor pilot and tactics officer in the 380 Air Refueling Wing, Plattsburgh AFB, New York. Anderson has logged over 3000 hours in various models of the KC-135 and the T-38A aircraft.

NASA EXPERIENCE: Selected by NASA in December 1994, Anderson reported to the Johnson Space Center in March 1995. He completed a year of training and evaluation, and is qualified for flight crew assignment as a mission specialist. He was initially assigned technical duties in the Flight Support Branch of the Astronaut Office. Anderson is currently assigned as a mission specialist on the crew of STS-89. Scheduled for a January 1998 launch on Space Shuttle Endeavour, STS-89 is the eighth of nine planned missions to dock the Space Shuttle with Russia's Mir space station.

BIOGRAPHICAL DATA

BONNIE J. DUNBAR (PH.D.), PAYLOAD COMMANDER / MISSION SPECIALIST-3

PERSONAL DATA - Born March 3, 1949, in Sunnyside, Washington.

EDUCATION - Graduated from Sunnyside High School, Sunnyside, Washington, in 1967; received bachelor of science and master of science degrees in ceramic engineering from the University of Washington in 1971 and 1975, respectively; and a doctorate in mechanical/biomedical engineering from the University of Houston, 1983.

ORGANIZATIONS - Member of the American Ceramic Society (ACS), the National Institute of Ceramic Engineers (NICE), Keramos Honorary, the Society of Biomedical Engineering, American Association for the Advancement of Science, Tau Beta Pi, Materials Research Society (MRS); Board of Directors, Arnold Air Society and Angel Flight, International Academy of Astronautics (IAF), Experimental Aircraft Association (EAA), Society of Women Engineers (SWE), Association of Space Explorers (ASE).

SPECIAL HONORS - NASA Space Flight Medals, 1985, 1990, 1992, and 1995. Member, National Science Foundation (NSF) Engineering Advisory Board, 1993 - present. NASA Outstanding Leadership Award, 1993. Fellow of American Ceramic Society, 1993. Design News Engineering Achievement Award, 1993. IEEE Judith Resnik Award, 1993. Society of Women Engineers Resnik Challenger Medal, 1993. Boeing Corporation Pathfinder Award, 1992. AAES National Engineering Award, 1992. NASA Exceptional Service Award, 1991. University of Houston Distinguished Engineering Alumna, 1991. M.R.S. President's Award, 1990. ACS Schwartzwalder P.A.C.E. Award, 1990. University of Washington Engineering Alumni Achievement, 1989. NASA Exceptional Service Medal, 1988. ACS Life Membership, 1986. General Jimmy Doolittle Fellow of the Aerospace Education Foundation, 1986. Evergreen Safety Council Public Service in Space Award, 1986. American Ceramic Society (ACS) Greaves-Walker Award, 1985. Rockwell International Engineer of the Year in 1978. Graduated Cum Laude from the University of Washington in 1975.

EXPERIENCE - Following graduation in 1971, Dr. Dunbar worked for Boeing Computer Services for two years as a systems analyst. From 1973 to 1975, she conducted research for her master's thesis in the field of mechanisms and kinetics of ionic diffusion in sodium beta-alumina. In 1975, she was invited to participate in research at Harwell Laboratories in Oxford, England, as a visiting scientist. Her work there involved the wetting behavior of liquids on solid substrates. Following her work in England, she accepted a senior research engineer position with Rockwell International Space Division in Downey, California. Her responsibilities there included developing equipment and processes for the manufacture of the Space Shuttle thermal protection system in Palmdale, California. She also represented Rockwell International as a member of the Dr. Kraft Ehrlicke evaluation committee on prospective space industrialization concepts. Dr. Dunbar completed her doctorate at the University of Houston in Houston, Texas. Her multi-disciplinary dissertation (materials science and physiology) involved evaluating the effects of simulated space flight on bone strength and fracture toughness. These results were correlated to alterations in hormonal and metabolic activity. She is currently an adjunct assistant professor in mechanical engineering at the University of Houston.

She is a private pilot with over 200 hours in single engine land aircraft, has logged more than 700 hours flying time in T-38 jets as co-pilot, and has over 100 hours as co-pilot in a Cessna Citation Jet.

NASA EXPERIENCE - Dr. Dunbar accepted a position as a payload officer/flight controller at the Lyndon B. Johnson Space Center in 1978. She served as a guidance and navigation officer/flight controller for the Skylab reentry mission in 1979 and was subsequently designated project officer/payload officer for the integration of several Space Shuttle payloads.

Dr. Dunbar became a NASA astronaut in August 1981. Her technical assignments have included assisting in the verification of Shuttle flight software at the Shuttle Avionics Integration Laboratory (SAIL), serving as a member of the Flight Crew Equipment Control Board, participation as a member of the Astronaut Office Science Support Group, supporting operational development of the remote manipulator system (RMS). She has served as chief of the Mission Development Branch, as the Astronaut Office interface for "secondary" payloads, and as lead for the Science Support Group. In 1993 Dr. Dunbar served as Deputy Associate Administrator, Office of Life and Microgravity Sciences, NASA Headquarters, Washington, D.C. In February

1994, she traveled to Star City, Russia, where she spent 13-months training as a back-up crew member for a 3-month flight on the Russian Space Station, Mir. In March 1995, she was certified by the Russian Gagarin Cosmonaut Training Center as qualified to fly on long duration Mir Space Station flights. From October, 1995 to November, 1996, she was detailed to the NASA JSC Mission Operations Directorate as Assistant Director where she was responsible for chairing the International Space Station Training Readiness Reviews, and facilitating Russian/American operations and training strategies. She is currently assigned as a mission specialist on STS-89, scheduled for a January 1998 launch on Space Shuttle Endeavour. STS-89 is the eighth of nine planned missions to dock the Space Shuttle with Russia's Mir space station.

A veteran of four space flights, Dr. Dunbar has logged more than 996 hours (41.5 days) in space. She was a mission specialist on STS 61-A in 1985, STS-32 in 1990, was the Payload Commander on STS-50 in 1992, and was a mission specialist on STS-71 in 1995.

STS 61-A, the West German D-1 Spacelab mission, launched from Kennedy Space Center, Florida, on October 30, 1985. The 61-A mission was the first to carry eight crew members, the largest to fly in space, and was also the first in which payload activities were controlled from outside the United States. More than 75 scientific experiments were completed in the areas of physiological sciences, materials science, biology, and navigation. During the seven-day mission, Dr. Dunbar was responsible for operating Spacelab and its subsystems and performing a variety of experiments. Her mission training included six months of experiment training in Germany, France, Switzerland, and The Netherlands. After completing 111 orbits of the Earth in 168 hours 44 minutes 51 seconds, Challenger and her crew landed at Edwards Air Force Base, California, on November 6, 1985.

STS-32 launched from the Kennedy Space Center, Florida, on January 9, 1990. During the ten-day mission, crew members aboard Columbia successfully deployed the Syncom IV-F5 satellite, and retrieved the 21,400-pound Long Duration Exposure Facility (LDEF) using the RMS. They also operated a variety of middeck experiments including the Microgravity Disturbance Experiment (MDE) using the Fluids Experiment Apparatus (FEA), Protein Crystal Growth (PCG), American Flight Echocardiograph (AFE), Latitude/Longitude Locator (L3), Mesoscale Lightning Experiment (MLE), Characterization of Neurospora Circadian Rhythms (CNCR), and the IMAX Camera. Dr. Dunbar was principal investigator for the MDE/FEA Experiment. Additionally, numerous medical test objectives, including in-flight lower body negative pressure (LBNP), in-flight aerobic exercise and muscle performance were conducted to evaluate human adaptation to extended duration missions. Following 173 orbits of the Earth in 261 hours 1 minute 38 seconds, Columbia returned with a night landing at Edwards Air Force Base, California, on January 20, 1990.

Dr. Dunbar flew as Payload Commander on STS-50, the United States Microgravity Lab-1 mission dedicated to microgravity fluid physics and materials science. Over 30 experiments sponsored by over 100 investigators were housed in the "Spacelab" in the Shuttle's Payload Bay. A payload crew of 4 operated around-the-clock for 13 days performing experiments in scientific disciplines such as protein crystal growth, electronic and infrared detector crystal growth, surface tension physics, zeolite crystal growth, and human physiology. STS-50 launched from the Kennedy Space Center, Florida, on June 25, 1992, and concluded with a landing at the Kennedy Space Center on July 9, 1992, following 221 orbits of the Earth in 331 hours 30 minutes 4 seconds.

On STS-71 Dr. Dunbar served as MS-3 on a seven-member crew launched June 27, 1995, from the Kennedy Space Center and as a member of an eight-member crew which returned there on July 7, 1995. This was the first Space Shuttle mission to dock with the Russian Space Station Mir, and involved an exchange of crews. The Atlantis Space Shuttle was modified to carry a docking system compatible with the Russian Mir space station. It also carried a Spacelab module in the payload bay in which the crew performed medical evaluations on the returning Mir crew. These evaluations included ascertaining the effects of weightlessness on the cardio/vascular system, the bone/muscle system, the immune system, and the cardio/pulmonary system. Mission duration was 235 hours, 23 minutes

BIOGRAPHICAL DATA

SALIZHAN SHAKIROVICH SHARIPOV, MISSION SPECIALIST-4

PERSONAL DATA - Born August 24, 1964 in Uzgen, Oshsk region, Kirghizia. Married to Nadezhda Mavlyanovna Sharipova. They have one daughter and one son. He enjoys football, likes to read books. His father, Mr. Shakirzhan Sharipov, resides in Uzgen, Oshsk region, Kirghizia.

EDUCATION - Graduated from the Air Force Pilot School in 1987. In 1994, he graduated from Moscow State University with a degree in cartography.

EXPERIENCE - After graduation from the Air Force Pilot School in 1987, he worked as a pilot-instructor and taught 8 cadets. He has logged over 950 hours flying time. He has experience flying on MIG-21 and L-39 aircraft.

Selected by the Gagarin Cosmonaut Training Center (GCTC) Sharipov became a cosmonaut-candidate in 1990. In 1992, he completed general space training and became a cosmonaut. As a member of the group he has completed a full course of training for Mir space flights as a crew commander.

CURRENT ASSIGNMENT - Sharipov is assigned to fly on the crew of STS-89, scheduled for a January 1998 launch on Space Shuttle Endeavour. STS-89 is the eighth of nine planned missions to dock the Space Shuttle with Russia's Mir space station.

BIOGRAPHICAL DATA

ANDREW S. W. THOMAS (PH.D.), MISSION SPECIALIST-5/MIR 24-25 FLIGHT ENGINEER

PERSONAL DATA - Born December 18, 1951, in Adelaide, South Australia. Single. He enjoys horse riding and jumping, mountain biking, running, wind surfing, and classical guitar playing. His father, Adrian C. Thomas, resides in Hackham, South Australia. His mother, Mary E. Thomas, resides in North Adelaide, South Australia.

EDUCATION - Received a bachelor of engineering degree in mechanical engineering, with First Class Honors, from the University of Adelaide, South Australia, in 1973, and a doctorate in mechanical engineering from the University of Adelaide, South Australia, in 1978.

ORGANIZATIONS - Member of the American Institute of Aeronautics and Astronautics.

EXPERIENCE - Dr. Thomas began his professional career as a research scientist with the Lockheed Aeronautical Systems Company, Marietta, Georgia, in 1977. At that time he was responsible for experimental investigations into the control of fluid dynamic instabilities and aircraft drag. In 1980, he was appointed Principal Aerodynamic Scientist to the company and headed a research team examining various problems in advanced aerodynamics and aircraft flight test.

This was followed in 1983 by an appointment as the head of the Advanced Flight Sciences Department to lead a research department of engineers and scientists engaged in experimental and computational studies in fluid dynamics, aerodynamics and aeroacoustics. He was also manager of the research laboratory, the wind tunnels, and the test facilities used in these studies. In 1987, Dr. Thomas was named manager of Lockheed's Flight Sciences Division and directed the technical efforts in vehicle aerodynamics, flight controls and propulsion systems that supported the company's fleet of production aircraft.

In 1989, he moved to Pasadena, California, to join the Jet Propulsion Laboratory (JPL) and, shortly after, was appointed leader of the JPL program for microgravity materials processing in space. This NASA-sponsored research included scientific investigations, conducted in the laboratory and in low gravity on NASA's KC-135 aircraft, as well as technology studies to support the development of the space flight hardware for future Shuttle missions.

NASA EXPERIENCE - Dr. Thomas was selected by NASA in March 1992 and reported to the Johnson Space Center in August 1992. In August 1993, following one year of training, he was appointed a member of the astronaut corps and was qualified for assignment as a mission specialist on Space Shuttle flight crews.

While awaiting space flight assignment, he supported shuttle launch and landing operations as an Astronaut Support Person (ASP) at the Kennedy Space Center. He also provided technical support to the Space Shuttle Main Engine project, the Solid Rocket Motor project and the External Tank project at the Marshall Space Flight Center.

In June 1995 he was named as payload commander for STS-77 and flew his first flight in space on Endeavour in May 1996. During this 10-day mission the crew of STS-77 deployed two satellites, tested a large inflatable space structure on orbit and conducted a variety of scientific experiments in a Spacehab laboratory module carried in Endeavour's payload bay. The flight was launched from the Kennedy Space Center on May 19, 1996 and completed 160 orbits 153 nautical miles above the Earth while traveling 4.1 million miles and logging 240 hours and 39 minutes in space.

Dr. Thomas recently completed his training at the Gagarin Cosmonaut Training Center in Star City, Russia in preparation for a long-duration stay aboard the Russian Space Station. He will launch aboard Endeavour as a member of the STS-89 crew in January 1998 to begin a 4-month stay aboard Mir.

BIOGRAPHICAL DATA

DAVID A. WOLF (M.D.) MIR 24 FLIGHT ENGINEER / STS-89 MISSION SPECIALIST-6

PERSONAL DATA - Born August 23, 1956, in Indianapolis, Indiana. Single. He enjoys sport aerobatic flying, scuba diving, handball, running, and water skiing. His parents, Dr. and Mrs. Harry Wolf, reside in Indianapolis.

EDUCATION - Graduated from North Central High School, Indianapolis, Indiana, in 1974; received a bachelor of science degree in electrical engineering from Purdue University in 1978, and a doctorate of medicine from Indiana University in 1982. He completed his medical internship (1983) at Methodist Hospital in Indianapolis, Indiana, and USAF flight surgeon primary training at Brooks Air Force Base in San Antonio, Texas.

ORGANIZATIONS - Member of the Institute of Electrical and Electronics Engineers; the Aerospace Medical Association; the Experimental Aircraft Association; the International Aerobatic Club; and the Air National Guard.

SPECIAL HONORS - Recipient of the NASA Exceptional Engineering Achievement Medal (1990); NASA Inventor of the Year, 1992. Dr. Wolf graduated "with distinction" from the honors curriculum in electrical engineering at Purdue University and received an Academic Achievement Award upon graduation from medical school. He received the Carl R. Ruddell scholarship award for research in medical ultrasonic signal and image processing. He is a member of Eta Kappa Nu and Phi Eta Sigma honorary societies. Dr. Wolf has received 11 U.S. patents and over 20 Space Act Awards for 3- dimensional tissue engineering technologies, earning the Texas State Bar Patent of the Year in 1994. He has published over 40 technical papers.

EXPERIENCE - As a research scientist at the Indianapolis Center for Advanced Research from 1980 to 1983, he developed digital signal and image processing techniques utilizing matched filter detection of high time-bandwidth product transmissions producing "state of the art" high resolution medical ultrasonic images to the 100 micron level. He also developed new Doppler demodulation techniques extending the range velocity product limitation of conventional pulsed Doppler systems. He is a USAF senior flight surgeon in the Air National Guard (1982 to present) and is a member of the Board of Directors of the National Inventors Hall of Fame. He has logged over 2000 hours of flight time including air combat training as a weapons systems officer (F4 Phantom jet), T- 38 Talon, and competition aerobatics (PITTS Special and Christen Eagle).

NASA EXPERIENCE - In 1983, Dr. Wolf joined the Medical Sciences Division, Johnson Space Center, Houston, Texas. He was responsible for development of the American Flight Echocardiograph for investigating cardiovascular physiology in microgravity. Upon completion he was assigned as chief engineer for design of the Space Station medical facility. In 1986 he was assigned to direct development of the Space Bioreactor and associated tissue engineering and cancer research applications utilizing controlled gravitational conditions. This resulted in the state of the art NASA rotating tissue culture systems. He has particular expertise in the design of real time computer process control systems, communications, bioprocessing, physiology, fluid dynamics, and aerospace medicine. Dr. Wolf is an active public speaker.

Selected as a NASA astronaut in January 1990, Dr. Wolf became qualified for space flight in July 1991. His technical assignments have included Orbiter vehicle processing and test at Kennedy Space Center (1991-1992), STS-58 mission specialist (1993), and spacecraft communications (CAPCOM) (1994-1995). He is qualified for Extravehicular Activity (Spacewalk), Remote Manipulator System (Robot Arm), and Rendezvous. He was the CAPCOM for the first and third Shuttle-Mir rendezvous. He trained at the Gagarin Cosmonaut Training Center in Star City, Russia, in preparation for a long- duration stay aboard Mir. He has logged over 336 hours in space. He was a mission specialist on STS-58 and currently serves as Board Engineer 2 aboard the Russian Space Station Mir.

SPACEFLIGHT EXPERIENCE: STS-58 Columbia (10/16/93-11/1/93) was a 14-day dedicated Spacelab life sciences research mission. During this record length shuttle mission the crew conducted neurovestibular, cardiovascular, cardiopulmonary, metabolic, and musculoskeletal research utilizing microgravity to reveal fundamental physiology normally masked by earth gravity. Mission duration was 336 hours, 13 minutes, 01 seconds. On September 25, 1997, Dr. Wolf launched aboard Space Shuttle Atlantis as part of the STS-86 crew. Following docking, September 28, 1997 marked the official start of his expected 4-month stay aboard Space Station Mir.

